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Report No: PAD00137

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT ON A

PROPOSED LOAN

IN THE AMOUNT OF US$150 MILLION

TO THE

REPUBLIC OF PERU

FOR THE

IMPROVING LIMA TRAFFIC MANAGEMENT AND SUPPORTING SUSTAINABLE TRANSPORT PROJECT AS PHASE (1) OF THE MULTI-PHASE PROGRAMMATIC APPROACH - IMPROVING LIMA TRAFFIC MANAGEMENT AND SUPPORTING SUSTAINABLE TRANSPORT PROJECT

WITH AN OVERALL FINANCING ENVELOPE OF US$510 MILLION

September 20, 2024

Transport
Latin America And Caribbean

Republic of Peru

GOVERNMENT FISCAL YEAR

January 1 – December 31

CURRENCY EQUIVALENTS

(Exchange Rate Effective as of September 17, 2024)

Peruvian Soles (PEN) 3.78 = United States Dollars US$1.00

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ABBREVIATIONS AND ACRONYMS

AM	Accountability Mechanism
ANTSV	National Road Safety and Traffic Agency (*Agencia Nacional de Tránsito y Seguridad Vial*)
ATU	Lima-Callao Urban Transport Authority (*Autoridad de Transporte Urbano para Lima y Callao*)
BRT	Bus Rapid Transit
CAPEX	Capital Expenses
CBA	Cost-Benefit Analysis
CGR	General Comptroller Office of Peru (*Contraloría General de la República*)
CMF	Crash Modification Factor
CPF	Country Partnership Framework
CUT	Single Treasury Account (*Cuenta Única del Tesoro*)
DFIL	Disbursement and Financial Information Letter
E&S	Environmental and Social
EDGE	Excellence in Design for Greater Efficiencies
EHS	Environment, Health, and Safety
EIRR	Economic Internal Rate of Return
ESCP	Environmental and Social Commitment Plan
ESF	Environmental and Social Framework
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standards
FM	Financial Management
FMA	Financial Management Assessment
GDP	Gross Domestic Product
GDU	Urban Development Department *(Gerencia de Desarrollo Urbano*)
GHG	Greenhouse Gas
GM	Municipal Department (*Gerencia Municipal*)
GMU	Urban Mobility Department (*Gerencia de Movilidad Urbana*)
GoP	Government of Peru
GRM	Grievance Redress Mechanism
GRS	Grievance Redress Service
GTFS	General Transit Feed Specification
HLO	High-Level Outcome
IFR	Interim Financial Report
INEI	National Statistics and Information Institute (*Instituto Nacional de Estadística e Informática*)
IPF	Investment Project Financing
ITS	Intelligent Transport System
KfW	German Development Bank (*Kreditanstalt für Wiederaufbau)*
LEED	Leadership in Energy and Environmental Design
LMP	Labor Management Procedures
LRP	Livelihood Restoration Plan
M&E	Monitoring and Evaluation
MEF	Ministry of Economy and Finance (*Ministerio de Economía y Finanzas*)
MEP	Module of Project Execution (*Módulo de Ejecución del Proyecto*)
ML	Metro Line
MML	Metropolitan Municipality of Lima (*Municipalidad Metropolitana de Lima*)
MPA	Multiphase Programmatic Approach
MTC	Ministry of Transport and Communications (*Ministerio de Transportes y Comunicaciones*)

NDC	Nationally Determined Contribution
NMT	Non-Motorized Transport
NPV	Net Present Value
OCI	Internal Control Office (*Oficina de Control Interno*)
ONSV	National Road Safety Observatory (*Observatorio Nacional de Seguridad Vial*)
OPEX	Operating Expenses
PAIT	Immediate Traffic Actions Plan (*Plan de Acciones Inmediatas de Tránsito*)
PBS	Public Bicycle-Share
PDO	Project Development Objective
PLANMET	Metropolitan Development Plan (*Plan de Desarrollo Metropolitano de Lima*)
PLCC-LIMA	Local Climate Change Plan for the Province of Lima (*Plan Local de Cambio Climático para la provincia de Lima*)
PMU	Urban Mobility Plan (*Plan de Movilidad Urbana*)
PNMSV	National Multisectoral Road Safety Policy 2023-30 (*Política Nacional Multisectorial de Seguridad Vial al 2030)*
PNP	*Policia Nacional del Peru*
POM	Project Operational Manual
PPP	Public-Private Partnership
PPSD	Project Procurement Strategy for Development
PrDO	Program Development Objective
PROTRANSITO	Special Project for Traffic Management in Metropolitan Lima (*Proyecto Especial para la Gestión de Tránsito en Lima Metropolitana*)
PSC	Project Steering Committee
RFB	Request for Bids
SEA/SH	Sexual Exploitation and Abuse/Sexual Harassment
SEP	Stakeholder Engagement Plan
SIAF	Integrated Financial Management System (*Sistema Integrado de Administración Financiera*)
SOE	Statement of Expenditures
TCC	Traffic Control Center (*Centro de Control de Tránsito*)
TCU	Technical Coordination Unit
TDM	Transport Demand Management
TSP	Traffic Signal Priority
TVDCC	Traffic Violation Detection and Control Center
ZTC	Traffic Calming Zones (*Zonas de Trafico Calmado*)

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DATASHEET

BASIC INFORMATION

Project Beneficiary(ies)	Operation Name		
Peru	Improving Lima Traffic Management and Supporting Sustainable Transport Project		
Operation ID	Financing Instrument	Environmental and Social Risk Classification	
P178842	Investment Project Financing (IPF)	Substantial	

Financing & Implementation Modalities

[✓] Multiphase Programmatic Approach (MPA)	[ ] Contingent Emergency Response Component (CERC)
[ ] Series of Projects (SOP)	[ ] Fragile State(s)
[ ] Performance-Based Conditions (PBCs)	[ ] Small State(s)
[ ] Financial Intermediaries (FI)	[ ] Fragile within a non-fragile Country
[ ] Project-Based Guarantee	[ ] Conflict
[ ] Deferred Drawdown	[ ] Responding to Natural or Man-made Disaster
[ ] Alternative Procurement Arrangements (APA)	[ ] Hands-on Expanded Implementation Support (HEIS)

Expected Approval Date	Expected Closing Date	Expected Program Closing Date
15-Oct-2024	30-Oct-2029	31-Oct-2034
Bank/IFC Collaboration	Joint Level	
Yes	Complementary or Interdependent project requiring active coordination	

MPA Program Development Objective

To increase accessibility to job opportunities for the province of Lima population in a green, safe, and inclusive urban mobility system.

MPA FINANCING DATA (US$, Millions)

MPA Program Financing Envelope	660.00

Components

Component Name	Cost (US$)
Traffic lights system	92,950,000.00
Automated traffic violation detection system	7,200,000.00
Safe intersections and neighborhoods	44,300,000.00
Urban mobility, cycle-infrastructure and complete streets	38,740,000.00
Project management and capacity building	16,790,000.00

Organizations

Borrower:	Republic of Peru
Implementing Agency:	Metropolitan Municipality of Lima

MPA FINANCING DETAILS (US$, Millions)

MPA Program Financing Envelope:	660.00
of which Bank Financing (IBRD):	510.00
of which Bank Financing (IDA):	0.00
of which Other Financing sources:	150.00

PROJECT FINANCING DATA (US$, Millions)

Maximizing Finance for Development

Is this an MFD-Enabling Project (MFD-EP)?	Yes
Is this project Private Capital Enabling (PCE)?	No

SUMMARY

Total Operation Cost	**200.35**
Total Financing	**200.35**
of which IBRD/IDA	**150.00**

Financing Gap	**0.00**

DETAILS

Private Sector Investors/Shareholders

Equity	Amount	Debt	Amount
Government Contribution	181.15		
Government Resources	31.15		
IBRD	150.00		
Non-Government Contribution	19.20		
Private sector Equity	19.20		
Total	**200.35**		**0.00**

Expected Disbursements (US$, Millions)

WB Fiscal Year	2025	2026	2027	2028	2029	2030
Annual	5.00	40.00	60.00	30.00	10.00	5.00
Cumulative	5.00	45.00	105.00	135.00	145.00	150.00

PRACTICE AREA(S)

Practice Area (Lead)

Transport

Contributing Practice Areas

Urban, Resilience and Land; Digital Development

CLIMATE

Climate Change and Disaster Screening

Yes, it has been screened and the results are discussed in the Operation Document

SYSTEMATIC OPERATIONS RISK- RATING TOOL (SORT)

Risk Category	Rating
1. Political and Governance	Moderate
2. Macroeconomic	Low
3. Sector Strategies and Policies	Moderate
4. Technical Design of Project or Program	Substantial
5. Institutional Capacity for Implementation and Sustainability	Substantial
6. Fiduciary Financial Management Risk rating from Specialist: Substantial as of 2022-12-14T20:45:33Z No Procurement rating under Preparation Phase has been completed in PRAMS to date.	Substantial
7. Environment and Social Environment Risk rating from Specialist: Moderate as of 2024-08-15T19:36:02Z Social Risk rating from Specialist: Substantial as of 2024-08-15T19:36:02Z	Substantial
8. Stakeholders	Substantial
9. Overall	Substantial
Overall MPA Program Risk	Substantial

POLICY COMPLIANCE

Policy

Does the project depart from the CPF in content or in other significant respects?

[ ] Yes [✓] No

Does the project require any waivers of Bank policies?

[ ] Yes [✓] No

ENVIRONMENTAL AND SOCIAL

Environmental and Social Standards Relevance Given its Context at the Time of Appraisal

E & S Standards	Relevance

ESS 1: Assessment and Management of Environmental and Social Risks and Impacts	Relevant
ESS 10: Stakeholder Engagement and Information Disclosure	Relevant
ESS 2: Labor and Working Conditions	Relevant
ESS 3: Resource Efficiency and Pollution Prevention and Management	Relevant
ESS 4: Community Health and Safety	Relevant
ESS 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	Relevant
ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	Relevant
ESS 7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities	Not Currently Relevant
ESS 8: Cultural Heritage	Relevant
ESS 9: Financial Intermediaries	Not Currently Relevant

NOTE: For further information regarding the World Bank's due diligence assessment of the Project's potential environmental and social risks and impacts, please refer to the Project's Appraisal Environmental and Social Review Summary (ESRS).

LEGAL

Legal Covenants

Sections and Description
The Borrower, through MML, shall: (i) not later than sixty (60) days after the Effective Date, hire or appoint the professional with experience in procurement of high-value contracts and contract execution for the TCU; (ii) not later than ninety (90) days after the Effective Date, hire or appoint the senior financial management specialist and two (2) financial management analysts reporting to the head of the General Office of Planning and Finance of the MML, to support the TCU in the implementation of the Project. Section I.A.1(d) of Schedule 2 of the Loan Agreement.
The Borrower, through MML, shall, no later than one hundred twenty (120) days after the Effective Date, finalize the procurement for the feasibility pre-investment studies for the activities under Parts 3 and 4 of the Project in form and substance satisfactory to the Bank. Section I.B of Schedule 2 of the Loan Agreement.
To facilitate the carrying out of activities under Part 3 and 4 of the Project, the Borrower, through MML, shall: (a) prior to the carrying out of any such Project activity under the jurisdiction of a Participating District, enter into an agreement with that Participating District (each, a "District Interinstitutional Agreement"), under terms and conditions approved by the Bank, which shall include, inter alia, the obligation of each Participating District to take or permit to be taken all actions to enable MML to carry out, and provide the necessary technical and institutional support for the timely preparation and implementation of the relevant Project activity. Section I.C.1(a) of Schedule 2 of the Loan Agreement.
Not later than sixty (60) days after the Effective Date, the Borrower, through MML, shall create and thereafter maintain until completion of the Project, a committee (the "Project Steering Committee") to oversee the implementation of the Project, including, among others, a representative of the Ministry of Economy and Finance, a representative of MML, and a representative of the TCU. Said committee shall have membership and functions acceptable to the Bank, as defined in the Operational Manual, including follow up on the TCU's execution of the Project, the requirement to obtain

the Project Steering Committee's approval before making any change to key staff referred in Section I.A.1 of this Schedule 2, and provision of additional support related to Project implementation at MML's request. This committee does not participate in the functions or activities that correspond to the implementation of the Project, which are the responsibility of the TCU. Section I.C.2 of Schedule 2 of the Loan Agreement.

Conditions

Type	Citation	Description	Financing Source
Effectiveness	Section 4.01(a)	MML has prepared and adopted the Operational Manual in a manner satisfactory to the Bank	IBRD/IDA
Effectiveness	Section 4.01(b)	MML has issued a managerial resolution (resolución de gerencia) to empower PROTRANSITO to manage procurement and enter into contracts on behalf of MML, as required for the MPA Program including this Project, in form and substance satisfactory to the Bank	IBRD/IDA
Effectiveness	Section 4.01(c)	the Subsidiary Agreement has been executed on behalf of the Borrower and MML, in form and substance satisfactory to the Bank	IBRD/IDA

I. STRATEGIC CONTEXT

A. Country Context

1. **Peru, with a population of 33 million, is an upper-middle-income country and an economy that grew by over 5 percent per year in 2002–2019 but contracted sharply during the COVID pandemic.** Spatial disparities persist as one of Peru's main structural challenges, and developments since the mid-2010s reveal additional pressure points for urban areas. The poverty rate increased by almost 12 percent (reaching 32.6 percent in 2020), and poverty is increasingly concentrated in urban areas. In 2009, 46 percent of the poor lived in urban areas, while in 2021 the share had reached 69 percent.[1] Poverty increased sharply in the province of Lima[2] (Lima, hereinafter) from 14 percent in 2019 to 25 percent in 2021,[3] as a result of the COVID-19 shock.

2. **Beyond the impact of COVID-19, poverty has also been driven by demographic shifts and migration from poorer to richer areas, but in locations that are generally underserved by adequate access to infrastructure services.** Between 2015 and 2020, net migration to the Lima region represented almost 30 percent of the average annual population growth during that period. For Lima, the growth of urban poverty and processes of urban development with immigration coincides with the spatial location of this population in peripheral areas. These areas tend to be poorly served with basic infrastructure services, including transport services, which in practical terms represent an impossibility for this population to access the opportunities offered by the city.

3. **Peru's infrastructure is also highly exposed and vulnerable to climate impacts and is lacking sufficient adaptation strategies to improve the efficiency of response to climate events (emergency response).** During the 2003–19 period, Peru was affected by 61,708 emergencies caused by natural hazards (intense rains, floods, droughts, earthquakes, and landslides). Climate change will intensify these events with maximum monthly rainfall projected to increase by between 15 and 25 millimeters and maximum temperature by between 0.8 and 2.0°C by 2050.[4] In the El Niño Costero floods of 2017, Lima was the region with the second-largest number of districts under emergency.

B. Sectoral and Institutional Context

4. **The supply of public transport services in Lima has not kept pace with the rapid urban growth, hampering access to economic and social opportunities, particularly for the poor**. Nearly 86 percent of Lima's transit commuters are still dependent on inefficient and unsafe modes of public transport, sometimes requiring multiple transfers that add to the trip cost. These transport gaps hamper access to services, markets, and jobs, especially for the poor. Currently, only about 18 percent of all jobs in Lima can be accessed within 45 minutes of travel by public transport or non-motorized transport (NMT—walking and cycling), and less than 1 in 10 Lima residents report feeling satisfied with public transport quality.

5. **Most of Lima's population travels by public transport, with most of the supply concentrated in an inefficient bus transit system with substantial gaps in terms of quality of service.** About 30 percent of Peru's population live in Lima (11.3 million in 2023),[5] generating 24.7 million daily trips (2023),[6] of which 14.2 million trips (57 percent) are by public

[1] World Bank. 2023. *Rising Strong: Peru Poverty and Equity Assessment*. Washington, DC: The World Bank.
[2] The province of Lima is divided into 43 districts. Each of them is headed by a mayor, although the Metropolitan Municipality of Lima (*Municipalidad Metropolitana de Lima*, MML), led by the mayor of Lima, also exercises its authority in these districts.
[3] Calculations based on the national poverty rate estimated by the National Household Survey (*Encuesta Nacional de Hogares*).
[4] World Bank, "Peru: Climate Projections." https://climateknowledgeportal.worldbank.org/country/peru/climate-data-projections.
[5] INEI 2022, Índice Temático, Población y Vivienda. https://m.inei.gob.pe/estadisticas/indice-tematico/poblacion-y-vivienda/
[6] Preliminary results from the Origin-Destination household survey conducted in 2023 for the formulation of the Urban Mobility Plan of Lima and Callao.

transport (including taxis and mototaxis). There are substantial quality and capacity limitations to serve this demand in an efficient, safe, and inclusive manner. Modern mass transit service is limited to two corridors—the Bus Rapid Transit (BRT), called *Metropolitano*, and Metro Line (ML) 1—carrying a total of about 0.9 million trips per day. The *Metropolitano* BRT line (26 km) began commercial operation in 2011 and is now being extended by 10 km to the north, both investments with World Bank financial support.[7] ML 1,[8] a 34.6 km north-south elevated rail transit line, began commercial operations in 2010 and is the only transit system currently running with government operational subsidies. Four pre-BRT corridors (*Corredores Complementarios*) began operations in 2014 with formal transport service concession contracts and new bus fleets, carrying about 0.4 million trips per day. These corridors operate without segregated bus lanes and without the full benefits of travel time savings associated with BRT or metro.

6. **Lima's traffic congestion, transport-related environmental pollution, greenhouse gas (GHG) emissions, and road safety are other critical issues.** All the conventional public transport routes in Lima operate on major arterial corridors that are severely congested, without any segregated infrastructure or bus priority lanes/traffic light signals. Congestion costs are estimated at 1.8 percent of Peru's gross domestic product (GDP),[9] and Lima is usually ranked among the most congested cities.[10] Inadequate traffic management capacity is usually associated with the factors that exacerbate congestion levels.[11] Inefficient traffic management disproportionately affects the poor, whose mobility and access to opportunities depend on inefficient bus services operating in highly congested corridors. The system, dominated by motorized vehicles, generates other critical externalities. In 2018, the World Health Organization recognized Lima as a city with poor air quality and high noise levels. Peru's per capita GHG emissions grew by 123 percent in 2000–2016. About 92 percent of the transport GHG emissions come from road transport, mostly in Lima, given that it concentrates 52 percent of the national vehicle fleet.[12] Transport is the main source of emission in Lima, accounting for 40 percent of the total emissions (6.36 million tCO_2eq).

7. **Road traffic fatalities and injuries in Lima are worsening as the motorization rate increases, affecting human capital and productivity.** In 2022, 3,328 traffic deaths were officially reported in the country, and 371 of those were in Lima. Of those fatalities, 54 percent were pedestrians, 27 percent were motorcyclists, and 1 percent were cyclists.[13] The socioeconomic cost of road deaths, serious injuries, and disabilities have a disproportionate impact on the poor and other vulnerable urban transport users; overall, it is estimated to be equivalent to 4.6 percent of Peru's GDP.[14]

8. **Bicycle use in Lima has increased over the years, even though the existing bike lanes remain unconnected and have poor-quality infrastructure and unsafe intersections for pedestrians and cyclists.** Cycling in Lima rose from 0.3

[7] The Lima Transport Project (P035740) closed on April 30, 2011, and the Lima Metropolitano BRT North Extension (P170595) closed on April 30, 2024.
[8] In 2010, the Government of Peru (GoP) approved the Metro Network Plan for Lima and Callao, which includes five lines totaling 168 km. ML 2 is under construction since 2014 (52 percent physical progress in October 2023) with support from international financial institutions. ML 3, a 34.8 km line valued at US$6.9 billion and ML 4, a 23.6 km line valued at US$3.7 billion, are both currently at conceptual stage and the GoP is evaluating with World Bank support different transaction model schemes, including Government-to-Government and traditional PPP models, to launch their structuring and bidding in 2025–2026.
[9] According to Transitemos (2022), 38 percent of the working class lose 90 minutes per day during commuting because of congestion. https://transitemos.org/wp-content/uploads/2022/10/Informe-Tecnico-Junio-de-2022.pdf
[10] See analyses by INRIX, TomTom, Moovit.
[11] Lima is one of the few major urban areas in the world where it is common to see traffic policy overriding traffic lights in major avenues.
[12] Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ), "Sistematización de la estimación del parque vehicular de transporte terrestre circulante a nivel nacional." 2019.
[13] Observatorio Nacional de Seguridad Vial, Dirección de Seguridad Vial del MTC," Informe de víctimas fatales en siniestros de tránsito e identificación de puntos de alta siniestralidad en Lima Metropolitana, 2021–2022".
[14] This is an unofficial Global Road Safety Facility estimate.

percent of total trips in 2012 to 0.6 percent in 2023.[15] Despite this positive trend, the absolute numbers reflect the lack of provision of adequate cycling infrastructure. There are currently around 332 km of bicycle lanes, with low network coverage and connectivity, and few of them serve as last-mile connections to mass transit stations.[16] Only three of the existing BRT stations offer integrated bike parking facilities.[17] There is still a long way to go to improve the conditions of Lima's cycling infrastructure to consolidate a connected, low-stress network and make it more gender inclusive. The gap in the cycle infrastructure network remains significant: a 2020 World Bank study that aimed at informing the update of Lima's Bicycle Infrastructure Plan[18] estimated the need for a total of 1,383 km of protected cycle lanes. The most recent official cycle infrastructure plan dates to 2005,[19] and despite multiple studies being carried out since then, including calls for an additional 470 km in the recently approved Lima's Metropolitan Development Plan 2021–2040 (*Plan de Desarrollo Metropolitano de Lima 2021–2040*, PLANMET 2040),[20] Lima still does not have an updated cycle infrastructure plan adopted as a planning instrument with a sound policy strategy to reach these targets. Road safety issues at key intersections on arterial avenues and collector streets also limit the growth in cycling and active mobility in general, particularly for women. Vulnerable users (pedestrians and cyclists) account for almost 55 percent of all road annual fatalities and most of these incidents occur at intersections.

9. **Women bear a disproportionate burden in terms of limited availability, acceptability, accessibility, and affordability of transport options, which reduces their access to social and economic opportunities.** Women in Lima have more limited transport options, and cultural norms require women to take on a disproportionate share of household tasks, resulting in women representing only 45.2 percent of Lima's labor market participants. As a result, women spend less time on travel than men and typically tend to take more frequent short trips. Time poverty and transport deficiencies add to the list of factors that discourage women from joining the wider labor market or force them into part-time, low-wage jobs nearer home.[21] Compared to men, women in Lima are more dependent on walking or inefficient public transport modes (conventional transit system) and generally avoid crowded buses/mass transit systems. Women have differences compared to men on what they would consider acceptable given their needs and concerns, including road safety and personal security. They have a higher threshold of safety that has to be met for considering cycling an acceptable mode, which explains the lower share of cycling women (12 percent) compared to men, adding to the fact that more women than men in Lima do not know how to ride a bicycle.[22] Women in Peru earn 16 percent less than men;[23] therefore, any costs associated with transport represent a higher share of their overall budgets and spending on transport. Overall, women are more likely to incur extra transport expenses, given that they lack safe and affordable alternatives, including for relatively short distances.

10. **To improve the efficiency of transport service operations, Lima's traffic management system has been partially modernized in recent years, but there are still substantial gaps.** Since 2017, the Metropolitan Municipality of Lima (*Municipalidad Metropolitana de Lima*, MML), through the Special Project for Traffic Management in Metropolitan Lima

[15] Preliminary results from the Origin-Destination household survey conducted in 2023 for the formulation of the Urban Mobility Plan (*Plan de Movilidad Urbana,* PMU) of Lima and Callao.
[16] World Bank. 2023. "Bicycle Infrastructure Inventory."
[17] World Bank. 2021. '*Integración de transporte público masivo e infraestructura ciclista en Lima*.
[18] World Bank. 2020. *Propuesta de actualización del Plan de Infraestructura Cicloviaria para Lima y Callao*. Washington, DC.
[19] Plan Maestro de Ciclovías para Lima y Callao 2005–2025, World Bank GEF-MML.
[20] Approved on September 14, 2022, by Ordinance No. 2499-2022.
[21] Dominguez, K. et.al. 2020. "Why Does She Move? A Study of Women's Mobility in Latin American Cities." Washington, DC: World Bank.
[22] 94 percent of the surveyed men and 69 percent of women know how to ride a bicycle. Source: Rumbo Survey pilot (2023).
[23] World Bank, 2021. *Combating Gender-Based Violence in Peru: Increasing Awareness and Resources to Prevent Violence Against Women*.

(*Proyecto Especial para la Gestión de Tránsito en Lima Metropolitana,* PROTRANSITO),[24] has been implementing a strategy to improve traffic management by modernizing, integrating, and centralizing existing traffic lights under a Traffic Control Center (TCC). As of 2024, out of a total of 1,544 intersections with traffic lights in the city, 840 intersections (54 percent) are centralized with the TCC. The MML, through the Urban Mobility Department (*Gerencia de Movilidad Urbana*, GMU) and PROTRANSITO, manages 1,217 intersections (79 percent); 92 intersections (6 percent) are managed by the Lima and Callao Urban Transport Authority (*Autoridad de Transporte Urbano para Lima y Callao*, ATU)[25] for the operation of the *Metropolitano* BRT corridor, and the rest are managed by local districts (13 percent), urban highway concessions, and shopping malls (2 percent). The intersections are operated with substantial technological limitations and there are issues with the interoperability of traffic controllers' protocols and the capacity of communication systems (see annex 2). In addition to addressing the technological gap by modernizing and centralizing existing traffic lights,[26] PROTRANSITO has the mandate to close the coverage gap by expanding the traffic lights system to over 2,100 intersections.[27]

11. **Beyond the provision of infrastructure and technology, one of the main challenges in traffic management is that PROTRANSITO currently focuses on efficiency of motorized traffic flow rather than safe movement of vulnerable users.** PROTRANSITO's human and technological capacity to plan, prioritize, and implement interventions has not been informed by road safety approaches that focus on vulnerable users and promote sustainable mobility options. Despite recently adopted sectoral road safety strategies and plans at the national level and by the MML, PROTRANSITO's interventions do not yet include adequate geometric road design and signalization to prioritize NMT and transit.

12. **Peruvian authorities have adopted long-term strategies and policies to address the above challenges:**

- **The city council recently approved PLANMET 2040,[28] developed by the MML and the Ministry of Housing, Construction and Sanitation (*Ministerio de Vivienda, Construcción y Saneamiento*).** Under the strategic objective for road safety, emissions, and traffic congestion (9.2), it calls for the implementation of a TCC with an integrated network of traffic lights in coordination with local district municipalities. Its strategic objectives include the implementation of traffic calming zones (*Zonas de Trafico Calmado,* ZTCs) in areas that require urban regeneration due to the impact of metropolitan traffic (Strategic Objective 9.2) and the integration of bicycle infrastructure with transit and the implementation of a bikeshare system (9.1).
- **The National Government and the MML have undertaken significant efforts to improve the governance and institutional framework for urban transport management, creating ATU and leaving the traffic management to the subnational governments.** ATU's mandate is to develop the strategy for the institutional, operational, physical, and fare integration of transit systems (*Sistema Integrado de Transporte*, SIT) in Lima and Callao, and close the mass transit infrastructure gap.[29] To that end, ATU is developing a long-term PMU expected to be adopted in 2024. Traffic management is still under the mandate of the MML and the Callao Provincial Municipality with a direct relationship to road safety strategies and policies. In 2015, the Ministry of Transport and Communications (*Ministerio de Transportes y Comunicaciones*, MTC) created the National Road Safety Observatory (*Observatorio Nacional de Seguridad Vial*, ONSV) to coordinate efforts

[24] Created by Mayoral Decree No. 017 of December 30, 2016, as modified by Ordenanza No. 2537, the *Proyecto Especial para la Gestión de Tránsito en Lima Metropolitana* (PROTRANSITO) is a special project and decentralized body of the MML assigned (*adscrito*) to the GMU whose objective is to optimize, modernize, and integrate traffic management and control systems in the entire jurisdiction of the province of Lima. Between 2019 and 2022, PROTRANSITO implemented an investment project to modernize and centralize 291 traffic light intersections.

[25] ATU is a central government entity created in December 2018 and is responsible for urban transport planning, integration, infrastructure provision, service concession, permitting, and fare policy in Lima and Callao.

[26] PLANMET 2040's Specific Objective 9.2.1 aims to get to 1,400 intersections with centralized traffic lights connected to ProTransito's TCC.

[27] World Bank. 2023. *Gap Analysis of the Lima Traffic Light System*. Elaborated by IDOM.

[28] Approved on September 14, 2022, by Ordinance No. 2499-2022.

[29] Since 2017, the World Bank supported the design and implementation of ATU with multiple trust fund grants.

around the collection of systematic data on fatal and non-fatal traffic injuries.[30] In 2023, the MTC approved the National Multisectoral Road Safety Policy 2023–30 (*Política Nacional Multisectorial de Seguridad Vial al 2030*, PNMSV 2030)[31] and announced the creation of a National Road Safety and Traffic Agency (*Agencia Nacional de Tránsito y Seguridad Vial*, ANTSV), law project under revision by the MTC.[32] The MML adopted a Road Safety Plan for 2022–24,[33] aligned with the objectives of PLANMET 2040, to be harmonized with the national policy and mandate of the future ANTSV for urban areas.

- **The MML is reviewing the World Bank proposal to update the Bicycle Infrastructure Plan and adopt a Bicycle Strategy,[34] to be formally adopted as part of the MML's planning instruments**. This proposal aims to increase the bicycle mode share to 12 percent by 2030. The proposed plan informed the MML's COVID approach for pop-up bike lanes during the pandemic, adding almost 100 km of new bike lanes in two years, and informed subsequent efforts such as the ongoing design and construction of 98 km of bicycle lanes with support from the German Development Bank (*Kreditanstalt für Wiederaufbau*, KfW). In 2024, the World Bank also completed the analysis of the transaction model and financing options and is now supporting the MML to structure a co-financed public-private partnership (PPP) project for a metropolitan Public Bicycle-Share (PBS) system.
- **Peru has committed to GHG emissions mitigation efforts in its latest Nationally Determined Contribution (NDC) and aims to achieve carbon neutrality by 2050, and subnational plans for climate change are in place.** In the latest NDC (2022), Peru committed to reducing GHG emissions by 40 percent by 2030 and increasing the climate adaptation and resilience in seven sectors, including transport. Peru's NDC adaptation measures were reinforced in the National Adaptation Plan[35] (2021), including transport. In 2021, the MML's city council approved the Local Climate Change Plan for the province of Lima 2021–2030 (*Plan Local de Cambio Climático para la Provincia de Lima,* PLCC-LIMA), which strengthens initiatives of the MML, such as the implementation of an air quality monitoring network with low-cost sensors and 640 km of new bicycle lanes and green corridors along them, as well as the creation of climate-smart neighborhoods.

13. **The proposed phased program (Multiphase Programmatic Approach, MPA) aims to support the implementation of the city's long-term vision as presented in PLANMET 2040 and climate change mitigation plans and further supports the MML in changing the traffic planning/management culture from a vehicle-centric to a people-centric approach to support sustainable transport options.** Improving traffic management and road safety, while reducing the barriers for sustainable mobility options and reducing the environmental impact of urban transport requires a comprehensive and sustained effort with sizable public resources over a long period of time. This also requires a phased framework that allows for an adaptive learning agenda across and within phases, adjusting the design and targeting of interventions to introduce innovations and maximize the economic and social benefits of the MPA and allowing for progressive cultural change in planning practices and behavioral changes in the population.

[30] In 2021, the ONSV and the National Police for the first time published georeferenced and standardized data of traffic fatalities for the whole country.
[31] Supreme Decree 009-2023-MTC.
[32] The World Bank is providing technical assistance to support the definition of functions, roles, interventions, and expected impacts for the new Road Safety Agency.
[33] *Municipalidad Metropolitana de Lima, Plan de Seguridad Vial de la Provincia de Lima* 2022–2024.
[34] World Bank. 2020. *Propuesta y recomendaciones para la actualización del Plan de Infraestructura Cicloviaria para Lima y Callao.* Washington, DC: World Bank. World Bank. 2020. *Propuesta y recomendaciones para la formulación de una estrategia para la Bicicleta en Lima Metropolitana*. Washington, DC: World Bank.
[35] Ministerial Resolution No. 096-2021-MINAM of June 9, 2021: https://www.gob.pe/institucion/minam/normas-legales/1955977-096-2021-minam.

C. Relevance to Higher Level Objectives

14. **The proposed Program is aligned with key World Bank strategies and the World Bank Group FY23–27 Country Partnership Framework[36] (CPF) for Peru.** In particular, the Program is aligned with the CPF high-level outcomes (HLOs) of Increased access to quality economic opportunities for workers and entrepreneurs (HLO1), Improved access to quality public services across the territory (HLO2), and Increased resilience to shocks (HLO3).

15. **The Program is consistent with Peru´s commitments on climate change (Paris Agreement) and the World Bank Group framework for Green, Resilient, Inclusive Development (GRID) approach**. The Program will contribute to implementing the NDC, which identifies transport as a priority sector for emissions mitigation. Specifically, the Program will help mitigate carbon emissions in Peru's largest metropolitan area, which disproportionately contributes to emissions due to having 52 percent of the country's vehicle fleet, by promoting a shift to low-carbon modes (walking, cycling, and public transport) and help reduce private vehicle-related trips and emissions through traffic management and implementation of low-traffic neighborhoods. The Program is also aligned with PLCC-LIMA, which lays out priority transport sector initiatives for GHG reduction in Lima, such as NMT development. It is also in line with the recommendations of the recently completed Peru Country Climate and Development Report,[37] such as the expansion of bicycle and BRT infrastructure, and a bicycle-based delivery system.

D. Multiphase Programmatic Approach

(i) Rationale for Using MPA

16. **A long-term vision of the city, as presented in PLANMET 2040, requires a holistic approach and comprehensive urban transformations that address interrelated and complex development challenges, while driving changes in planning/management cultures and behaviors that require time and a constant process of learning and adaptation**. Unlike other more traditional urban transport projects financed through stand-alone Investment Project Financing (IPF) operations that focus on single linear infrastructure investments, this Program is supporting the implementation of a long-term vision that requires comprehensive urban transformations, including a progressive cultural change in terms of urban transport planning practices (that is, efficiency of motorized traffic flow versus prioritizing NMT and solving road safety problems with a gender focus), the incorporation of technological innovations and data-driven solutions, and behavioral changes among transport and public space users. Such a change will only be possible through the implementation of a series of incremental reforms and interventions that will have an impact through their complementarity over time.

17. **The GoP has demonstrated a strong commitment to the long-term goals promoted in the MPA through the adoption of key long-term strategies and planning instruments.** The development challenges require a comprehensive approach that addresses multiple causes and solutions, taking advantage of the long-term policies and strategies already in place (that is, PLANMET 2040, PNMSV, the upcoming PMU, PLCC-LIMA, and climate change mitigation commitments, which are directly supported by the Program) and a strong political commitment to this long-term vision on the GoP side.

18. **To achieve results, the Program requires a longer time frame than a traditional IPF operation.** According to studies prepared by PROTRANSITO and analytical work conducted by the World Bank, an investment of approximately

[36] The World Bank Group. 2023. The Peru CPF FY23–FY27 (Report No. 179046) was discussed by the Board of Executive Directors on January 31, 2023. http://documents.worldbank.org/curated/en/099150001232325672/BOSIB0f4cc4c400e30b762022261092365f
[37] The World Bank Group. 2022. *Peru Country Climate and Development Report*. November.

US$700 million over a 10-year period is needed to close the investment gaps and comprehensively address the gaps in traffic management, road safety, NMT, and gender inclusion in Lima's urban transport system.

19. **The innovative nature of the proposed solutions, which are new to Lima and not common in the region—requires phasing to learn from piloting and adjusting the approach before scaling up interventions**. In an urban area with 43 different municipal districts and potential interventions in dozens of corridors and thousands of intersections, the envisioned changes in planning and design culture, and the need to adapt to changes in citizen behavior, require a phased approach to achieve the expected program outputs and outcomes in the most efficient and effective way. Identifying the causes of road safety and congestion issues at a local level will inform the relevance of specific low-traffic neighborhood designs and the need for complementary 'soft' interventions such as road safety management and promotion of cycling, especially among women, to ensure that the interventions achieve their intended results. These types of innovative solutions require testing, learning, and adaptation, so that the design of subsequent phases is informed by the learning and results of the previous phases, and where previous phases support the readiness for subsequent phases. Phase 1 will be critical for testing solutions and informing the design and implementation approach for different neighborhood and district characteristics. In subsequent phases, interventions will be adjusted based on the knowledge of what worked in the previous phase.

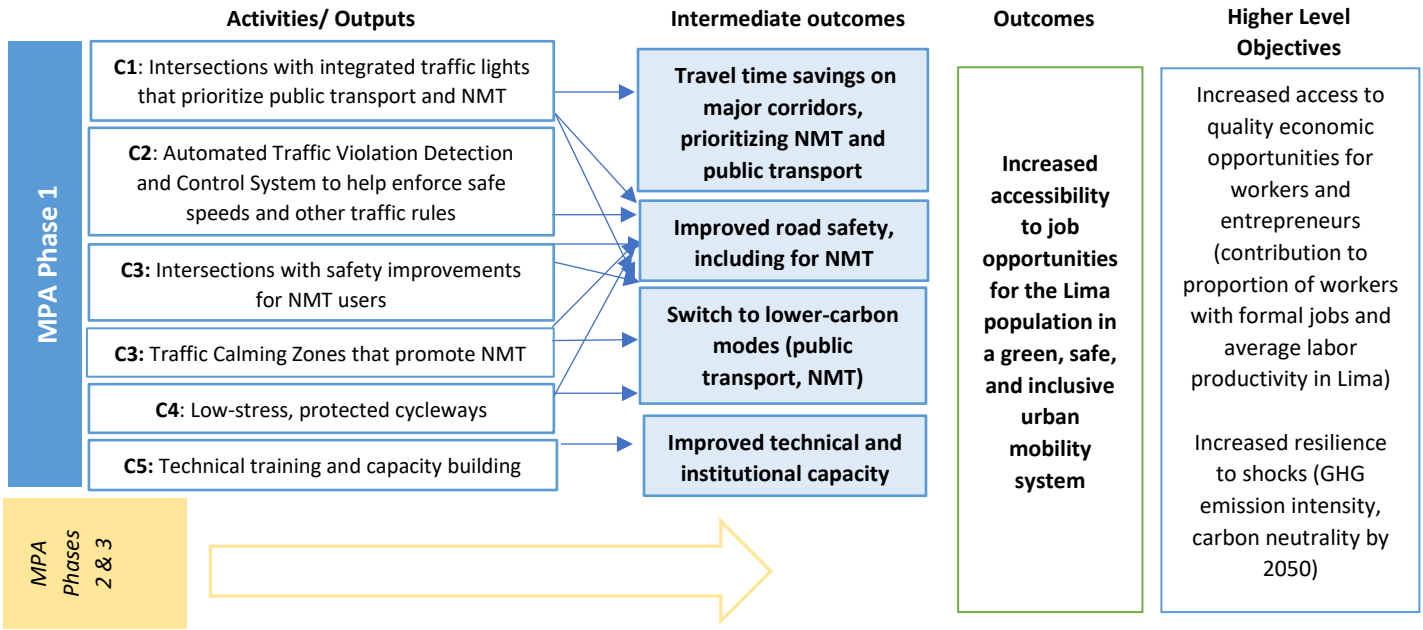
20. **The MPA provides the flexibility needed to adjust the timing and focus of interventions**, which will require the participation of different institutions or stakeholders to ensure sound monitoring and evaluation (M&E). This dynamic and collaborative process will help ensure that the approaches are tailored to the needs of PROTRANSITO, the GMU, ATU, and local districts, while maintaining the focus on a systemic approach to traffic management in Lima.

21. **The MPA approach will allow for a more efficient and streamlined preparation, reducing the time required to prepare and implement the entire investment package, given Peru's requirements for external debt financing.** A phased approach will allow to include in the initial phase, the financing of preinvestment and engineering design studies needed for the projects to be financed in subsequent phases and to meet the 'viability' threshold required for external debt financing under the country's internal approval process. Such a process requires that at least 50 percent of the total investment program (projects) be declared 'viable' at the time of the country's internal approval. Under current country regulations, the use of a series of IPF projects would not allow for the inclusion of financing for preinvestment and engineering design studies for projects in later phases.

22. **The MPA timeline and phasing is consistent with the long-term commitment of the GoP to improving urban mobility in Lima.** The Ministry of Economy and Finance (*Ministerio de Economía y Finanzas*, MEF) has demonstrated strong commitment to developing the MPA, seeing its value in bringing important climate, gender, and road safety benefits through improvements in urban mobility for Lima.

(ii) Program Results Chain

Figure 1. MPA Results Chain



Critical Assumptions: (a) No significant political shifts during the Program implementation; (b) Sustained ownership of the safe, green, and inclusive urban transport and people-centric traffic management agenda; (c) No serious natural disasters during Program implementation.

Note: The future MPA Phases 2 and 3 will be overlapping in preparation and implementation and will include the same structure of components as Phase 1 but adjusting the scope of activities under the components for each Phase 2 and 3.

(iii) Program Development Objective with Key Program Development Objective Indicators

23. **The MPA Program Development Objective (PrDO) is to increase accessibility to job opportunities for the province of Lima population in a green, safe, and inclusive urban mobility system.** The proposed PrDO indicators are listed below, with two sub-indicators capturing the Program's outcomes in terms of inclusive mobility:

(1) Share of jobs in Lima that can be reached by public transport and NMT within 45 minutes.
Sub-indicator: Share of jobs in Lima that can be reached by public transport and NMT within 45 minutes (low-income population).

(2) GHG emissions savings in Lima related to urban transport as a result of the MPA.

(3) Annual traffic fatalities in the intervention areas.
Sub-indicator: Annual traffic fatalities in the intervention areas among pedestrians and cyclists.

(iv) Program Framework

24. **The World Bank will provide up to US$510 million (MPA envelope) to finance the Lima Traffic Management and Sustainable Transport Program.** The 10-year MPA Program will have three simultaneous (overlapping) phases with the same development objectives and mostly the same components in each phase but with activities that will evolve in nature and scope based on the learning agenda and the enabling environment to implement more innovative solutions. It will complement other IPF projects currently under preparation with ATU for extensions and improvements of the BRT

Metropolitano system. This engagement is in line with ATU's mandate on public transport and the MML's coordinated support to make transit corridors more efficient through sound traffic management.

25. **Phase 1 of the MPA will lay the groundwork for traffic management systems and technologies to enable new innovative solutions for prioritizing transit and NMT flows, and road capacity charging schemes to be included in Phases 2 and 3.** Phases 2 and 3 of the MPA will build upon Phase 1, maintaining the same structure of components but adjusting the scope of activities. Phase 1 will partially close the gap of integrated and modernized traffic lights (reaching 60 percent of the program target), implement a revamped TCC, pilot Lima's first automated traffic violation detection system (20 percent of the program's targeted intersections), implement Lima's first metropolitan PBS system with private sector participation, and improve road safety at intersections—targeting transit and bicycle corridors—(nearly 300 intersections out of the thousands in Lima) and neighborhoods (five superblocks in five of Lima's 43 district municipalities). In terms of traffic lights and control systems, key public transport (commuting) corridors were selected for Phase 1 based on their strategic location in terms of traffic flows as well as their readiness for implementation. For Phases 2 and 3, new and innovative technology solutions to optimize signal timing for public transport and NMT (tested in Phase 1) will be evaluated to meet the needs for bus and NMT priority corridors to be defined in the upcoming ATU PMU and the associated new network of bus priority routes and services. The technological improvements of the traffic management system will also support other traffic management functionalities such as future road capacity charging schemes (for example, on-street parking and an initial pilot of road capacity charging to eventually evolve into complex dynamic congestion charging systems) to generate new revenue sources and improve the sustainability of the program investments.[38]

26. **Phases 2 and 3 will continue to close the gap in integrated traffic lights (80 and 100 percent, respectively) and safe intersections and neighborhoods, while closing other investment gaps for sustainable mobility options, such as in bicycle infrastructure and services.** Phase 1 will partially close the bicycle lanes gap (48 percent of the kilometers of bike lanes targeted in Lima's PLANMET 2040). Phases 2 and 3 will continue to close this gap (68 and 100 percent, respectively), while expanding to other bicycle infrastructure and services, including the integration of bicycle infrastructure and public transport with parking and intermodal facilities at mass transit stations, and the expansion of the PBS system, both of which are targeted in Lima's PLANMET 2040. The metropolitan PBS system, conceived as a PPP, is currently undergoing structuring analysis with advisory support from the World Bank. If implemented by the MML during Phase 1, it will mobilize approximately US$19.2 million in private sector financing, and the required public sector availability payments could be included in Phases 2 and 3 of the MPA. Phases 2 and 3 will also continue to close the gap of low-traffic neighborhoods or superblocks (35 and 70 percent, respectively), also targeted in Lima's PLANMET 2040, assuming there is a potential for at least one of these interventions in each of Lima’s 43 district municipalities.[39]

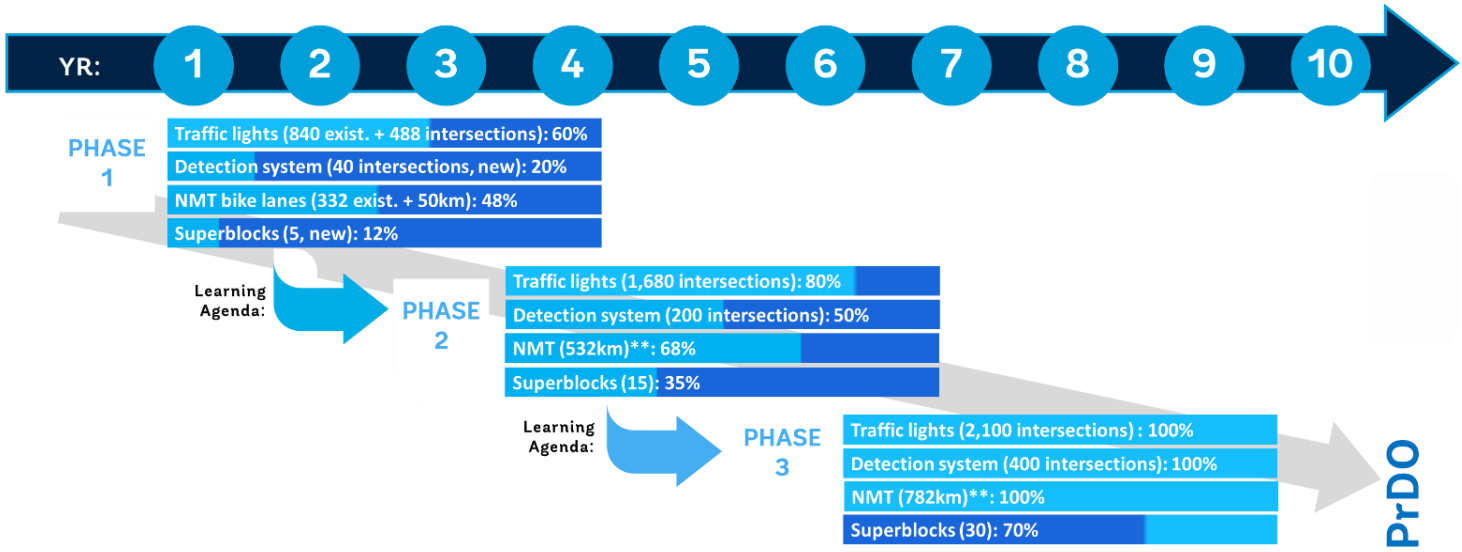
27. **The interventions planned in Phases 1 to 3 aim to progressively implement a comprehensive safe system approach and a Transport Demand Management (TDM) framework for the MML.** Phase 1 will advance two elements of the Safe System Approach for Lima—safe speeds and safe streets. The capacity-building activities included in Phase 1, in coordination with the establishment of the ANTSV expected in 2024/2025, will lay the groundwork for the implementation of three other elements of the Safe Systems Approach—safe users, safe vehicles, and post-crash care—in MPA Phases 2 and 3, including vehicle registration and driver licensing reforms and support from the revamped TCC to post-crash care protocols. Among all the TDM measures, specific interventions were selected for Phase 1 (that is, traffic signaling, NMT, speed management, and traffic calming) based on two factors: (a) availability of individual investment projects feasible in

[38] The World Bank is conducting analytical and advisory services to support the MML in the identification of enabling conditions and policy options for these new revenue generation sources and improve the sustainability of the Program investments, including the definition of a comprehensive policy for parking management in Lima.

[39] For Phase 1, 19 district municipalities submitted superblock project proposals to the MML, but only five were selected for the first pilot of its kind in Lima.

the national public investment system and (b) evidence from available analytical work supporting their need, impact, and urgency. Phases 2 and 3 will pilot and implement complementary TDM measures (for example, road capacity charging and parking policy). The MPA framework will also help 'avoid' motorized trips and 'shift' them to NMT and public transport, thus mitigating the risk of induced demand from improved traffic management efficiency achieved as a result of the interventions financed under Phase 1.

Figure 2. Progressive Scale-up of Interventions through the MPA Program



Note: **NMT: Bike lanes + PBS + Bike parking (transit stations).

(v) Learning Agenda

28. **First, the traffic lights system optimization and impacts simulation modeling methods developed in Phase 1 will be used in subsequent phases to improve the identification and design of interventions to optimize the traffic lights system**. In Phase 1, the project-funded sensors and embedded technology will collect data on the performance of the traffic signal system and technology solutions to optimize signal timing from a travel time perspective for public transport and NMT modes. This will help the MML to further optimize the system to better prioritize traffic management improvements for public transport passengers and NMT users, focusing on interventions on new corridors to be defined in the upcoming PMU that maximize the overall benefits of the Program.

29. **Second, the Program's capacity-building activities will include a continuous multimodal road safety intersection design learning from a user-centric approach and informed by citizen engagement.** Designing road safety solutions at intersections or neighborhoods includes not only improvements in traffic signal and control systems but also specific knowledge for tailor-made geometric redesigns. These designs will focus on improving road safety elements for all users, especially pedestrians and cyclists, and will be based on the specific local context of each intersection or neighborhood. The knowledge generated through this interactive process, including citizen engagement, will be captured in the M&E framework of the Program and will inform the planning and design of interventions, allowing the MML to learn how to combine safe infrastructure design with project-funded modelling and simulation tools to evaluate potential impacts from

alternative design scenarios.[40] Similar learning will be relevant for the design of ZTCs in different conditions throughout Lima along the MPA phases.

30. **Third, the MPA will generate valuable lessons for prioritizing investments to promote gender inclusion, in terms of road safety, use of public space, and cycling.** Through the collection of survey and focus group data in the Program's M&E framework, the MML will assess innovative interventions such as low-traffic neighborhoods (superblocks) in terms of their acceptability, urban quality, and perceived safety from women's perspectives. The design of activities for Phases 2 and 3 will leverage lessons from Phase 1 on the interventions that best facilitate women's use of public space, including those related to violence-prevention environmental design (that is, openness, lightning, proximity to businesses) in the case of cycling infrastructure and ZTCs. It will also try to understand how access to safe cycling infrastructure affects women's employment choices through an impact evaluation, for which the baseline survey will be collected before the implementation of the Phase 1 investments and the endline at the completion of Phase 1. The MML will collect and conduct baseline, midterm, and final impact evaluation activities with project (Phase 1) funds. Results will be shared with local stakeholders to allow for further feedback and understanding of the impact of intervention design elements. This will allow improving the prioritization of investments financed in Phases 2 and 3 to maximize the benefits generated by the Program for women.

31. **Fourth, the MPA will ensure learning between phases on the institutional and coordination aspects of traffic management, road safety, and other topics.** From the road safety perspective, Phase 1 will focus mainly on physical interventions, but with the creation of the new ANTSV, a new reform agenda could be supported in the subsequent phases of the MPA from a national and subnational coordination and a Safe System Approach.

32. **Finally, the MPA Phase 1 will generate learning on how a revamped traffic management system can leverage the implementation of innovative road capacity charging schemes.** The learning agenda around the implementation of the first automated traffic violation detection system in Lima, piloted and financed in Phase 1, will pave the way for the design and scope of innovative road capacity charging schemes to be piloted in Phase 2. The Program's M&E activities of this pilot scheme in Phase 2 will inform and support the necessary preparatory and regulatory work to scale up this road capacity charging scheme in Phase 3.

Table 1. MPA Phases

Phase #	Project ID	Sequential or Simultaneous	Phase's Proposed Development Objective*	IPF or PforR	Estimated IBRD Amount (US$, millions)	Estimated Other Amount (US$, millions)	Estimated Approval Date	Estimated Environmental and Social (E&S) Risk Level
1	P178842		Increased accessibility to job opportunities for the Lima population in a green, safe, and inclusive urban mobility system	IPF	150.0	31.4	October 2024	Substantial
2	n.a.	Simultaneous		IPF	180.0*	72.0*	May 2027	Moderate
3	n.a.	Simultaneous		IPF	180.0*	46.6*	May 2030	Moderate
Total					**510.0***	**150.0***		

Note: PforR = Program for Results. *=indicative amounts.

[40] Initial steps have already been taken, with the delivery of a safe intersection design workshop by the World Bank with support from the World Resources Institute, completing the detailed design of five key intersection typologies as an example of the learning agenda that can be replicated to the other remaining intersections.

II. PROJECT DESCRIPTION

A. Project Development Objective

(i) PDO Statement

To increase accessibility to job opportunities for the province of Lima population in a green, safe, and inclusive urban mobility system.

(ii) PDO Level Indicators

- Share of jobs in Lima that can be reached by public transport and NMT within 45 minutes.
    - Share of jobs in Lima that can be reached by public transport and NMT within 45 minutes (low-income population)
- Millions of people living within the areas that benefit from improved access to sustainable transport infrastructure and services (new corporate scorecard indicator)
- Concentration of particulate matter (PM2.5) emissions in the intervention areas
- GHG emissions savings in Lima related to urban transport as a result of the MPA
- Annual traffic fatalities in the intervention areas
    - Annual traffic fatalities in the intervention areas among pedestrians and cyclists.

B. Project Components

33. **Phase 1 consists of five components, which will be implemented under Phases 2 and 3 until the investment gap of each component is closed.** The Phase 1 interventions, while covering a large spatial scope in Lima, are broadly aligned along several corridors (key commuting corridors in Lima) and are combined in a way to enhance the overall impact in terms of traffic management, road safety, and promotion of low-carbon modes of transport (annex 2).

Component 1: Traffic lights system (US$93.0 million, of which US$81.5 million is financed by the International Bank for Reconstruction and Development, IBRD).

34. This component focuses on expanding and improving the centralized traffic lights network and strengthening the TCC, including the application of Traffic Signal Priority (TSP).[41] By improving the effective traffic monitoring and management in Lima and helping develop protocols and capacity-building needs for PROTRANSITO to be able to leverage the new traffic lights and traffic control capabilities, the project will help improve disaster and emergency response (including traffic redirecting and evacuation during floods and landslides) and thus contribute to climate adaptation. Component 1 is divided into two subcomponents:

Subcomponent 1.1: Centralized traffic lights network (US$85.6 million)

35. This subcomponent covers 488 intersections across 20 Lima districts and is aimed at expanding and improving the centralized traffic lights network through interventions on nine corridors across Lima (annex 5 analyzes the congestion patterns on these corridors). For these intersections, which have been prioritized to cover major public transport corridors

[41] TSP is a solution that leverages optimized signal timing to provide public transport and NMT has a higher likelihood of getting a green light at specified intersections.

and the existing and projected bicycle lane infrastructure in Lima, the project will finance works and goods, including field equipment with TSP technology capable of prioritizing public transport and NMT flows. The works, goods, and services will include new vehicular, pedestrian, and bicycle traffic lights, as well as the installation of fiber optics, traffic control devices, and training/service support for TSP and other technologies related to sensors and peripherals. Pedestrian and bicycle traffic lights will account for about 60 percent of the cost, considering both direct purchase and installation costs and the indirect costs associated with the installation of traffic sensors, fiber-optic underground cables, controllers, and other ancillary elements. Another 20 percent of the subcomponent will finance the direct and indirect installation costs of traffic lights that give priority to public transport (buses). The remaining 20 percent will be allocated to the direct and indirect costs of traffic lights for other vehicles. These sensors and peripherals will also improve traffic data collection and analytics to improve road safety planning and operational decision-making. The project will also finance consulting and non-consulting services for supervision contracts and engineering designs.

Subcomponent 1.2: Traffic Control Center (US$7.4 million).

36. This subcomponent will improve the TCC to meet the city's current and future needs for efficient and effective traffic monitoring and management. The TCC is essential for improving and maintaining the service levels of the centralized traffic lights network. Under Subcomponent 1.2, the project will finance detailed engineering designs and supervision contracts, works, and provision of goods and services to (a) improve the TCC's Data Center (in line with Excellence in Design for Greater Efficiencies [EDGE] level certification to ensure a reduction of energy use of at least 20 percent); (b) renew the TCC's core switches; (c) improve and renew TCC's traffic management software, including training and service support; and (d) improve and expand the TCC's building premises, control stations, and integration of the TCC with ATU's bus monitoring and control center. Energy-efficient equipment and technologies will be used in the TCC upgrade, aligned to the level of Leadership in Energy and Environmental Design (LEED) and similar best practice standards.

Component 2: Automated traffic violation detection system (US$7.2 million, of which US$6.5 million is financed by IBRD).

37. This component will implement an automated Traffic Violation Detection and Control Center (TVDCC) and equip the intersections with the highest rates of traffic-related incidents with an electronic traffic violation detection system, prioritizing control of traffic violations that affect safety of NMT and efficient flow of public transport services. The component includes the following:

(a) The installation of automated traffic violation detection equipment at approximately 40 intersections to detect, through photos, videos, and other type of sensors and mobile devices (cinemometers), vehicles violating a variety of traffic regulations, such as exceeding the maximum speed limit, running a red light, making illegal turns, invading bus or bicycle lanes, and blocking intersections. The location of the cameras will be dynamically adjusted based on georeferenced data of traffic incidents in Lima from the ONSV, disaggregated by gender.

(b) The implementation of a TVDCC, next to the TCC, to collect and analyze the information coming from the equipment and sensors and where the necessary actions will be taken, such as the notification of traffic fines imposed with personnel from the MML. The component will finance detailed engineering designs, supervision services, works, and goods for the installation of the automated traffic violation detection system, including data center equipment, workstations, and supporting software and hardware to operate 24 hours a day, 365 days a year. Energy-efficient equipment and technologies will be used throughout the TVDCC, aligned with best international practice standards (in particular, the entire TVDCC is expected to be EDGE certified).

Component 3: Safe intersections and neighborhoods (US$44.3 million, of which US$31.1 million is financed by IBRD)

38. Component 3 will finance the implementation of low-cost, high-impact interventions at intersections with high crash rates and improve safety and public life in selected neighborhoods to promote mode shift to walking and cycling.

Subcomponent 3.1: Immediate Traffic Actions Plan (US$21.3 million)

39. This subcomponent will finance detailed engineering designs, supervision services, works, and goods to improve the safety for NMT through the implementation of an Immediate Traffic Actions Plan (*Plan de Acciones Inmediatas de Tránsito*, PAIT), a low-cost traffic management and road safety intervention scheme at 295 intersections with high crash rates in Lima.[42] The interventions include the installation of pedestrian, cyclist, and vehicular traffic lights and their respective pedestrian/cyclist crossings, construction and resurfacing of ramps to ensure universal accessibility, installation of medians, installation of bollards and recovery of pedestrian circulation space, resurfacing of lanes, and horizontal and vertical signaling, among others. All 295 PAIT intersection improvements focus on improving safety and connectivity for NMT. 'Heavy' interventions (24 percent) include bicycle and pedestrian signalization, geometric changes to the intersection, and safety improvements for bicyclists and pedestrians. 'Moderate' interventions (18 percent) include the same elements, but less, as some signalization is already in place. 'Light' interventions (58 percent) fund geometric modifications to the intersection that provide safety improvements for NMT while relying on the existing bicycle and pedestrian signal elements. The feasibility and detailed engineering designs of the PAIT intersections will incorporate climate resilience considerations in the materials used and the implementation of nature-based solutions.

Subcomponent 3.2: Traffic Calming Zones (Superblocks) (US$23.0 million)

40. The second subcomponent will implement ZTCs in five districts of Lima,[43] with traffic calming measures in both residential and commercial areas with high potential for improving public life, which is hampered by the use of local streets as cut-through routes for motorized traffic. This subcomponent focuses mainly on local roads and therefore requires close coordination between the MML and the district municipalities, although the MML has the mandate to manage traffic on all roads in Lima. This subcomponent will finance detailed engineering designs; supervision services; and works and goods for traffic calming measures, such as narrowing of vehicle lanes, implementation of modal filters and passable barriers, leveling of the roadway to a single platform, and widening of sidewalks for pedestrian traffic. The implementation of street furniture and green landscaping elements are also contemplated as part of the elements used to implement traffic calming measures. These interventions aim to improve the conditions for walking and cycling and thus promote mode shift to these modes as well as help avoid the need for motorized vehicle trips through increased proximity to commercial, residential, and employment activity centers. The feasibility and detailed engineering designs will be informed by a qualitative assessment and consultations with women and groups in a situation of vulnerability that visit/travel to places in the vicinity of the ZTCs using citizen engagement and participatory methodologies.

Component 4: Urban mobility, cycle-infrastructure and complete streets (US$38.7 million, of which US$17.5 million is financed by IBRD and US$19.2 million by private sector)

41. This component will implement bicycle infrastructure as part of comprehensive complete streets interventions to improve travel conditions for pedestrians and cyclists and integrate NMT with public transport, thereby promoting modal shift from motorized modes. The component will finance the detailed engineering designs, supervision services, goods,

[42] During project preparation, the World Bank assisted the MML by developing a methodology for the prioritization of intersections in areas that concentrate schools or other places where population is at risk of traffic incidents while walking or cycling.
[43] During project preparation, the World Bank assisted the MML by conducting several site visits and hands-on workshops to support the selection of five superblock areas in the local districts of Lima. Conceptual designs were developed to initiate the preparation of feasibility studies.

and works for the construction of approximately 50 km of high-quality segregated cycle infrastructure to create a connected network in the 15 districts of central Lima. The engineering designs of the cycleways will also include climate resilience considerations in terms of the materials used and the implementation of nature-based solutions. The detailed engineering designs will also cover the next 150 km of bicycle infrastructure to be implemented in the MPA Phase 2. The structuring of a PPP tender for the metropolitan PBS system (Component 5) will enable the mobilization of approximately US$19.2 million in private sector financing for capital expenses (CAPEX) and operating expenses (OPEX) in the metropolitan PBS system. The technical specifications of the PBS system will address the 'care mobility' needs that currently fall to women, such as providing cargo bicycles, bicycles with child seats, and ensuring that women's safety priorities are considered when defining the technical specifications of the system, such as sufficient lighting at bicycle docking locations.

Component 5: Project management and capacity building (US$16.8 million, of which US$13.4 million is financed by IBRD)

42. This component aims to ensure adequate project management as well as to develop and strengthen capacities transversal to all project components. Component 5 has two subcomponents:

Subcomponent 5.1: Technical and administrative project management (US$11.6 million)

43. The subcomponent includes (a) activities to support project administration and management distributed across the MML, including a Technical Coordination Unit (TCU) within PROTRANSITO, covering procurement, financial, and technical management as well as M&E activities of the project and the MPA learning agenda (including, among others, operating costs[44] and project external audits) and (b) project-related capacity-building activities for the MML.

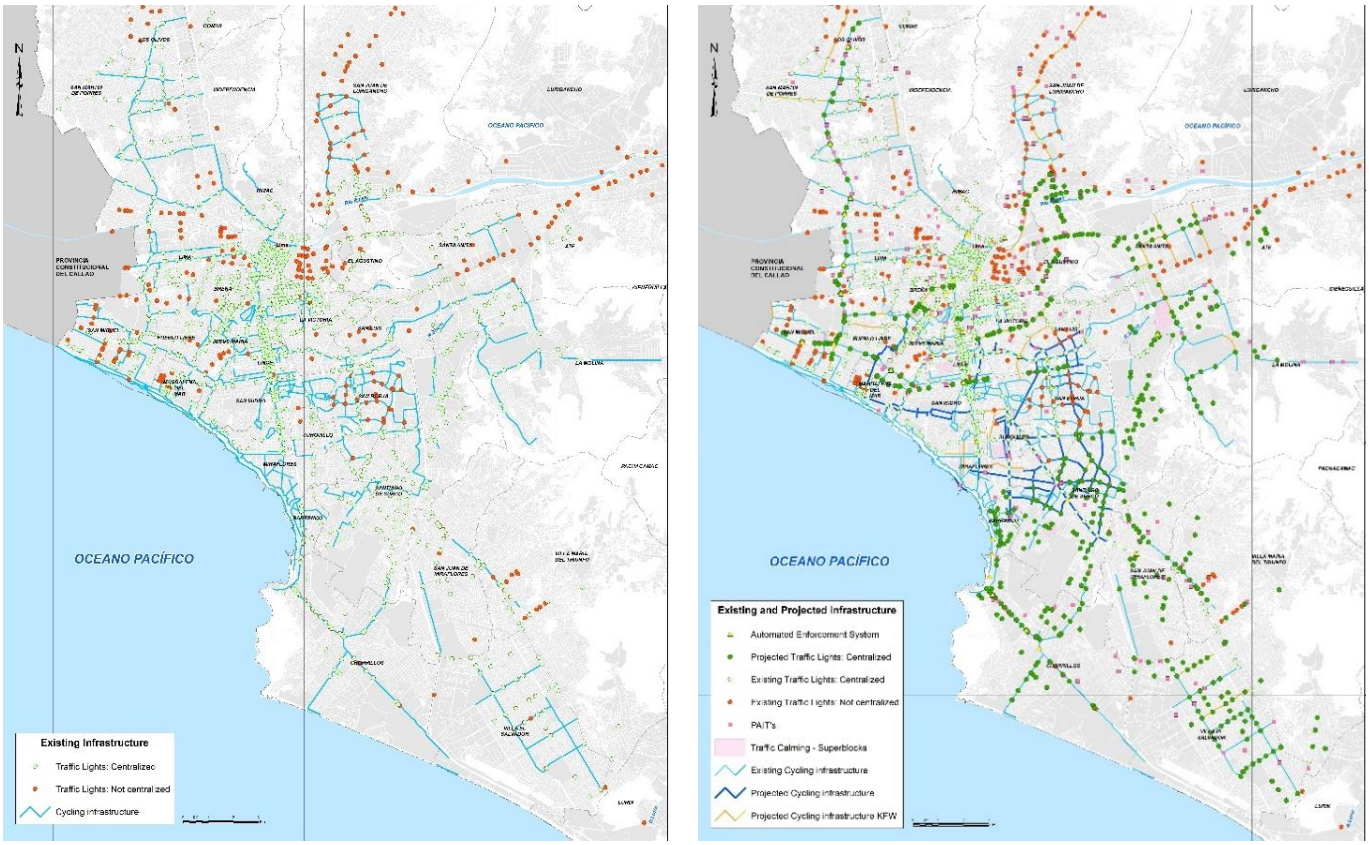
Subcomponent 5.2: Environmental and Social management, and sectoral strategies (US$5.2 million)

44. This subcomponent include services to (a) develop and implement communication strategies, including informative, educational, and awareness campaigns and develop, implement, or supervise the E&S instruments, including the Stakeholder Engagement Plan (SEP), the grievance redress mechanisms (GRM), Resettlement Plans, and/or Livelihood Restoration Plans (LRPs); (b) develop a comprehensive strategic plan to promote sustainable transport modes (NMT and public transport) through state-of-the-art intelligent transport system (ITS) tools and analytical methods; (c) recommend institutional reforms for safe and efficient traffic management in Lima; (d) develop guidelines and norms on planning, design, and evaluation of urban infrastructure with a gender perspective; (e) structure a PPP tender for the metropolitan PBS system; and (f) update the Bicycle Infrastructure Plan and develop a bicycle promotion strategy with a strong focus on attracting more women and vulnerable groups to cycling (conducting an analysis of the barriers women face in using bicycles to inform design features and technical specifications of project activities, in collaboration with women's cycling groups and urban cycling training initiatives).[45]

[44] Operating costs includes the reasonable incremental operating costs (other than for consulting services) incurred by the MML, including the TCU, in connection with project implementation, such as, among others, rental and maintenance of equipment and vehicles; rental of office facilities; purchase of office equipment and furniture, utilities, supplies, and materials; domestic travel and per diem of MML (including the TCU) staff; and logistics expenses, in each case which would not have been incurred absent the project and excluding salaries, fees, honoraria, bonuses, and any other salary supplements of members of the borrower's or MML's civil service.

[45] Some organizations in Lima are already working on similar initiatives, such as 'Cicleando en Lima', where women mentor other women on how to use bicycles and provide companionship on their routes.

Figure 2. Before and after Project Interventions



45. **Project costs by component and subcomponent are shown in table 2.**

Table 2. Project Components and Financing Amounts

Components and Subcomponents	IBRD (US$, millions)	Counterpart (US$, millions)*	Private Sector	Total (US$, millions)
Component 1: Traffic lights system	**81.5**	**11.5**		**93.0**
1.1. Centralized traffic lights network	74.9	10.7		85.6
1.2. Traffic Control Center	6.6	0.8		7.4
Component 2: Automated traffic violation detection system	**6.5**	**0.7**		**7.2**
Component 3: Safe intersections and neighborhoods	**31.1**	**13.2**		**44.3**
3.1. Immediate Traffic Actions Plan	19.2	2.2		21.3
3.2. Traffic Calming Zones (Supermanzanas)	11.9	11.0		23.0
Component 4: Urban mobility, cycle-infrastructure and complete streets	**17.7**	**2.0**	**19.2**	**38.7**
Component 5: Project management and capacity building	**13.4**	**3.4**		**16.8**
5.1. Technical and administrative Project management	8.6	2.9		11.6
5.2. Environmental and social management, and sectoral strategies	4.8	0.5		5.2
TOTAL	**150.0**	**30.8**	**19.2**	**200.0**

Note: *counterpart funds from the MML.

C. Project Beneficiaries

46. **The Program, including Phase 1, includes interventions in all districts of Lima.** The number of people within the areas benefiting from improved access to sustainable transport modes is estimated at 4.56 million (corporate scorecard indicator). The protected cycling lanes will benefit women in Surquillo, Santiago de Surco, Miraflores, and San Luis districts, improving the availability of transport options acceptable to them, and thereby increasing the overall transport affordability and accessibility to economic opportunities and essential services.

D. Rationale for Bank Involvement and Role of Partners

47. **The rationale for public sector provision/financing is justified by two market failures.** First, given the positive externalities of urban transport infrastructure, private provision would result in a quantitative and qualitative level of service that is lower than the social optimum. Second, these interventions require some degree of monopolistic structures that justify the participation of the public sector in the provision of services. Particularly, malfunctioning traffic lights and unregulated intersections generate undesired effects, such as congestion, increased traffic fatalities, and injuries, and inefficient transport networks due to the lack of coordination in their planning and operation. Some degree of consolidation mitigates this risk, but it is achieved through the creation of monopolistic structures that require public regulation and intervention.

48. **The World Bank's value added includes access to funding beyond the MPA financing, through dedicated trust funds, as well as technical assistance inputs.** The World Bank worked closely with the MML to design and evaluate the MPA Program scope and the Phase 1 activities and alternatives considering international good practices.

49. **The World Bank will offer specialized advice in terms of public and citizen engagement and communications efforts that can increase the likelihood of implementation success.** The World Bank will draw from experiences, best practices, and learnings from successful and unsuccessful initiatives in Peru and internationally and incorporate such knowledge into public engagement and communications efforts specifically tailored for the Lima context.

E. Lessons Learned

50. **Lessons learned from the implementation of the Metropolitano BRT North Extension Project (P170595) and other relevant IPF operations and analytical work conducted in Lima informed the design of the MPA Program and Phase 1.**

- **Citizen engagement and socialization processes.** Given the complexity of the urban environments in which these projects are developed and implemented, and as identified in the Metropolitan BRT Northern Extension project, meaningful consultation and continuous engagement with stakeholders are needed, particularly with communities, groups, and individuals affected by the interventions proposed under Phase 1 and subsequent MPA phases. Project-based GRMs will be implemented in a coordinated manner. Communication processes with the different stakeholders are being developed before the implementation of project activities. During implementation, continuous communication will help mitigate possible risks derived from works or other interventions that may generate complaints about aspects such as dust, noise, and lack of crosswalks in the work area and changes in traffic management plans,[46] among other issues.

[46] An inspection panel to investigate the Metropolitano BRT project financed by the World Bank was set up in 2010 due to the lack of information being disseminated to the residents of the district municipality of Barranco. The lack of an adequate assessment of traffic impacts in the area and of a well-designed traffic management and mitigation mechanism contributed to the investigation.

Although communications and citizen engagement processes cannot solve inevitable technical inconveniences related to the works, contingency plans and protocols to address unpredictable damages to neighbors' property will include strong communication and engagement processes with local communities.

- **Gender-based violence.** Analysis of the different protocols to respond to sexual harassment in Lima suggests a governance issue among different protocols. The World Bank presented recommendations to be shared with different transport authorities, operators, and stakeholders with the aim of harmonizing procedures and identifying a link with sexual harassment in public spaces, public transport systems, and NMT users.
- **Readiness for implementation.** Special attention has been placed on all preparatory arrangements for the different project components and the readiness of their activities. This includes preinvestment concept and feasibility studies, detailed engineering designs, and complementary E&S studies (to ensure compliance with the World Bank's Environmental and Social Framework, ESF), which should be completed by the relevant authorities in due time. The lion's share of the loan proceeds (50 percent) will be implemented through a single procurement under Subcomponent 1.1: Centralized traffic lights network (US$85.6 million). Critical studies for the detailed engineering designs are being developed by PROTRANSITO during project preparation, and the procurement of the works and goods of this activity is expected to be completed during the first year of project implementation. For the other activities of the project (Components 3 and 4), the MML has initiated the procurement of the feasibility preinvestment studies and will be required to complete the procurement of the remaining studies within four months after effectiveness. The project will finance detailed engineering designs to ensure all component activities are ready for procurement within the first two years of implementation.
- **Sustainability of interventions.** The financial capacity of the MML to undertake major infrastructure investments and provide adequate maintenance has been historically limited. During the identification phase, the World Bank identified a serious financial stress on PROTRANSITO's budget allocations, which depend on transfers and budget availability from the MML to maintain the existing traffic management system and keep its technical teams on the payroll. Project activities and complementary World Bank technical assistance is focused on exploring new revenue generation sources from the revamped traffic management system that may contribute to ensuring the sustainability of the MPA Program interventions over time.

III. PROJECT IMPLEMENTATION

A. Institutional and Implementation Arrangements

51. **The MML will act as the implementing agency during the life of the MPA Program and will be implementing all project components, maintaining accountability and coordination mechanisms with other institutions.** The Republic of Peru, represented by the MEF, will be the borrower and responsible for the allocation of loan resources to the MML's annual budget. The MML will act as the implementing agency and will be responsible for implementing, monitoring, and supervising the works and the provision of goods and services, as well as the financial management (FM) aspects of the project. The MML will maintain, throughout project implementation, adequate fiduciary and administrative personnel, including a senior FM specialist and two FM analysts reporting to the head of the General Office of Planning and Finance of the MML, to support the TCU in the implementation of the project, as set forth in the Project Operational Manual (POM). PROTRANSITO will provide technical assistance to the MML. To this end, the MML will create and maintain, throughout project implementation, a TCU within PROTRANSITO which will be responsible for assisting in the implementation, monitoring, and supervision of the project (including its procurement and E&S aspects), with adequate fiduciary (procurement), administrative, M&E, and technical personnel, as set forth in the POM. The TCU will procure and

supervise the works and the provision of goods and services under the ESF standards, as set forth in the POM. Project Component 5 will reinforce PROTRANSITO's capacity with personnel and equipment to support project implementation and capacity-building activities for other MML areas, including the GMU, Urban Development Department *(Gerencia de Desarrollo Urbano*, GDU), and Municipal Department (*Gerencia Municipal*, GM).

52. **The MML has the mandate for traffic management throughout the province of Lima, but for interventions that occur on local district streets, the MML will require coordination with the municipal districts and formalization of interinstitutional agreements.** Implementation of Components 3 and 4 will require interinstitutional agreements with the municipal districts before the carrying out of any activity under the jurisdiction (local roads and public space) of the municipal district, under terms and conditions approved by the World Bank.

53. **Traffic management interventions financed by the project to make public transport and NMT modes safer and more efficient must be coordinated with ATU priorities and national government road safety policies, which will be supported by a Project Steering Committee (PSC).** The elaboration of the Lima and Callao PMU has a coordination committee with the MML GMU as a key member. In addition to this mechanism, the MML will establish and maintain a PSC until project completion to oversee the implementation of the project, including, among others, a representative of the MEF, a representative of the MML, and a representative of the TCU within PROTRANSITO. The PSC will have membership and functions acceptable to the World Bank, as defined in the POM, including follow-up on the TCU's execution of the project, the requirement to obtain PSC approval before making any change to key TCU staff, and the provision of additional support related to the implementation of the project as requested by the MML.

B. Results Monitoring, Evaluation, and Verification Arrangements

54. **PROTRANSITO will be responsible for the project M&E.** The overall MPA Program and project M&E plan will monitor project progress, outcomes, and result indicators, detailed in Section VII. Results Framework and Monitoring. In the case of specific individual outcome and intermediate indicators, PROTRANSITO will also coordinate with the MTC/ONSV and ATU to provide the needed data for the MPA Program's and project's M&E framework. The progress and performance for most PrDO- and PDO-level indicators will be monitored and evaluated semiannually against the outcome and output indicators of the Results Framework, including a midterm review before disbursements reach 40 percent or no later than three years after effectiveness. It will also include qualitative assessment of project performance with respect to the quality of works, governance, and transparency in procurement and contract management and compliance with the commitments related to fiduciary and E&S safeguards agreed. The M&E strategy will include timely collection of data and conduct of studies and assessments to establish baseline data and progress data, where applicable.

C. Sustainability

55. **There is strong evidence of the borrower's and MML's commitment to and ownership of the MPA Program as shown in PLANMET 2040, the Multisectoral Road Safety Policy, forthcoming PMU, PLCC-LIMA, and NDCs**. The long-term nature and the strong emphasis on building institutional and technical capacity will strengthen the MML's ability to develop quality, reliable, sustainable, and resilient urban transport infrastructure and supportive traffic management systems. During project preparation, the World Bank supported the strengthening of PROTRANSITO and ATU through various workshops and capacity-building activities laying the ground to continue doing this type of work in the future more independently. The proposed MPA also addresses factors critical to the sustainability of the Program's objectives, such as ensuring predictable and sustained flow of revenues for the operation and maintenance of the Program's interventions, including of infrastructure and equipment. Phase 1 of the MPA will create an enabling environment for future road capacity dynamic charging schemes to generate new revenue sources for PROTRANSITO and improve the sustainability of the MPA Program investments.

IV. PROJECT APPRAISAL SUMMARY

A. Technical, Economic and Financial Analysis

(i) Technical Analysis

56. **The proposed project will significantly contribute to reducing road fatalities and injuries and mitigating carbon emissions from the urban transport sector in Lima, as a result of improved traffic flows, enhanced safety for NMT users, and mode shift from private vehicles to public transport and NMT**. Key technical considerations include the following: (a) traffic lights system expansion, modernization, and integration to improve safety for all road users, reduce travel times, improve emergency response, and prioritize public transport; (b) detection and control of traffic offenders to protect all road users, especially the most vulnerable, and make the flow of public transport services more efficient; (c) intersection design to promote safety for NMT users; (d) planning and design of ZTCs to promote walkability and increase the quality of public space; and (e) cycle infrastructure improvements protecting cyclists from vehicle traffic and improving connectivity and intermodality with public transport. The selected interventions are targeted to the characteristics and challenges of the specific corridors, intersections, and neighborhoods. For example, in the central and southern districts of Lima, given the elevated levels of congestion and traffic crashes, there is a greater concentration of interventions aimed at improving traffic flows and compliance with traffic regulations. In the northern districts, given the higher poverty rates and density of cycleways, the emphasis is more on enhancing the safety and mobility of NMT users (see annex 2 for more details).

57. **Technical aspects of Component 1 include characteristics and functionalities of intelligent traffic lights systems, traffic control centers, and technological platforms for sound traffic management.** The World Bank benchmarked selected cities with best practices and relevant experiences in ITS and smart traffic control implementations to inform the design of the project interventions and the MPA Program scope. The following aspects were identified:

- Best practices in cities have open communication protocols, which allow interoperability, reduce technological lock-in and obsolescence risks, and facilitate both the implementation of flexible logical and physical architectures as well as the system's scalability.
- Fiber-optic networks are preferred as they allow covering long distances while carrying high information flows.
- ITS devices and sensors allow collecting information that enables real-time analysis and traffic management and citywide mobility decision-making.
- Given that its use is context sensitive, the adaptative traffic control operational mode is preferred as it permits location-specific, real-time traffic management to guarantee safer and more efficient conditions, particularly for NMT and public transport users.
- All the reviewed cities have traffic control centers, collecting, managing, and treating the data received from the field devices. The study findings thus provided valuable recommendations to PROTRANSITO to carry out a technological upgrading process as part of the MPA Program activities that are expected to result in a centralized traffic operational and management platform capable of integrating multiple technology types.

58. **Technical aspects of Component 2 include a conceptual design and technical specifications for the implementation and operation of an automated traffic violation detection and control system.** The World Bank contracted a study that looked at best practices in cities that have implemented automated detection and enforcement systems as part of their overall road safety strategies and provided relevant and recent experiences to inform the project

interventions. While various types of sensing technologies are available and the latest advances allow for greater capabilities, some of those can rapidly increase the system's cost and the required data storage and communications and processing requirements. Therefore, a simple, flexible, and scalable logical architecture is proposed for the project interventions under the project's Component 2. From a legal perspective, Articles 324 and 327 of Supreme Decree No. 016-2009-MTC, which approve the National Traffic Regulation (*Reglamento Nacional de Tránsito*), define that the MML is competent in its jurisdiction to use electronic or other technological means for the detection of traffic violations, as well as to issue the corresponding administrative act. These competencies are within the legal framework for the use of personal data (Law No. 29733), considering the proportionality for the protection of the vital interests of the data subjects and the public and legitimate interest of safe traffic management.

59. **Technical aspects of Component 3 include conceptual designs and capacity-building workshops for safe intersections and ZTC design.** Specifically, the analysis of technical aspects included workshops for five municipal districts and ZTC areas, as well as accompanying the prioritization and typology classification of the 295 PAIT intersection designs through road safety audits with international organizations and experts.

60. **Technical aspects of Component 4 include continued conceptual design review and feedback for cycle infrastructure designs and the PBS system PPP transaction model.** The World Bank is assisting with specialized consultant services, the conceptual design review of the six-cycle lane infrastructure projects, as well as support for the definition of the metropolitan PBS system transaction model and PPP requirements.

61. **The project design has benefited from collection and/or leveraging of various sources of specialized data.** The World Bank helped collect baseline data on traffic counts disaggregated by mode and gender in the project area of influence and data on traffic lights cycles on 24 intersections. It also leveraged data through the Development Data Partnership to inform the optimization and modeling of the traffic lights system on several corridors under Component 1 and interventions under Component 3. In addition, the World Bank conducted a comprehensive cycle network inventory during 2023 that produced a detailed assessment of over 320 km of existing bicycle lane infrastructure. This is in addition to volume counts for cyclists and motorized vehicles at key locations of Component 4 intervention areas and a nonrepresentative, indicative origin-destination survey of cyclists. This activity provided an updated view of cycling infrastructure and supported the identification of areas for prioritization.

62. **The project is aligned with the goals of the Paris Agreement on both mitigation and adaptation.**[47]

63. **Assessment and reduction of mitigation risks: the project is aligned with the goals of the Paris Agreement on mitigation, with the proposed activities either universally aligned or considered low risk.**

(a) **Universally aligned.** Activities focused on promoting cycling through improved cycling infrastructure and road safety (Components 3 and 4) and activities aimed at developing low-traffic neighborhoods and safe intersections thus promote both cycling and walking (Component 3), contribute to the decarbonization of Lima's transport system and are considered universally aligned. These activities do not pose any inherent risks.

(b) **Low risk.** Interventions aimed at improving traffic management cover for major transit corridors and the existing and projected bicycle lane infrastructure in Lima (Component 1) and helping enforce compliance with traffic rules that affect safety of NMT, and efficient flow of public transport services (Component 2) correspond to ITS, a category of interventions considered to be associated with low mitigation risk.

[47] This is assessed using the three-step World Bank IPF Investment Method for Assessing Paris Alignment. Step 1, which assesses the project's consistency with the country's climate strategies, is discussed in the Higher-Level Objectives section.

Subcomponent 1.2 and Component 2 will finance data centers (respectively, TCC and TVDCC); their technical design will systematically incorporate energy-efficient technologies to systematically lead to substantially better energy efficiency performance (reduction of energy use of at least 20 percent). These international practices will make the data center low risk.

64. The project will contribute to a reduction of traffic congestion in Lima, transition to low- and zero-emission modes (public transport and NMT), and, consequently, to a reduction of GHG emissions. Reinforcing the direct decarbonization impacts of promoting zero-carbon modes (Components 3 and 4), the improvement of the centralized traffic lights network and the strengthening of the TCC (Component 1), and improvement of the enforcement of traffic regulations (Component 2) will improve traffic efficiency and road safety, including for public transport and NMT users, thus further promoting mode shift from private motorized vehicles to these low-carbon modes. The project complements a range of other interventions currently ongoing or planned in Lima (for example, investment in the cycleway network, expansion of efficient public transport systems, and others), including with World Bank assistance, which will allow improving the efficiency of the movement of people and goods in Lima. These interventions aim to gradually transition to lower-carbon pathways. Within the scope of the specific project and given the country's unique circumstances, no lower-carbon options are available.

65. **Assessment and reduction of adaptation risks: residual risks to adaptation objectives were deemed acceptable.** The project activities cover a large share of Lima, which is exposed to various climate risks, including flooding associated with the El Niño phenomenon. By improving the traffic conditions and the effective traffic management and by leveraging the traffic control technologies, the project will help improve disaster and emergency response—specifically, by strategically rerouting traffic and directing traffic evacuation from disaster-affected areas—and thus contribute to climate adaptation. The potential for the integrated traffic lights system to enhance disaster emergency response in Lima is being evaluated, and concrete recommendations for next steps will be provided, such as in terms of protocols and capacity-building needs for PROTRANSITO. The design of ZTC (Subcomponent 3.2) will include measures to reduce the risk of flooding on the usability of the space, including the use of permeable materials and reintroduction of nature (vegetation) in the public space (previously street space). The engineering designs of the cycleways (Component 4) will also include climate resilience considerations in terms of the materials used and the implementation of nature-based solutions. The maintenance plans for the cycleway network will consider the additional stress on the infrastructure associated with climate hazards. Therefore, the residual adaptation risk is considered low, and the project is aligned from an adaptation perspective.

(ii) Economic Analysis

66. **The project is expected to improve the safety, efficiency, and environmental sustainability of urban transport in Lima.** The quantifiable economic benefits include a reduction of traffic fatalities and serious injuries, travel time savings due to reduced congestion, urban quality benefits, public health benefits, and reduction in GHG emissions due to an expected mode shift to NMT and public transport. Road safety benefits are expected to disproportionately accrue to lower-income residents who tend to rely more on NMT modes. Project costs include total capital costs during the construction phase and operation and maintenance costs during the operations phase.

67. **Economic feasibility of Phase 1 was assessed through a socioeconomic cost-benefit analysis (CBA), covering Components 1, 2, 3, and 4.** The CBA is based on the available data on public transport, NMT, and private motorized mobility demand; geolocated road traffic fatality and injury data from the ONSV; and other data inputs. The time savings benefits of Component 1 were estimated based on traffic optimization and microsimulation models developed by PROTRANSITO. The expected GHG reduction impacts of Component 1 and Components 3 and 4 were estimated using a stated preference mode choice model and references from similar interventions in other cities.

68. **The economic analysis follows a standard incremental CBA methodology in compliance with World Bank Operational Policy 10.04.** The CBA considers the stream of expected costs and benefits over a 14-year horizon. It compares likely outcomes with and without the project and calculates the net present value (NPV) of estimated net costs and benefits and the economic internal rate of return (EIRR).

69. **The project is highly economically justified, with an EIRR of 145.3 percent[48] and an NPV of US$3,669.7 million.** The largest share of overall economic benefits is estimated to come from travel time savings (68.1 percent) and reduction in traffic fatalities and injuries (26.3 percent), followed by public health benefits (2.8 percent), urban quality benefits (2.7 percent), and reductions in GHG emissions (0.1 percent). Overall, the planned road safety interventions are expected to save 42 lives per year, in addition to 1,365 less traffic injuries and 1,913 less crashes. The project is expected to result in an overall net reduction of 34,616 metric tons of CO_2 over the evaluation horizon or 2,472 tons per year on average. The gross emissions of the project are estimated at 91 tCO_2eq.[49] The economic benefits (NPV) related to net GHG emissions reductions in constant 2022 prices are estimated at US$2.34 million in a low Social Price of Carbon (SPC) value scenario and at US$4.67 million in a high value scenario.

70. **Sensitivity analysis was conducted to assess the impact on the NPV of assumptions of discount rates, CAPEX and OPEX, and travel time and road safety benefits**. Details are provided in annex 4.

71. **The project will generate other benefits that are not monetized in the CBA:** increase in the average share of jobs accessible by public transport and NMT, reduction in local pollutants and vehicle operating costs, and improvement in public trust in local governments due to the provision of critically needed NMT infrastructure and sound traffic management systems. The implementation of safe cycleways is expected to promote accessibility to schools and health care facilities. The improvement in traffic management and implementation of the integrated traffic lights system and revamped TCC will also improve emergency response to severe climate or seismic events.

72. **Annex 6 provides a detailed explanation of the project's contribution to climate objectives.**

B. Fiduciary

(i) Financial Management

73. **The World Bank performed a Financial Management Assessment (FMA) to evaluate the FM arrangements to implement the project.** The FMA was conducted in January and August 2023 and February 2024 following World Bank Policy 'Investment Project Financing', World Bank Directive 'Investment Project Financing (IPF)',[50] and FM Manual for IPF

[48] The high EIRR is explained by the high spatial coverage of relatively low-capital intensity investments; for example, NMT projects are known to have high benefit-cost ratios, typically exceeding 10:1. For example, the protected cycle lane networks in Bogotá and Guangzhou, respectively, save cyclists US$80 million and US$30 million per year in transport costs, compared to a total project investment of US$132 million and US$69 million, respectively. A report from the UK Department for Transport shows that some cycling schemes, such as in Cambridge, have a benefit-to-cost ratio of up to 35:1 (Department for Transport. 2014. *Value for Money Assessment for Cycling Grants*.) Investments in cycle lane networks have also proven to be extremely cost-effective compared to investments in BRT and metro (World Bank/ITDP. 2023. *The Path Less Traveled: Scaling Up Active Mobility to Capture Economic and Climate Benefits*.) Studies have also confirmed that significant net economic benefits are generated for both speed and traffic light cameras: in the United Kingdom, investment made to install speed cameras generated a return of 5 times this amount after one year and more than 25 times the amount after five years (Hooke, A. et al. 1996. *Cost Benefit Analysis of Traffic Light and Speed Cameras*. Police Research Group.) The high EIRR is also explained by the project's strong focus on road safety through relatively low-cost, high-impact interventions in road safety hotspots, with 42 lives saved per year, each valued at US$900,000 according to the iRAP guidance.

[49] The emissions associated with the public transport vehicles that would have to be put into circulation to accommodate modal shift from private vehicles as a result of the interventions to be financed under Component 1 (6.5 tCO_2eq per year over a 14-year period).

[50] Bank Directive for Investment Project Financing (issued on March 13, 2023, by OPCS) and the Bank Directive-FM Manual for World Bank Investment Project Financing (issued by OPCS on February 10, 2017).

operations which requires that for each operation supported by a World Bank loan, the borrower needs to maintain FM arrangements acceptable to the World Bank and provide reasonable assurance that the proceeds of the loan are used for the intended purposes. This assessment reflects the FM arrangements proposed for Phase 1, which will be implemented by the MML.

74. **The MML will implement the project with assistance from a TCU that will be created within PROTRANSITO.** Currently, PROTRANSITO does not conduct procurement processes for investment projects. The MML will provide PROTRANSITO the capacity to procure works and the provision of goods and services. This provision will be included in the effectiveness conditions of the Loan Agreement. The roles and responsibilities of PROTRANSITO's TCU and the other MML areas will be included in the POM. The MML has previous experience in managing World Bank projects and in the use of Peru's sound public FM systems, including systems in areas of budgeting, flow of funds, accounting, auditing, and the use of the Integrated Financial Management System (*Sistema Integrado de Administración Financiera*, SIAF) and the General Chart of Accounts established in SIAF. Disbursement of funds will be made to the Single Treasury Account (*Cuenta Única del Tesoro*, CUT) identified with a segregated code. The selection of the audit firm will be made through the General Comptroller Office of Peru (*Contraloría General de la República*, CGR). The World Bank will provide capacity building on fiduciary management matters upon recruitment of MML FM staff.

(ii) Procurement

75. **Procurement activities will be carried out by PROTRANSITO according to the World Bank's 'Procurement Regulations for IPF Borrowers', issued in September 2023, for the supply of works, goods, and non-consulting and consultant services under the project.** A procurement capacity assessment of PROTRANSITO was carried out by the World Bank. The assessment analyzed mainly the organizational structure, staffing, and procurement systems in place in PROTRANSITO to determine the risks and mitigation measures. Based on the information reviewed, it was found that PROTRANSITO has not previously executed World Bank-financed projects. Therefore, for the implementation of the project, PROTRANSITO will have to strengthen its procurement capacity by hiring at least one procurement specialist fully dedicated to the project. This specialist should have experience in procurement utilizing the Procurement Guidelines and/or Regulations.

76. **The Project Procurement Strategy for Development (PPSD) has been developed by PROTRANSITO under the close support of the World Bank.** The PPSD establishes the best procurement arrangements to ensure value for money while efficiently achieving the PDO. The PPSD focuses on the high-risk and high-value contracts and summarizes the operational environment in which the project will be implemented, the market analysis, the risk assessment, and the analysis of different approaches to carry out the procurement for these activities. A summary of the draft PPSD is included in annex 1. The Procurement Plan for the first 18 months of project implementation has been also developed based on the results of the PPSD.

C. Environmental, Social and Legal Operational Policies

Legal Operational Policies	Triggered?
Projects on International Waterways OP 7.50	No
Projects in Disputed Area OP 7.60	No

77. **The Environmental and Social Standards (ESS) relevant to Phase 1 are ESS 1, 2, 3, 4, 5, 6, 8, and 10.** E&S risks of Phases 2 and 3 of the MPA are expected to be similar to those of Phase 1, considering that they are expected to be of similar nature and scope and also located within Lima. The risks associated to Phases 2 and 3 will be assessed as part of the preparation of each phase, adjusting the corresponding ratings as necessary, and seeking Board approval if the ESF risk for any of the future Phases 2 or 3 is determined High or Substantial.

78. **Given the nature and scale of activities, low to moderate environment, health, and safety (EHS) risks and impacts are expected under components 1 through 4.** These risks are mainly associated with the implementation of the traffic light infrastructure at high vehicular and pedestrian traffic intersections and accessibility improvements, expansion, and improvement of NMT infrastructure, including reconstruction of existing pavement and sidewalks. These are expected to be (a) temporary and/or reversible, (b) not significant nor complex/large, (c) not expected to cause serious adverse effects to human health and/or the environment, and (d) with readily available management measures. Key anticipated EHS risks and impacts during the execution of project works and operation are related to (a) overall nuisances to communities due to noise and vibration, dust, traffic congestion, and waste generation; (b) potential adverse impacts to houses and other infrastructure next/close to construction activities due to vibrations; (c) occupational health and safety issues: unskilled workforce, poor labor and working conditions, and risk of occupational accidents; (d) inadequate sourcing and transportation of construction materials, as well as inadequate transportation and disposal of surplus materials from the reconstruction of pavements and sidewalks; (e) inadequate management of e-waste generated during equipping of controllers, cameras, repeaters, and traffic lights; (f) risks of community accidents due to construction activities and increased/changes in vehicular traffic during start-up and operation; (h) potential impacts on chance archaeological finds and/or cultural heritage areas; (i) potential incremental and cumulative impacts and risks associated with other current and future projects in the project area; and (j) impacts on urban green areas, negatively affecting local communities in terms of landscape, recreation, and so on.

79. **Social risks are substantial and related to** (a) the relocation of kiosks located on public space that could cause economic displacement; (b) temporary restrictions to areas where civil works are located, some of which can produce economic impacts for local businesses; (c) limits on the ability of local residents and business customers to move around and park vehicles in those areas (during the implementation of traffic lights at intersections); (d) community health and safety risks, particularly risks of accidents during construction, including pedestrians and bicyclists at road intersections which is sensitive in the Lima context, with low levels of compliance with traffic regulations and high levels of traffic informality; (e) risks of noncompliance with labor issues covered by ESS2, including hiring modalities in the TCU; (f) potential conflicts with specific segments of the local population due to disagreements with certain project activities, such as implementing increased traffic control measures like surveillance and fines using traffic cameras. Sexual exploitation and abuse/sexual harassment (SEA/SH) risk, is considered moderate because of (a) the social context with high prevalence of cases of sexual harassment in Lima's public spaces[51] (mainly in public transport) and (b) the characteristics of the Peruvian culture related to sexist behaviors and mindsets (*machismo*) that could affect women and LGBTI,[52] to a greater degree than other population groups.[53] These social risks for future phases will be assessed as part of the preparation of

[51] A study by the National Institute of Statistics and Informatics (INEI) indicates that 65% of women in Lima have experienced some form of sexual harassment in public spaces, particularly prevalent in public transport systems (INEI: Encuesta Nacional sobre Relaciones Sociales – ENARES, Lima: 2020; cfr.: www.inei.gob.pe). A broader research about the high prevalence of GBV in the form of SH, specifically in public transport services was performed by the Peruvian Ministry of Transportation (MTC: *Estudio sobre la Seguridad y Presencia de Mujeres en el Transporte Público*. Lima: 2020; https://cdn.www.gob.pe/uploads/document/file/560781/Estudio_sobre_la_seguridad_y_presencia_de_mujeres_en_el_transporte_p%C3%BAblico.pdf). This statistic highlights the significant risks women face in urban environments like Lima.

[52] LGBTI = Lesbian, Gay, Bisexual, Transgender, Intersex.

[53] Research performed by the United Nations Development Programme (UNDP) emphasizes that such cultural attitudes contribute to widespread tolerance of gender-based violence in Peru (cfr. UNDP: *Human Development Report 2018*. Cfr. https://www.pe.undp.org).

each subsequent phase and could differ from Phase 1.

80. **To adequately manage the E&S risks and impacts during the implementation of MPA Phase 1, in a manner consistent with the ESF, PROTRANSITO has prepared the following documents:**

(a) An Environmental and Social Management Framework (ESMF), which identifies potential E&S risks and impacts of Phase 1 and guides their adequate management and mitigation. The ESMF establishes that PROTRANSITO will need to prepare Environmental and Social Management Plans (ESMPs) for interventions not subject to the National Environmental Impact Assessment System (*Sistema Nacional de Evaluación de Impacto Ambiental*). The ESMPs will be drafted, consulted, finalized, adopted, and disclosed by the MML before the start of works, during project implementation. The ESMPs will be implemented by the contractors, an obligation that will be reflected in the corresponding bidding documents.

(b) An SEP describing the consultations and stakeholder engagement activities carried out during project preparation, the activities planned in the MPA Program, and a project-specific GRM.

(c) Labor Management Procedures (LMP) establishing the procedures to ensure appropriate labor and working conditions in a manner aligned with ESS2, including a code of conduct and grievance mechanism for project workers.

(d) An Environmental and Social Commitment Plan (ESCP), including specific commitments to strengthen the TCU's ability to manage E&S risks and impacts in accordance with the World Bank's ESF, the timelines and commitments for the preparation and implementation of E&S instruments needed, and training and capacity-building actions. The ESMF, ESCP, SEP, and LMP are published on the MML's and World Bank's website.

81. **The ESF's SEP will define strategies to promote active citizen engagement.** This strategy will include stakeholder meetings, websites, presentations, forums, and design sessions, providing a platform for different interest groups to provide project-specific feedback that can be incorporated into project planning, design, and implementation. Such activities require complex mechanisms due to the multiple activities included in each of the different components. Moreover, the communication process will also inform the stakeholders that participated in the consultation activities of the status of their requests. While complex, the proposed citizen engagement process will allow the MML authorities to close the feedback loop and ensure that stakeholder participation is directly considered in project planning and implementation.

82. **Phase 1 of the MPA will contribute to closing gender gaps, specifically benefiting women's mobility in the Surquillo, Santiago de Surco, Miraflores, and San Luis districts.**

- **The project will increase the availability of sustainable transport options for relatively short trips.** Protected cycling lanes decrease the number of car-cycle crashes and reduce crashes per cyclist;[54] they disproportionately increase the sense of safety for women[55] and encourage them to shift to bicycles. The construction of protected cycling lanes will provide a faster alternative for the 30 percent of trips in the project area that are under 3 km and are currently mostly conducted by walking.

[54] Reynolds, C. C., et al. 2009. "The Impact of Transportation Infrastructure on Bicycling Injuries and Crashes: a Review of the Literature." *Environmental Health,* 8, 1-19; Bernard, L. 2023. *The Impact of Segregated Cycling Lanes on Road Users*. Available at SSRN 4353625.
[55] Dill, J., et al., "Can Protected Bike Lanes Help Close the Gender Gap in Cycling? Lessons from Five Cities" (2014). *Urban Studies and Planning Faculty Publications and Presentations*. 123. http://archives.pdx.edu/ds/psu/16603; Akar, G., N. Fischer, and M. Namgung. 2013. "Bicycling Choice and Gender Case Study: The Ohio State University." *International Journal of Sustainable Transportation*, 7(5): 347-365.

- **The project will increase the overall acceptability of cycling as a viable travel option, especially among women, thus adding it to the options they have available for travel.** The project will include soft measures to bring more women into cycling such as a program to teach how to bike in the city and how to move and choose routes that respond to women's needs. A study in 17 countries across six continents found that, when cycling mode share in a city reaches at least 7 percent, it becomes a universally accepted alternative and women undertake as many trips as men. The median age of women cyclists ranges from 24 years to as much as 51 years in the cities studied.[56]
- **By providing a faster alternative for relatively short trips currently conducted by walking, the project will expand women's accessibility to jobs and key destinations such as schools and clinics.** Given that women are more sensitive to safety when selecting transport modes, their access to jobs and other opportunities will benefit once safe cycling infrastructure is put in place, by enabling a shift from walking to cycling, allowing to access over three times more jobs within 45 minutes compared to walking and increasing the number of schools and health care facilities near protected cycling lanes by 12 and 30 percent, respectively. This is expected to particularly benefit women because they disproportionately travel to these destinations in their daily trips as part of 'care mobility'.[57] Protected cycling lanes will also complement existing ones and provide better connectivity to transport hubs.

Grievance Redress Services:

Grievance Redress. Communities and individuals who believe that they are adversely affected by a project supported by the World Bank may submit complaints to existing project-level grievance mechanisms or the Bank's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the Bank's independent Accountability Mechanism (AM). The AM houses the Inspection Panel, which determines whether harm occurred, or could occur, as a result of Bank non-compliance with its policies and procedures, and the Dispute Resolution Service, which provides communities and borrowers with the opportunity to address complaints through dispute resolution. Complaints may be submitted to the AM at any time after concerns have been brought directly to the attention of Bank Management and after Management has been given an opportunity to respond. For information on how to submit complaints to the Bank's Grievance Redress Service (GRS), visit http://www.worldbank.org/GRS. For information on how to submit complaints to the Bank's Accountability Mechanism, visit https://accountability.worldbank.org.

V. KEY RISKS

83. **The overall risk to the MPA Program is rated Substantial,** mostly based on continued political, governance, and stakeholder risks and potentially more significant (compared to Phase 1) E&S risks, given the increased focus of Phases 2 and 3 on NMT infrastructure investment, the scaling up of traffic enforcement, and, eventually, the introduction of road capacity dynamic charging schemes. Risks for Phases 2 and 3 have not yet been assessed in detail, but the phases will be designed in a way to mitigate key risks based on lessons learned from Phase 1.

84. **The overall risk to the PDO of the MPA Phase 1 is rated Substantial,** considering the technical design, institutional capacity, fiduciary, stakeholder, and social risks (described below).

[56] This excludes the data from Delhi, where the median age of women cycling is 16 years versus 40 years among men. Goel, R. et al. 2022. "Cycling Behaviour in 17 Countries across 6 Continents: Levels of Cycling, who Cycles, for What Purpose, and How Far?" *Transport Reviews*, 42(1): 58-81.
[57] Meta. 2021. *Survey on Gender Equality*. https://www.equalityathome.org/charts; Asociación Movemos. 2022. *Estresometro*.

85. **The technical design of project risk is rated Substantial.** The project will improve the operational capacity of PROTRANSITO to improve its traffic management capacity in Lima. However, there is an inherent risk associated with interoperability of existing and new procured systems, technological lock-in, and obsolescence risks for the incorporation of new technological advances for traffic management. Mitigation measures include specialized consultants the World Bank has provided to support the MPA conceptualization and the feasibility and detailed engineering design studies for the project's Components 1 and 2. Another mitigation measure during project preparation was a technical assistance activity for PROTRANSITO, ATU, and the MTC to support the definition of open communications protocols for interoperability of traffic light systems and TCCs. The World Bank also assisted PROTRANSITO with training and institutional capacity-building activities for the initial concept design proposals of activities under the project's Components 3 and 4. For PAITs, ZTCs, and NMT infrastructure, the World Bank has implemented a constant follow-up and technical assistance support for project preparation activities to incorporate innovative approaches in road safety and NMT. The World Bank will continue bringing global expertise and good practice from technological advances that are commercially feasible from its global engagement in similar projects around the world. Despite these mitigation measures, the technological specification for Components 1 and 2 and the related procurement processes may still pose a Substantial residual risk. Similarly, despite the continuous follow-up and technical assistance support to the conceptual design of the interventions under Components 3 and 4, the final policy decision on design standards may prevent these interventions from meeting the minimum eligibility criteria set out in the POM.

86. **The Institutional Capacity for Implementation and Sustainability risk is rated Substantial.** There is a risk associated with the TCU within PROTRANSITO, which needs to increase capacity and gain experience with World Bank procedures and policies to avoid potential delays on the project implementation. There is also a risk related to the functions that PROTRANSITO will need to coordinate with other MML agencies (the MML GM and other departments such as the GDU) for the integration of the traffic lights system and with ATU for public transport planning and operations, as well as with local district municipalities for the local NMT infrastructure. To mitigate these risks, the MML will create and maintain a TCU and Component 5 will reinforce PROTRANSITO TCU capacity with personnel and equipment to support project implementation, as well as capacity-building activities for other MML areas. The MML teams, including the TCU, will receive training on World Bank project management aspects, ESS, and fiduciary policies. As a further mitigation measure, Components 3 and 4 will require interinstitutional agreements with the municipal districts, and PROTRANSITO and the GMU will continue participating in the ATU Board and Committee for the PMU. Furthermore, the MML will establish the PSC to oversee the implementation of the project for the provision of additional support related to the implementation of the project as requested by the MML. Given the complexity and the lessons learned from the BRT North Extension Project's preparation and implementation, the supervision of the project interventions will follow strict project management standards for quality control of works and progress. Although technical teams of the future TCU are already getting on board and coordination arrangements with ATU, around the implementation of the PMU, and local district municipalities for the ZTCs and NMT infrastructure is well advanced, the residual risk remains Substantial.

87. **The Fiduciary risk is rated Substantial.** There is an FM risk associated with delays in the implementation of funds related to: delays in budget allocation, continued staff turnover, pending establishment of the TCU within PROTRANSITO with capacity to procure works, goods, and services. To mitigate this risk, the MML needs to take important actions to ensure proper project implementation: (a) execution of the subsidiary agreement between the MEF and the MML to implement the project with external source of funds; (b) provision of the MML to give PROTRANSITO the capacity to procure works and provide goods and services; (c) timely allocation of the budget from the MEF to MML for external and local source of funds for project implementation, especially during the first year of implementation; (d) definition of processes and procedures in PROTRANSITO in the POM to expedite the approval of invoices and reduce delays in requesting payments to vendors from the TCU to the MML; (e) adoption of the POM, including the FM chapter; and (f) adoption of a hiring strategy to reduce the high turnover of FM staff that may affect the implementation of funds, delay the submission of financial reports, and avoid situations of ineligible expenditures. An action plan has been agreed with

the MML to put in place the necessary FM personnel for project implementation within three months after effectiveness. Based on the assessment performed and the agreed action plan, the proposed FM arrangements are considered acceptable, subject to the successful implementation of agreed strengthening measures. Regarding procurement, PROTRANSITO has no history of implementing World Bank-financed projects nor of bidding for high-value contracts. A mitigation plan to strengthen the procurement capacity of PROTRANSITO includes (a) PROTRANSITO needing to hire a qualified professional with experience in procurement of high-value contracts and contract implementation within two months after effectiveness, (b) continuous training and close support from the World Bank throughout the procurement cycle of the processes, and (c) PROTRANSITO needing to develop a detailed contract management plan. For now, the residual risk for fiduciary aspects remains Substantial.

88. **The Environment and Social risk is rated as Substantial.** This classification responds to the nature and scale of activities. Low to moderate EHS risks and impacts are expected under Components 1 through 4, mainly associated with the implementation of the traffic lights infrastructure at intersections with high rates of vehicular and pedestrian traffic and accessibility improvements such as expansion and improvement of bicycle and pedestrian infrastructure including the reconstruction of existing pavement and sidewalks. Substantial social risks are expected, due to the social impacts associated with the proposed works and activities that involve (a) temporary restrictions to areas where civil works are located, some of which can produce economic impacts for local businesses or informal mobile vendors; (b) traffic interruptions and risks of accidents during construction, including pedestrians and bicyclists; (c) the relocation of kiosks located in public spaces, with potential economic displacement; and (d) risks of noncompliance with labor issues covered by ESS2. The SEA/SH risk rating is rated Moderate, considering a high prevalence of cases of sexual harassment in Lima's public spaces and public transport and a sexism culture that affects women to a greater degree.[58]

89. **The Stakeholder risk is rated as Substantial.** Some measures planned as part of the project are likely to generate opposition from certain stakeholder groups. These include, for instance, neighborhood associations against the proposed changes to their neighborhood dynamics, and motorized transport users against the traffic violation detection and speed limit enforcement activities to be supported under Components 1 and 2. On a smaller scale, potential risks could also arise from neighbors and businesses located near the ZTC rejecting modal filters, speed reduction measures, and on-street parking reductions, which in the past have resulted in the rejection of traffic calming interventions executed by some local district governments in Lima. They could potentially undermine the sustainability of the interventions over the longer term. If these risks materialize, they could delay implementation. To mitigate these risks, the Program includes an SEP, with activities throughout project preparation and implementation. It also plans to create awareness about the project benefits, through broad communications and educational campaigns, with an added transparency message to explain the use of the additional revenues generated by traffic fines. The project is also expected to generate support from stakeholder groups benefiting from the improvements, such as groups of traffic crash victims, cyclists, and people with disabilities, which can help highlight the project's goal of improving road safety for all users. The project will apply citizen engagement mechanisms to obtain stakeholder engagement support as well and inform final design of the interventions. Lessons from other World Bank experiences in Bogota (ZTC Vital Neighborhoods) will be incorporated to the project.

[58] Research performed by the United Nations Development Programme (UNDP) emphasizes that such cultural attitudes contribute to widespread tolerance of gender-based violence in Peru (cfr. UNDP: *Human Development Report 2018*. Cfr. https://www.pe.undp.org).

VII. RESULTS FRAMEWORK AND MONITORING

PDO Indicators by PDO Outcomes

Baseline	Closing Period
Improve transport system efficiency in Lima	
Share of jobs in Lima that can be reached by public transport and NMT within 45 minutes (Percentage)	
Aug/2024	Oct/2029
17.80	19.90
➢Share of jobs in Lima that can be reached by public transport and NMT within 45 minutes (low-income population) (Percentage)	
16.20	19.10
PrDO: Share of jobs in Lima that can be reached by public transport and NMT within 45 minutes (Percentage)	
Aug/2024	Oct/2034
17.80	25
➢PrDO: Share of jobs in Lima that can be reached by public transport and NMT within 45 minutes by (low-income population) (Percentage)	
16.20	22
Millions of people living within the areas that benefit from improved access to sustainable transport infrastructure and services (Number)	
Aug/2024	Oct/2029
0	4.56
Improve environmental quality in Lima	
PrDO: GHG emissions savings in Lima related to urban transport as a result of the MPA (Metric ton)	
Aug/2024	Oct/2034
0	10,000
Concentration of PM2.5 emissions in the intervention areas (Microgram/m3)	
Aug/2024	Oct/2029
15.90	15.00
GHG emissions savings in Lima related to urban transport as a result of the MPA (Metric ton)	
Aug/2024	Oct/2029
0	3,162
Improve road safety in Lima	

PrDO: Annual traffic fatalities in the intervention areas (Number)	
Dec/2021	Oct/2034
327	250
➢PrDO: Annual traffic fatalities in the intervention areas among pedestrians and cyclists (Number)	
Dec/2021	Oct/2034
61	25
Annual traffic fatalities in the intervention areas (Number)	
Dec/2021	Oct/2029
327	284
➢Annual traffic fatalities in the intervention areas among pedestrians and cyclists (Number)	
Dec/2021	Oct/2029
61	33

Intermediate Indicators by Components

Baseline	Period 1	Period 2	Closing Period
Traffic lights system			
Intersections in which the Centralized Traffic Light Network has been implemented (Number)			
Aug/2024			Oct/2029
0			488
Automated traffic violation detection system			
Implementation of an automated Traffic Violation Detection and Control Center (Yes/No)			
Aug/2024			Oct/2029
No			Yes
Intersections equipped with automated traffic violation detection equipment (Number)			
Aug/2024			Oct/2029
0			40
Safe intersections and neighborhoods			
Intersections where Immediate Traffic Actions Plan (PAIT) is implemented (Number)			
Aug/2024			Oct/2029
0			295
Surveyed road users perceiving the intervened PAITs intersections to be safer/ feeling more comfortable walking & biking (Percentage)			
Aug/2024	Oct/2027		Oct/2029
0	50		75

➢Surveyed female road users perceiving the intervened PAITs intersections to be safer/ feeling more comfortable walking & biking (Percentage)			
Aug/2024	Oct/2027		Oct/2029
0	50		75
Traffic calming zones (ZTCs) implemented at Tactical Urbanism stage (Number)			
Aug/2024			Oct/2029
0			5
Surveyed ZTC residents who consider the interventions an improvement over previous conditions (Percentage)			
Aug/2024	Oct/2026	Oct/2028	Oct/2029
0	50	70	80
Urban mobility, cycle-infrastructure and complete streets			
Length of additional cycleways implemented (Kilometers)			
Aug/2024			Oct/2029
0			50
Cycling trips in the intervention areas (Number)			
Oct/2023			Oct/2029
2,538			3,045
Women as share of cyclists in the intervention areas (Percentage)			
Oct/2023			Oct/2029
12.10			20.00
Share of women in the intervention districts cycleways who can access a health clinic within 15 min by protected cycleways and walking (Percentage)			
Oct/2023			Oct/2029
71			76
Project management and capacity building			
Strategic ITS plan to promote sustainable transport modes implemented (NMT and public transport) (Yes/No)			
Aug/2024			Oct/2029
No			Yes
Gender-informed Bicycle Infrastructure Plan and Bicycle Strategy implemented (Yes/No)			
Aug/2024			Oct/2029
No			Yes

Monitoring & Evaluation Plan: PDO Indicators by PDO Outcomes

Improve transport system efficiency in Lima	
Share of jobs in Lima that can be reached by public transport and NMT within 45 minutes (overall population) (Percentage)	
Description	Population weighted average number of jobs that can be reached by a combination of walking, cycling, and any public transport mode within 45 minutes in Lima
Frequency	At project start and completion
Data source	Travel speeds on the Phase 1 intervention corridors, population (World Pop), jobs (modeled using a World Bank methodology)
Methodology for Data Collection	The indicator will be calculated using accessibility modeling tools, using as an input the travel speeds measured on the nine project intervention corridors (C1).
Responsibility for Data Collection	PROTRANSITO
Share of jobs in Lima that can be reached by public transport and NMT within 45 minutes (low-income population) (Percentage)	
Description	Poor population weighted average number of jobs that can be reached by a combination of walking, cycling, and any public transport mode within 45 minutes in Lima
Frequency	At project start and completion
Data source	Travel speeds on the Phase 1 intervention corridors, poor population (INEI, 2017), jobs (modeled using a World Bank methodology)
Methodology for Data Collection	The indicator will be calculated using accessibility modeling tools, using as an input the travel speeds measured on the nine project intervention corridors (C1).
Responsibility for Data Collection	PROTRANSITO
PrDO: Share of jobs in Lima that can be reached by public transport and NMT within 45 minutes (Percentage)	
Description	Population weighted average number of jobs that can be reached by a combination of walking, cycling, and any public transport mode within 45 minutes in Lima
Frequency	At project start and completion
Data source	Travel speeds on the MPA intervention corridors, population (World Pop), jobs (modeled using a World Bank methodology)
Methodology for Data Collection	The indicator will be calculated using accessibility modeling tools, using as an input the travel speeds measured on the intervention corridors.
Responsibility for Data Collection	PROTRANSITO
PrDO: Share of jobs in Lima that can be reached by public transport and NMT within 45 minutes by low-income population (Percentage)	
Description	Poor population weighted average number of jobs that can be reached by a combination of walking, cycling, and any public transport mode within 45 minutes in Lima
Frequency	At project start and completion
Data source	Travel speeds on the MPA intervention corridors, poor population (INEI, 2017), jobs (modeled using a World Bank methodology)
Methodology for Data Collection	The indicator will be calculated using accessibility modeling tools, using as an input the travel speeds measured on the intervention corridors.
Responsibility for Data Collection	PROTRANSITO
Improve environmental quality in Lima	
PrDO: GHG emissions savings in Lima related to urban transport as a result of the MPA (Metric ton)	
Description	Metric tons of CO_2-equivalent emissions avoided as a result of project interventions
Frequency	At project start and completion
Data source	Travel speeds on the MPA intervention corridors, data on the implemented road safety interventions
Methodology for Data Collection	The same methodology used to calculate expected GHG emissions at appraisal will be used at the end of the project. It is based on the World Bank Guidance Note and uses as main input the micro-simulation model and data provided by PROTRANSITO (C1) and mode choice models.
Responsibility for Data	PROTRANSITO

Collection	
Concentration of PM2.5 emissions in the intervention areas (Microgram/m3)	
Description	Average concentration of fine Particulate Matter (PM2.5) in intervention areas, measured in micrograms per cubic meter of air; measured by an average of 39 sensors located in the area of project interventions.
Frequency	At project start and completion
Data source	ATU-installed sensors located in project intervention areas
Methodology for Data Collection	Sensor readings (non-selected sensor IDs are: 3,6,7,11,18,19,20,33,34,43,48)
Responsibility for Data Collection	ATU
GHG emissions savings in Lima related to urban transport as a result of the MPA (Metric ton)	
Description	Metric tons of CO2-equivalent emissions avoided as a result of project interventions
Frequency	At project start and completion
Data source	Travel speeds on the Phase 1 intervention corridors, data on the implemented road safety interventions
Methodology for Data Collection	The same methodology used to calculate expected GHG Emissions at appraisal will be used at the end of the project. It is based on the World Bank Guidance Note and uses as main input the micro-simulation model and data provided by PROTRANSITO (C1) and mode choice models.
Responsibility for Data Collection	PROTRANSITO
Improve road safety in Lima	
PrDO: Annual traffic fatalities in the intervention areas (Number)	
Description	Annual fatalities in areas intervened under Components 1-4: within a 100 m buffer from traffic lights and intersections (due to the precision of fatality data), and a 250 m buffer for cameras
Frequency	Annually
Data source	MTC/ONSV and Policia Nacional del Peru (PNP) database
Methodology for Data Collection	Digitized records of road crashes
Responsibility for Data Collection	MTC/ONSV and PNP
PrDO: Annual traffic fatalities in the intervention areas among pedestrians and cyclists (Number)	
Description	Annual pedestrian and cyclist fatalities in areas intervened under Components 1-4: within a 100 m buffer from traffic lights and intersections (due to the precision of fatality data), and a 250 m buffer for cameras
Frequency	Annually
Data source	MTC/ONSV and PNP database
Methodology for Data Collection	Digitized records of road crashes
Responsibility for Data Collection	MTC/ONSV and PNP
Annual traffic fatalities in the intervention areas (Number)	
Description	Annual fatalities in areas intervened under Components 1-4: within a 100 m buffer from traffic lights and intersections and within a 250 m buffer of cameras
Frequency	Annually
Data source	MTC/ONSV and PNP database
Methodology for Data Collection	Digitized records of road crashes
Responsibility for Data Collection	MTC/ONSV and PNP
Annual traffic fatalities in the intervention areas specific to pedestrians and cyclists (Number)	
Description	Annual pedestrian and cyclist fatalities in areas intervened under Components 1-4: within a 100m buffer from traffic lights and intersections (due to the precision of fatality data), and a 250m buffer for cameras
Frequency	Annually
Data source	MTC/ONSV and PNP database

Methodology for Data Collection	Digitized records of road crashes
Responsibility for Data Collection	MTC/ONSV and PNP

Monitoring & Evaluation Plan: Intermediate Results Indicators by Components

Traffic lights system	
Intersections in which the Centralized Traffic Light Network has been implemented (Number)	
Description	Number of intersections on which the centralized traffic lights have been implemented
Frequency	Annually
Data source	PROTRANSITO
Responsibility for Data Collection	PROTRANSITO
Automated traffic violation detection system	
Implementation of an automated Traffic Violation Detection and Control Center (Yes/No)	
Description	Implementation of an automated Traffic Violation Detection and Control Center
Frequency	End of project
Data source	PROTRANSITO
Responsibility for Data Collection	PROTRANSITO
Intersections equipped with automated traffic violation detection equipment (Number)	
Description	Number of intersections equipped with automated traffic violation detection equipment
Frequency	Annually
Data source	PROTRANSITO
Responsibility for Data Collection	PROTRANSITO
Safe intersections and neighborhoods	
Intersections where Immediate Traffic Actions Plan (PAIT) is implemented (Number)	
Description	Number of PAITs implemented
Frequency	Annually
Data source	PROTRANSITO
Responsibility for Data Collection	PROTRANSITO
Surveyed road users perceiving the intervened PAITs intersections to be safer/ feeling more comfortable walking & biking (Percentage)	
Description	Share of pedestrian and cyclist road users crossing the PAITs intersections that report feeling safer and more comfortable compared to pre-project
Frequency	Annually
Data source	PROTRANSITO
Methodology for Data Collection	A representative survey of PAITs intersections users will be designed to monitor the perceptions of safety and comfort
Responsibility for Data Collection	PROTRANSITO
Traffic calming zones (ZTCs) implemented at Tactical Urbanism stage (Number)	
Description	Number of ZTC's implemented at the tactical urbanism stage
Frequency	End of project
Data source	PROTRANSITO
Responsibility for Data Collection	PROTRANSITO
Surveyed ZTC residents who consider the interventions an improvement over previous conditions (Percentage)	
Description	Share of ZTC residents who consider the interventions an improvement in terms of urban quality, traffic conditions, and

	other outcomes
Frequency	End of project
Data source	PROTRANSITO
Methodology for Data Collection	A representative survey of ZTC residents will be designed to monitor the perceptions of urban quality, traffic conditions, and other outcomes as a result of the traffic calming and tactical urbanism measures
Responsibility for Data Collection	PROTRANSITO
Cycle-infrastructure and complete streets	
Length of additional cycleways implemented (Kilometers)	
Description	Kilometers of cycleways implemented as part of the project
Frequency	Annually
Data source	PROTRANSITO
Methodology for Data Collection	Field measures/ reports
Responsibility for Data Collection	PROTRANSITO
Cycling trips in the intervention areas (Number)	
Description	Total number of cycling trips (including by bicycle, cargo bicycle, scooter, or roller skates), recorded on a sample of 10 PAIT intersections between 6:30 a.m. and 9:30 a.m.
Frequency	Annually
Data source	Traffic counts, disaggregated by mode
Methodology for Data Collection	Identification of traffic participants, by mode, based on video monitoring of a sample of 10 intersections receiving PAIT
Responsibility for Data Collection	PROTRANSITO
Women as share of cyclists in the intervention areas (Percentage)	
Description	Women as a share of all bicycle users recorded on a sample of 10 PAIT intersections between 6:30 a.m. and 9:30 a.m.
Frequency	Annually
Data source	Traffic counts, disaggregated by mode
Methodology for Data Collection	Identification of traffic participants, by mode and gender, based on video monitoring of a sample of 10 intersections receiving PAIT
Responsibility for Data Collection	PROTRANSITO
Share of women in the intervention districts cycleways who can access a health clinic within 15 min by protected cycleways and walking (Percentage)	
Description	Only considering the protected cycleways, share of women who can reach the nearest health clinic by a combination of cycling and walking
Frequency	End of project
Data source	Geospatial data on the location of health clinics and cycleways in C4.1 districts; spatial data on population (WorldPop)
Methodology for Data Collection	The indicator will be calculated using accessibility modeling tools, using as an input the spatial data on population, health clinics, and the presence of protected cycleways in the districts intervened in C4.1
Responsibility for Data Collection	PROTRANSITO
Project management and capacity building	
Strategic ITS plan to promote sustainable transport modes implemented (NMT and public transport) (Yes/No)	
Description	Develop and implement a comprehensive strategic ITS plan to promote sustainable transport modes (NMT and public transport) through state-of-the-art ITS tools and analytical methods
Frequency	End of project
Data source	PROTRANSITO
Methodology for Data Collection	
Responsibility for Data Collection	PROTRANSITO

Gender-informed Bicycle Infrastructure Plan and Bicycle Strategy implemented (Yes/No)	
Description	Update and adopt the Bicycle Infrastructure Plan, including a bicycle promotion strategy, with a strong focus on attracting more women and vulnerable groups to cycling
Frequency	End of project
Data source	PROTRANSITO
Methodology for Data Collection	
Responsibility for Data Collection	PROTRANSITO

ANNEX 1: Implementation Arrangements and Support Plan

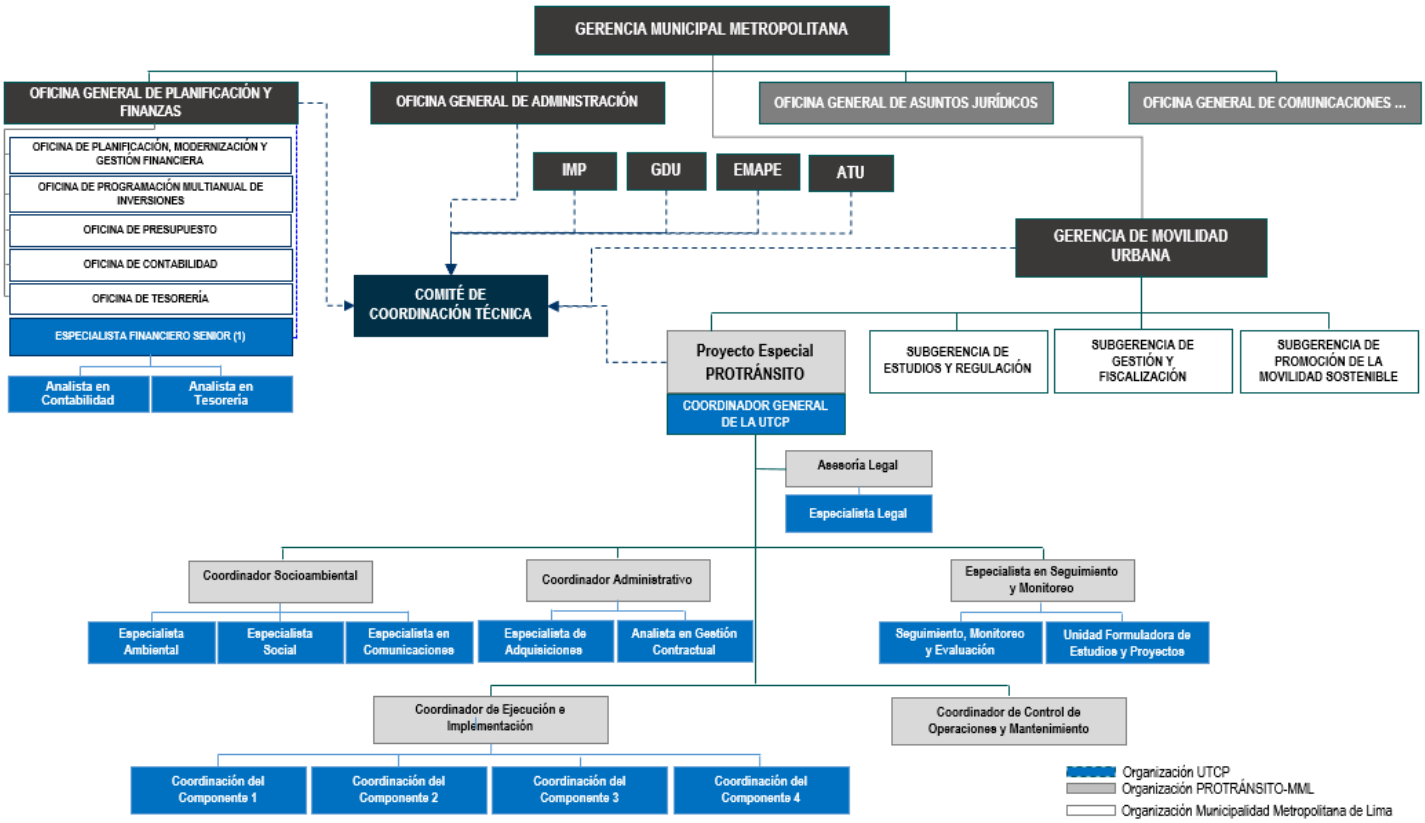
COUNTRY: Republic of Peru
Improving Lima Traffic Management and Supporting Sustainable Transport Project

Fiduciary

Financial Management Arrangements

1. **Organization and staffing.** The MML will act as the project implementing agency for the MPA and will be responsible for the management of funds for the project. PROTRANSITO will provide technical assistance to the MML by a TCU responsible for assisting in the implementation, monitoring, and supervision of the project (including its procurement and E&S aspects), with adequate fiduciary (procurement), administrative, M&E, and technical personnel (figure 1.1), as set forth in the POM. The MML will provide PROTRANSITO the capacity to procure works and the provision of goods and services. Under this arrangement, the MML will be responsible for the FM of the project (budget, accounting, financial reports, internal controls, flow of funds, and auditing). The roles and responsibilities of the TCU and other MML areas will be included in the POM. The MML has experience in working with World Bank project funds as it is currently implementing project P170595. The MML will be strengthened with a senior FM specialist and two FM analysts reporting to the head of the General Office of Planning and Finance of the MML, and thereafter maintained throughout project implementation to be responsible for the FM aspects of the project. The FM specialists should be recruited by the MML no later than three months after effectiveness under terms of reference approved by the World Bank and the selection of fiduciary staff will require the World Bank's no-objection. The roles and responsibilities between the other MML areas and the TCU will be reflected in the POM which requires the World Bank's no-objection. A draft version of the POM was submitted to the World Bank and was considered acceptable. The approved POM is considered an effectiveness condition.

Figure 1.1. MPA Phase 1 Organogram for Implementation Arrangements



2. **Planning and budgeting.** The preparation of annual work program and budget will be in accordance with the procedures established by the MEF through its General Public-Sector Budget Office (*Dirección General de Presupuesto Público*). Those procedures will be complemented by specific processes and procedures established in the POM (preparation of an annual operating plan with at least a semiannual budget, including all sources of financing—IBRD and counterpart funds). The MML will be responsible for coordinating the budget proposal for both resources of funds. The MML will request the MEF the external budget resources for approval and allocation, considering that the MEF is representing the borrower of the loan. To ensure adequate budget control, the MML will be responsible for (a) timely provision of resources for each year established in the work plan and budget formulation and approval; (b) proper recording of the approved budget in the respective information systems following a classification by project component/subcomponent; and (c) timely recording of commitments, accruals, and payments, to allow adequate budget monitoring and provide accurate information on project commitments for programming purposes.

3. **Accounting and information system.** The MML will have to comply with Peru's laws governing budget management and FM, including the use of SIAF and the General Chart of Accounts established in SIAF. Accounting and payment transactions of the project will be recorded in SIAF. Considering the nature of project activities and information needs for monitoring purpose, the MML will complement the use of SIAF with the Module of Project Execution (*Módulo de Ejecución del Proyecto*, MEP) in SIAF for further issuance of financial reports and preparation of statements of expenditures (SOEs) according to the project components in US dollars to submit them to the World Bank.

4. **Financial reporting.** The MML will prepare the interim financial reports (IFRs) from the transaction information recorded in SIAF, which will be downloaded in the MEP-SIAF. The IFRs will include the following:

- A statement of sources and uses of funds, including reconciling items (as needed) and cash balances, with expenditures classified by project component/subcomponent/category.
- A statement of cumulative funds, reporting the current semester and the accumulated operations against the component of ongoing plans and footnotes explaining the important variances and comparing the annual budget allocation versus the respective budget execution.

5. The reports will include loan proceeds and local counterpart funds. The IFRs would be prepared in local currency and in US dollars and submitted to the World Bank on a semiannual basis no later than 45 days after the end of each calendar semester.

6. On an annual basis, the MML will prepare project financial statements including statement of source and use of funds, cumulative figures, and SOEs for the beginning of the year and as of the end of the year, and explanatory notes in accordance with International Public Sector Accounting Standards. The MML will prepare the financial statements of the project. Those financial statements, duly audited in accordance with the World Bank's requirements, will be submitted to the World Bank within the six months after the end of the Government's fiscal year (December 31). Working papers for the preparation of the semester and annual financial statements will be maintained by the MML and made easily accessible to World Bank supervision missions and to external auditors.

Internal Controls and Audit

7. **Internal controls.** Overall, the MML will have to comply with local requirements related to FM, including internal controls and internal procedures. In addition, the World Bank will review and agree with both entities on specific roles, processes, segregation of responsibilities, and procedures for the approval and processing of payments to vendors for all components of the project and these will be reflected in the POM.

8. **Internal audit.** The MML's organizational structure includes an Internal Control Office (*Oficina de Control Interno*, OCI) that also oversees PROTRANSITO. The OCI's staff is designated by the CGR that oversees the activities of the MML and its entities. The OCI may play a role in ex post internal control on project transactions. The OCI has adequate capacity to oversee the internal control environment of the MML and PROTRANSITO.

External Audit

9. Annual audit reports on project financial statements, including Management Letters, should be submitted to the World Bank, within six months of the end of the borrower's fiscal year (December 31). The audit should be conducted by an independent audit firm acceptable to the World Bank and under terms of reference approved by the World Bank. The selection of the audit firm should be performed through the General Audit CGR. Audit costs can be financed out of loan proceeds. The scope of the audit would be defined by the MML in agreement with the World Bank based on project-specific requirements and responding, as appropriate, to identified risks including through a Management Letter and review of compliance with agreed processes and procedures. Audit requirements would include those listed in table 1.1.

Table 1.1. Audit Due Dates

Audit Type	Due Date
Project financial statements	June 30
Special opinion: SOE	June 30

Disbursements

10. The World Bank loan proceeds will follow the World Bank`s disbursement policies and procedures, as described in the Disbursement and Financial Information Letter (DFIL). The borrower and the World Bank have agreed to use the CUT as a disbursement mechanism for the project, and hence, advances to the Designated Account will be made to the CUT.[59] Funds of the loan will be identified with a segregated code or subaccount of the CUT. The POM will include specific procedures that will allow the project to operate the CUT.

11. The World Bank will disburse loan proceeds using one of following three methods: (a) advance method: under the CUT with a flexible ceiling based on a quarterly forecast (under the advance method, the forecast-format to be used will be annexed to the DFIL), (b) direct payment: the minimum application size for direct payment requests will be US$1 million, and (c) reimbursement: the minimum application size for reimbursement method will be US$1 million.

12. The disbursement accounts in US dollars will be operated by the MML. Funds deposited into the CUT as advances would follow the World Bank's disbursement policies and procedures to be described in the Legal Agreements and DFIL. To process payments, the MML will use a code (subaccount) assigned by the MEF to pay vendors' and consultants' bank accounts. The payment process and procedures will be reflected in the POM.

13. **Counterpart funds.** The MML will manage the counterpart funds for the project using the CUT established by the Government. Funds for the project will be identified with a specific project code (subaccount for counterpart funds) and account in SIAF to process payments.

14. **Retroactive financing.** No retroactive financing amount has been considered for the project.

15. **Supporting documentation.** Supporting documentation for documenting project expenditures (SOEs) under the disbursement methods authorized for the project should be in accordance with the provisions established under the DFIL. The World Bank will recognize an expenditure when payments to the vendor have been processed and been cleared.

16. **Disbursement deadline date.** The disbursement deadline date is four months after the closing date specified in the Loan Agreement. Any changes to this date will be notified by the World Bank.

17. **Disbursement categories.** Loan proceeds will be disbursed against the expenditure categories as described in table 1.2.

Table 1.2. Table of Loan Proceeds (US$)

Category	Amount of the Loan Allocated	Percentage Expenditures to be Financed (exclusive of taxes)
(1) Goods, works, non-consulting services, consulting services, and Operating Costs [and Training] for the Project	150,000,000	**100%**
Total Amount	**150,000,000**	

[59] The CUT for the use of loan resources is in place in Peru according to the Legislative Decree No.1441.

Supervision Plan

18. On a preliminary basis, the World Bank plans to conduct at least two supervision missions per year, while also reviewing the annual audit reports and the semester IFRs.

Procurement

19. **Procurement activities will be carried out by PROTRANSITO according to the World Bank's 'Procurement Regulations for IPF Borrowers,'** issued in September 2023 for the supply of works, goods, and non-consulting and consultant services under the project. The World Bank's Standard Procurement Documents will govern the procurement of World Bank-financed Open International Competitive Procurement. For procurement involving National Open Competitive Procurement and other methods, the documents will be agreed on with the World Bank.

20. **Summary of the PPSD.** PROTRANSITO, under the World Bank's close support has prepared the PPSD. The PPSD describes how procurement in this operation will support the PDO and deliver value for money invested under a risk-based approach. The PPSD focuses on high-value contracts to be financed by the project.

21. **The cost estimate for Subcomponent 1.1 is US$85.6 million, which represents about 57 percent of the total World Bank funds.** The activities to be carried out under this subcomponent comprises civil works and goods. The civil works include all the activities needed to install the traffic signal network such as smart traffic lights and related equipment, excavations, construction of chambers, removal of pavement, fiber-optic channeling, cabling, pavement repair, horizontal and vertical signing, and so on. These works will be carried out in densely populated urban areas covering 488 intersections across 20 Lima districts with direct implications in terms of safeguards, vehicular and pedestrian traffic flow, commercial activity, and so on. Regarding the contracting strategy, technical requirements linked to the standardization of controllers and their compatibility with PROTRANSITO's existing equipment and systems, are among the main reasons for considering that a single contract is the best alternative, instead of grouping options by batches. The preliminary analysis concluded that the appropriate market approach is an international competitive Request for Bids (RFB) process, using the World Bank's Standard Procurement Documents for Small Works (due to the low complexity of the works). Rated criteria are applied, and thus, bids are obtained that optimize value for money through a process with two envelopes (technical and financial) considering as possible scoring criteria, for example, the organization of the company in works with multiple work fronts, as it is a relevant issue in the urban area where the services will be developed, technological aspects of traffic lights, and social and environmental safeguards, such as the disposal of technological and construction waste. On the other hand, for the supervision of the works (cost estimate US$2.4 million), a consultant firm will be selected through a Quality and Cost-Based Selection.

22. **Subcomponent 3.1 includes the implementation of low-cost traffic interventions at 295 intersections.** The cost estimate for this subcomponent is US$21.3 million, which represents more than 14 percent of the total World Bank funds. The interventions to be carried out under this subcomponent include the installation of pedestrian, cyclist, and vehicular traffic lights and their respective pedestrian/cyclist crossings, construction and resurfacing of ramps to ensure universal accessibility, installation of medians, installation of bollards and recovery of pedestrian circulation space, resurfacing of lanes, and horizontal and vertical signaling, among others. All these are very simple and minor works with typified designs. The contract strategy has been evaluated. Preliminarily, a single contract in a few RFB processes would be the most appropriate approach, under a national competitive process with the World Bank's Standard Procurement Documents for Small Works or other simplified bidding document acceptable to the World Bank.

23. **Subcomponent 3.2 includes the implementation of ZTCs and public space improvement measures in both residential and commercial areas rates.** The cost estimate for this subcomponent is US$23 million, which represents

almost 15.3 percent of the total World Bank funds. The interventions under this subcomponent include, among others: vehicle calming works such as narrowing of vehicular lanes, implementation of modal filters and passable barriers, leveling of the roadway to a single platform, widening of sidewalks for pedestrian circulation, the implementation of urban furniture (bike racks, benches, and bollards), and the improvement of landscaping. Since the five municipalities have different levels of progress in their pre-bidding activities, preliminarily, the most appropriate approach would be to carry out, for each municipality (US$4.1 million each) (a) one bidding process for the elaboration of the technical design and works under an RFB process and (b) one bidding process for the supervision of the designs and works to be selected through a Quality- and Cost-Based Selection .

24. **Component 4 includes the implementation of approximately 50 km of high-quality segregated cycle infrastructure as part of comprehensive Complete Streets interventions.** The cost estimate for this component is US$19.5 million, which represents almost 13 percent of the total World Bank funds. Preliminarily, the contract includes (a) one bidding process for the elaboration of the technical design and works under an RFB process and (b) one bidding process for the supervision of the designs and works to be selected through a Quality- and Cost-Based Selection.

25. Procurement for works, goods, consulting services, and non-consulting services will be implemented based on Mandatory Procurement Prior Review Thresholds detailed in annex I of the World Bank's Procurement Procedures. All procurement procedures, including the roles and responsibilities of different participating entities and units, will be defined in the POM.

26. PROTRANSITO has prepared a Procurement Plan, which provides adequate market analysis for the selection methods detailed in the Procurement Plan, based on the PPSD. In accordance with Paragraph 5.9 of the Procurement Regulations, the World Bank's Systematic Tracking of Exchanges in Procurement system will be used to prepare, clear, and update Procurement Plans and conduct all procurement transactions for the project.

27. **A procurement capacity assessment was carried out to evaluate the adequacy of PROTRANSITO's procurement arrangements.** The assessment analyzed mainly the organizational structure, staffing, and procurement systems that are in place in PROTRANSITO to determine the risks and mitigation measures. The assessment concluded that PROTRANSITO has no experience working with World Bank-financed projects and has no experience in bidding for high-value contracts. A mitigation plan to strengthen the procurement capacity of PROTRANSITO includes (a) the need to hire a qualified professional with experience in procurement of high-value contracts, and contract execution, (b) continuous training and close support from the World Bank along the procurement cycle of the processes, and (c) the need to develop a detailed contract management plan.

28. **Frequency of procurement supervision.** In addition to prior review supervision to be carried out by the World Bank office, annual supervision missions will be carried out to visit the field and conduct post review of procurement actions.

ANNEX 2: Detailed Project Description

COUNTRY: Peru
Improving Lima Traffic Management and Supporting Sustainable Transport Project

1. **The proposed project has an extensive spatial scope, with the various interventions broadly aligned along several key corridors in Lima and complementing one another in terms of their expected impact on avoiding, shifting, or improving transport use.** The corridors' direct 'areas of influence' are heterogeneous in terms of socioeconomic and mobility characteristics that motivate the emphasis on- and combinations of- the specific interventions included in the project, such as those aimed at managing congestion and speed, improving road safety, and enhancing mobility of NMT users. The interventions are tailored in a way that address the specific challenges of each area.

2. **In the north**, **there are several densely populated districts, such as San Juan de Lurigancho, Rimac, Independencia, Comas, and San Martin de Porres with a high concentration of poverty.** The incidence of traffic crashes is also particularly high in the north, in Independencia, Los Olivos, and Comas. Ave. Universitaria, one of the main connecting routes from the northern districts to central Lima, has the highest concentration of crashes among the nine corridors included in Component 1, with 3.04 crashes per km^2, compared to 1.28 crashes per km^2 across all corridors on average. Ave. Universitaria also has the highest density of cycling lanes of all the corridors included in Component 1, followed by Javier Prado and Cercado de Lima. Under Component 1, interventions to improve traffic flow and safety on Ave. Universitaria will benefit the connectivity between the north and the central employment centers. Given the high traffic crash rates, these areas are also planned to be targeted by interventions that will improve compliance with traffic regulations (Component 2) and non-motorized mobility and safety (Component 3).

3. **Congestion and fatal crashes are particularly high in the central areas, in Cercado de Lima,** motivating the combination of interventions aimed at improving traffic flow (Component 1), compliance with traffic rules (Component 2), and pedestrian and cyclist safety (Component 3). Similarly, in the south, the districts of Chorrillos, San Juan de Miraflores, Santiago de Surco, Villa María del Triunfo, and Villa El Salvador concentrate high population density, and crashes are common, with fatal crashes especially concentrated in San Juan de Miraflores.

Component 1: Traffic lights system

4. **The traffic lights system in Lima has been managed by four separate entities:**

- **PROTRANSITO**, a special project created by the MML to improve traffic management in Lima through a centralized traffic lights system. Its main goals are to reduce travel times for all modes, reduce air and noise pollution, optimize road infrastructure, prioritize sustainable modes of transport, reduce traffic crashes, and promote the use of ITS tools to manage transport in the city.
- **ATU**, a specialized technical entity attached to Peru's MTC. ATU's main objective is the organization, integration, and articulation of the urban public transport system in Lima and Callao. It is the operator of Lima's metro system and of the Metropolitano, a public transport integrated system that operates the BRT.
- **GMU**, responsible for promoting the development and implementation of sustainable urban mobility plans and traffic management solutions and designing integrated mass public transport systems.
- **Districts.** Lima's 43 districts all have competencies in public spaces and local streets.

5. **The Lima traffic lights system is not integrated and lacks interoperability between solutions, reducing the operational capabilities of PROTRANSITO.** The traffic lights system managed by PROTRANSITO includes three different traffic management applications that integrate traffic controllers from different suppliers.

6. **The existing traffic management system faces technical challenges**. First, available communication facilities to centralize traffic controllers and cameras with traffic management centers are not homogeneous. Although most intersections use fiber optics, many still use low-capacity communication services (radiolink or mobile operator). In addition, fiber-optic communication is not defined as a multiservice network that could be useful for the implementation of other smart mobility solutions. Second, monitoring is limited to motorized vehicle traffic flows. Third, neither public transport nor emergency priority is implemented, and coordination with transport operators and emergency agents is lacking. Fourth, the TCC operates without an operational manual.

7. **To optimize traffic management and control, it is necessary to integrate and centralize Lima's traffic lights system.** Lima has only 840 centralized traffic light intersections out of a total of 1,544. Intersections with decentralized traffic lights are considered inadequate as they do not feature the technical or technological elements that would allow their integration to the TCC. The proposed MPA will significantly contribute to that goal by helping to close both the coverage and the technological gaps of the traffic lights system. In Phase 1, it will intervene in 488 intersections (102 with new traffic lights at currently unsignalized intersections) so that 1,217 intersections[60] (79 percent) are integrated in and managed from the TCC.

8. **Component 1 aims to expand and improve the centralized traffic lights network and strengthen the TCC.** Component 1 is divided into two subcomponents, focusing on the expansion and improvement of the centralized traffic signal network and the strengthening of the TCC.

9. **Subcomponent 1.1: Centralized traffic lights network interventions consist of interventions at 488 intersections on nine corridors across 20 Lima districts, as follows:** 50 intersections in El Agustino and San Juan de Lurigancho; 57 intersections in Santa Anita and La Molina; 32 intersections at Ave. Universitaria; 32 intersections with bicycle lanes in Zona Centro (Cercado de Lima, Breña, and Pueblo Libre); 52 intersections with bicycle lanes in Zona Sur (Villa El Salvador); 49 intersections at Av. Javier Prado, Av. Carrion, and Av. La Marina (La Molina, San Borja, San Isidro, Magdalena and San Miguel); 72 intersections in Chorrillos and Barranco; 48 intersections in Villa Maria del Triunfo and San Juan de Miraflores; and 95 intersections in Santiago de Surco.

10. **The intersections covered by Subcomponent 1.1 will receive equipment which will allow for improved road safety and traffic management.** This includes traffic lights, traffic sensors, controllers, 360° rotating traffic detection cameras, braille plates and acoustic repeaters, and variable messaging panels. About 60 percent in terms of total cost—direct purchase and installation as well as the supporting infrastructure mentioned above—will be NMT-specific traffic lights and another 20 percent will be traffic lights that give priority to public transport. To account for the different mobility contexts, two conceptual types of intersections were developed for the project: (a) type A, with ITS sensors, is technologically simpler and less expensive to implement, operate, and maintain, and it is appropriate for locations with stable and identifiable traffic flows and (b) type B, with intelligent traffic light system's sensors, involves the use of vehicle and pedestrian-detecting technologies, which allows the implementation of real-time operational models.

[60] Including 769 existing, 102 new, and 275 to be centralized.

11. **Subcomponent 1.2 aims at strengthening the TCC.** It includes the following activities:

(a) Data center: integrated electronic security system, three-phase electrical power supply, electrical system redundancy, and automatic information back-up systems, among other technical and technological improvements.

(b) Renewal of the core switches to allow for higher network loads and new fiber-optic trunk lines.

(c) TCC's traffic management software: integration of the three existing types of traffic controllers into one platform, improving the server's capacity, and improving the software's source code.

(d) Monitoring and control Center: improving and expanding building premises, workstations, and videowall capabilities and integration of the TCC with ATU's bus monitoring and control center.

12. **A functional architecture model for the TCC was proposed that serves both current and future needs of the traffic lights system and includes communications and other smart technologies (such as ITS and Internet of Things).** The physical infrastructure of the center is planned to be divided into technical and operational areas (at a minimum for communications and equipment, ITS visualization and operation, crisis room, press room, and support areas), as well as internal technical and technological subsystems (communications, audiovisuals, security, and access control, and general facilities control). The World Bank has provided specialized technical advisory services to PROTRANSITO as input for a conceptual design proposal for the TCC, identifying technical and technological specification to ensure consistency with the intersection projects from Subcomponent 1.1 as well as with all other technological subsystems contemplated as part of the smart city plan. Energy-efficient equipment and technologies will be used in the TCC upgrade, aligned to the level of LEED and similar standards and in line with EDGE-level certification to ensure a reduction of energy use of at least 20 percent.

Component 2: Automated Traffic Violation Detection System

13. **Violations of traffic rules are a key source of traffic incidents in Lima.** Typically detected violations include disregard for speed limits, failure to comply with road use regulations, turning or crossing on red lights, failure to stop before the stop line or to comply with pedestrian right of way, improper left turns, and parking in prohibited zones.

14. **Component 2 will seek to increase road safety in Lima by implementing a new automated traffic violation detection system**. It is proposed to have a simple, flexible, and scalable logical architecture, consisting of (a) field sensors (IP cameras and cinemometers) to detect the traffic violations; (b) a local processing system that includes video analysis software to process the images and register the evidences; (c) an intuitive, modular, and scalable centralized management system; and (d) an automated platform for the management of fines, where the system administrators can access the evidence and impose the fines. The communication network will be based on optic fiber to be able to handle the large data volumes and the long distances from the sensors to the control center. To add redundancy to the system, the devices will have a mobile connection through a router modem. The operational model will be based on detecting infractions at intersections and detecting speed offenders with mobile devices (cinemometers). At the front end, the system includes sensors to detect the infractions (IP cameras) and collect the evidence while the servers are locally installed to store the data (photos, videos, and metadata). At the back end, the equipment and the data will be managed and operated through a centralized platform to analyze and process the collected evidence at the control center.

15. **Component 2 will be implemented through a network of 230 traffic violation detection cameras and sensors on approximately 40 intersections, along with improvements in horizontal and vertical signaling**. This equipment will be connected through a communication network, with a fiber-optic connection (Component 1), to the TVDCC, to be

implemented also through this component. This will enable the detection of frequent infractions that negatively affect road safety and vehicular circulation, such as exceeding the maximum speed limit, running a red light, making illegal turns, invading bus or bicycle lanes, and blocking intersections, among others. The cameras will be located at road safety hotspots and on the main public transport corridors in 18 districts: Jesús María, Cercado de Lima, Surquillo, Barranco, San Luis, Los Olivos, San Juan de Miraflores, La Victoria, Chorrillos, San Isidro, Rimac, Santiago de Surco, Miraflores, San Martin de Porres, San Miguel, Comas, San Borja, and La Molina. The cameras will allow the identification of the infractions as well as the vehicle information.

16. **The component will implement a new TVDCC to collect, process, and analyze the information from the cameras and sensors on the roads.** The information coming from the cameras and sensors on the roads will be collected, analyzed, and processed at the TVDCC, where the traffic fines will be issued, when appropriate. Implementing the TVDCC involves installing the connection to the fiber-optic communications network as well as the acquisition and installation of the data center equipment, including software and hardware, with the goal of operating 24 hours a day, 365 days a year, and having a minimum availability of 99 percent. It will also involve the installation of adequate workstations for the personnel in charge of reviewing and processing traffic violations and notifying alerts.

Component 3: Safe intersections and neighborhoods

Subcomponent 3.1: Immediate Traffic Actions Plan (PAIT)

17. **With World Bank assistance, PROTRANSITO has identified priority intersections for improvement within the primary (metropolitan) road network to improve the safety of NMT.** The selection was based on NMT connectivity with the existing and projected pedestrian-bike network, road safety hotspot analysis, traffic congestion levels, and proximity to a ZTC attractor (health and education facilities, parks, and markets). Of the more than 1,000 intersections ranked, 295 intersections were prioritized for implementation in Phase 1 of the MPA.

Subcomponent 3.2: Traffic Calming Zones (ZTC)

18. **ZTCs are envisioned as part of the priorities defined in PLANMET 2040,** planned to be located near health and educational facilities, parks, and public markets, to improve road safety and last-mile connectivity by walking/cycling within these catchment areas. The proposed approach for developing a citywide ZTC program in Lima is based on the Vital Neighborhoods model and other international experiences, such as Superblocks in Barcelona and Low Traffic Neighborhoods in London. These projects represent best practices in traffic calming, coupled with public space and eco-urbanism interventions to create urban revitalization.

19. **The MPA will include the key ZTCs identified in PLANMET 2040 through a phased and incremental approach.** In alignment with the long-term planning efforts under way, five ZTCs will be developed as part of Phase 1, each roughly between 1 and 2 km^2. These areas will cover diverse contexts, including neighborhoods centered around public services (for example, education and health), local commercial centers, and recreation and culture-based activities. This approach will allow for the proper development and testing of the concept given the varying travel patterns, street layout, and morphology of public spaces in each of these areas.

20. **A flexible multi-phase approach toward ZTC implementation will be used to bring together key stakeholders at the MML and district levels.** This approach will include several phases, including ‘Idea’, ‘Profile’ or conceptual design, ‘Detailed or Construction Design’, ‘Tactical Urbanism’, and ‘Civil Works’. As a ZTC project matures, it can first be tested using Tactical Urbanism, and then, based on lessons learned, it can be implemented more permanently using civil works. The MML will support the implementation process throughout all the phases, in agreement with the corresponding

district-level governments. Alternatively, the MML may also receive developed proposals from the districts that have carried out their own technical studies and help finance the implementation of the investments.

21. **Idea and Conceptual Design Phase.** This phase lays the groundwork for the project, developing the initial planning studies using data collection and processing frameworks that are tailored to the specific local context. In addition, policy recommendations are developed to identify and assist local authorities in updating required legal frameworks that will assist in implementation, financing, and project sustainability in later stages. This phase allows for an initial testing of the concepts, given their innovative nature, and hence will receive feedback from on-the-ground implementation using temporary materials and low-cost interventions. Finally, this phase lays out a citizen engagement strategy and its execution, which encompasses all the other aspects of project implementation.

22. **Tactical Urbanism.** A key part of the ZTC development is the implementation of temporary (1–2-year maximum duration) physical installations in one or more of the selected implementation areas to test potential project impacts on vehicle traffic performance and user legibility, public space use by local commerce, and road safety issues, among others. Despite being significantly less expensive than permanent installations, Tactical Urbanism interventions can add up to an important part of the required resources to properly execute and develop the project. Some of the key components to be installed include but are not limited to road signage, vertical barriers, vertical special signage, decorative paint schemes, removable speed humps, decorative planters, public seating, wayfinding signage, public art installations, outdoor lighting (both decorative and functional), and texture changes to pavement.

23. **Construction Design Phase.** Studies are developed to move from a conceptual design-level intervention that can be tested at the Tactical Urbanism level to more permanent installations with multidimensional improvements to the built environment.

24. **Civil Works Phase.** Permanent physical interventions take place to solidify the selected ZTC pilots. These physical interventions make up the largest part of potential project financing and include traffic calming measures such as lane narrowing and speed humps; public space improvements; landscape improvements; drainage and utilities; urban furniture, lighting, and special signage to guide vehicle circulation; and pedestrian and cycle users.

25. **Several aspects of the subcomponent can assist in leveraging additional private sector investment and buy-in.** For example, the ZTC projects allow for a new model for urban revitalization that departs from traditional 'modernist' planning urban renovation practices that prioritize top-down models of implementation, for a more bottom-up, participatory, and inclusive approach, leading to ownership, sustainability, and better project designs that benefit those who use them. Private sector companies in the areas of real estate development, construction, planning, and design, landscape architects, and local businesses that provide proximity services, logistics, and freight distributors would benefit from advancing ZTCs. Fundacion Transitemos, a local sustainable mobility nongovernmental organization, is offering workshops to municipal district staff to leverage private funding sources for their projects through their 'Adopt a Street' program.

Component 4: Urban mobility, cycle-infrastructure and complete streets

26. **The project has identified approximately 50 km of priority connections in the cycle network for Lima Center**, the most actively used part of the system, to advance in project prefeasibility studies and investment engineering designs. The 50 km were prioritized using criteria such as connectivity of the Lima Center network, aiming to close the missing links between the existing primary bike infrastructure lanes. The links were proposed based on a combination of the World Bank 2020 cycle network plan and new corridors identified with the GMU as having high potential demand for cycle trips.

Initially, 68 km of potential cycle lanes were identified, from which 50 km were selected based on their feasibility and concept design. However, a final stage was also carried out to identify parallel routes to those initially proposed, because they were all primarily located along arterial routes. The proposed network is also complementary to the nearly 90 km of cycle lanes financed and under implementation by KfW.

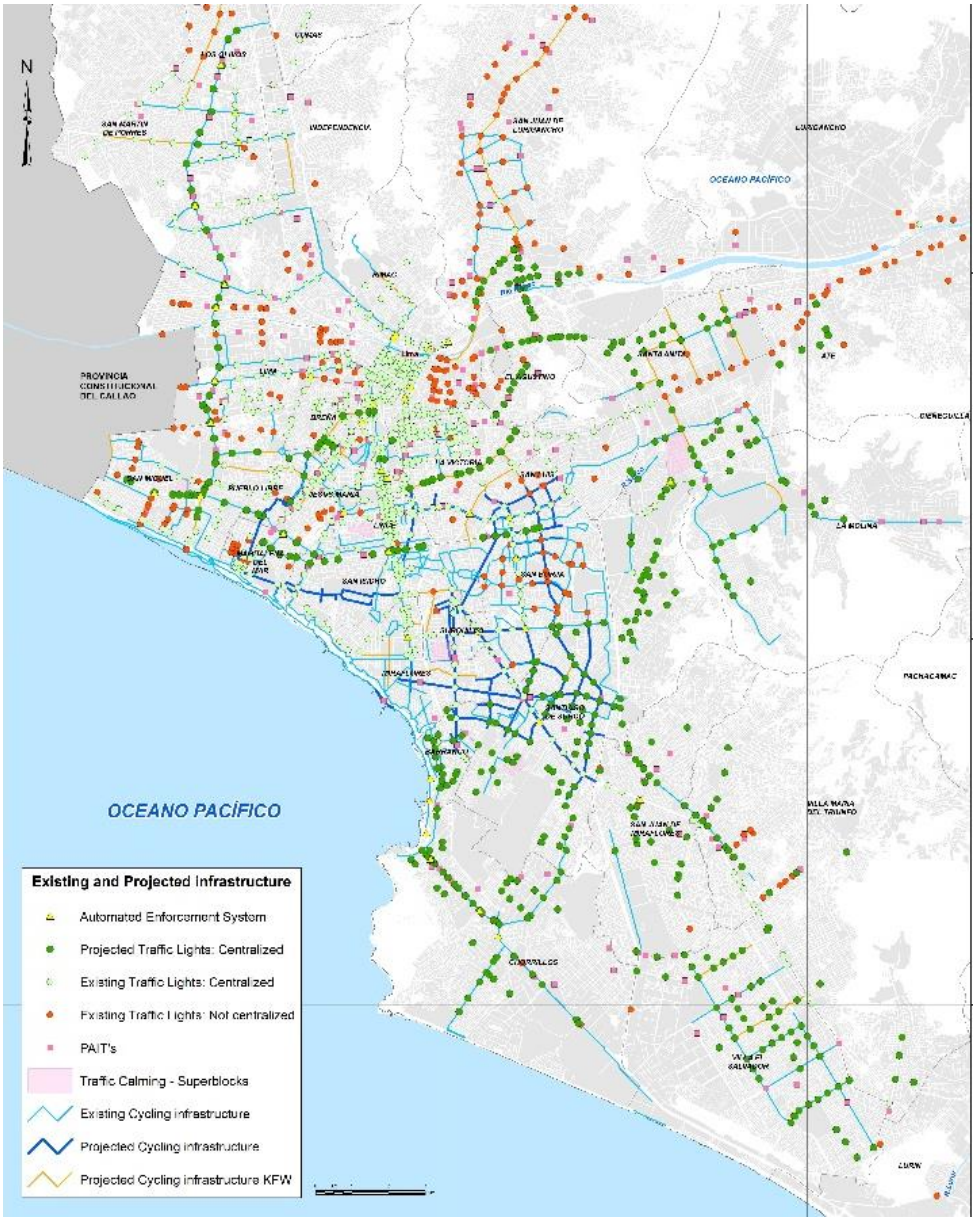
27. **In addition, the project will support the preparation of engineering designs for 150 km of cycle infrastructure throughout Lima, for the interventions to be investment-ready during Phase 2 of the MPA**. Innovative planning methodologies, including the use of level of traffic stress characterization of infrastructure quality from the perspective of the user, as well as data from global positioning systems (GPS) and cellphones, will be used to automate future planning.

28. **A total of 124 intersections of Component 1 and Subcomponent 3.1 intersections will be on the existing and future cycle network**. The selection of PAIT intersections coincides strongly with the existing and projected cycle infrastructure network. Component 1 intersections are aligned with the KfW-funded cycle lanes being implemented to increase their functionality and safety, with nearly 35 intersections being aligned.

29. **PLANMET 2040 stipulates the implementation of a metropolitan PBS system with a preliminary estimate of 2,100 bicycles.** The World Bank conducted a prefeasibility assessment for a potential PBS system and is ready to engage with the city through a PPP process (also specified in PLANMET 2040). Systems recently implemented in Bogota and Mexico City have strong private sector participation and business model schemes funded through a combination of fare, advertising, and sponsorship revenues, and potentially with public sector investment. In addition, recent schemes such as the one in Stockholm show that 'virtual' station docking technology is as effective as docked solutions, with a lower CAPEX investment required. The World Bank assisted the MML with specialized advisory services to define a transaction model and financing scheme, alongside a feasible technical definition of a metropolitan PBS system with high-quality operation standards and the use of newer technologies than existing in the city, such as electric-assist pedal bikes.

30. **The World Bank will update its 2020 cycle infrastructure recommendations strategy for Lima, focusing on the next 150 km to be prioritized for implementation, along with an intermodal bicycle parking system at mass transit stations.** The World Bank procured consulting services to complement the MML's in-house technical staff and updated the current inventory of cycle infrastructure in the city, produced a demand estimate for cycle trips, and developed conceptual designs for 50 km of prioritized cycle infrastructure investments. The World Bank will also work alongside the MML and ATU to continue to define and procure an intermodal bicycle parking system that can operate alongside mass transit stations from the Metro and BRT systems.

Figure 2.1. MPA Phase 1 Project Interventions



Component 5: Project management and capacity building

31. This component aims to ensure adequate management and coordination of the project, to promote meaningful citizen engagement, and develop and strengthen capacities that are transversal to all project components.

Subcomponent 5.1: Technical and administrative Project management

32. **The subcomponent will support the strengthening and adequate project management by the MML, including the TCU, and the coordination and implementation of activities that are transversal to the project's components.** This subcomponent will finance, among others, (a) activities to support project administration and management distributed across the MML, including the TCU within PROTRANSITO, covering procurement, financial, and technical management, as

well as M&E activities of the project and the MPA learning agenda (including, among others, operating costs[61] and project external audits) and (b) project-related capacity-building activities for the MML.

Subcomponent 5.2: Environmental and Social management and sectoral strategies

33. **Activities under this subcomponent will include services to** (a) develop and implement communication strategies, including informative, educational, and awareness campaigns, and develop, implement, or supervise the E&S instruments, including the SEP, the GRM, the Resettlement Plan, and/or the LRP; (b) develop a comprehensive strategic plan to promote sustainable transport modes (NMT and public transport) through state-of-the-art ITS tools and analytical methods; (c) recommend institutional reforms for safe and efficient traffic management in Lima; (d) develop guidelines and norms on planning, design, and evaluation of urban infrastructure with a gender perspective; (e) structure a PPP tender for the metropolitan PBS system; and (f) update the Bicycle Infrastructure Plan and develop a bicycle promotion strategy with a strong focus on attracting more women and vulnerable groups to cycling (conducting an analysis of the barriers women face in using bicycles to inform design features and technical specifications of project activities, in collaboration with women's cycling groups and urban cycling training initiatives)

34. **The project's citizen engagement efforts will go beyond the traditional unidirectional informative approach and, instead, will aim to allow the residents, business owners, and campaigners to learn about a project's details and impact, with sufficient time to incorporate their views as much as possible within the planning and design of the initiatives.** Although an SEP was prepared as part of the World Bank's ESF, the MML will reinforce key social aspects of the project, including specific communications and engagement strategies that each project in each subcomponent should include. Examples of these activities include websites, social media, and traditional media ads (TV and radio).

35. **The MML will develop a comprehensive strategy that will unite the four other project components into a single narrative.** The communication efforts should effectively prove that all the projects contribute to improving Lima's traffic management and incentivize sustainable mobility, bringing about a series of benefits to society. The strategies will feature actions that will allow authorities and planners to communicate with the project-specific stakeholders and the general population and receive feedback from them when relevant. Communications efforts will be present at the various stages of each project's lifecycle and will explain the problem to be solved, why the chosen solution is the most ideal, and its expected benefits. As progress is made, updated data will also be communicated so that stakeholders are aware of the project's development even after implementation.

[61] Operating costs includes the reasonable incremental operating costs (other than for consulting services) incurred by the MML, including the TCU, in connection with project implementation, such as, among others, rental and maintenance of equipment and vehicles, rental of office facilities, purchase of office equipment and furniture, utilities, supplies, and materials, domestic travel and per diem of the MML (including the TCU) staff, and logistics expenses, in each case which would not have been incurred absent the project and excluding salaries, fees, honoraria, bonuses, and any other salary supplements of members of the borrower's or the MML's civil service.

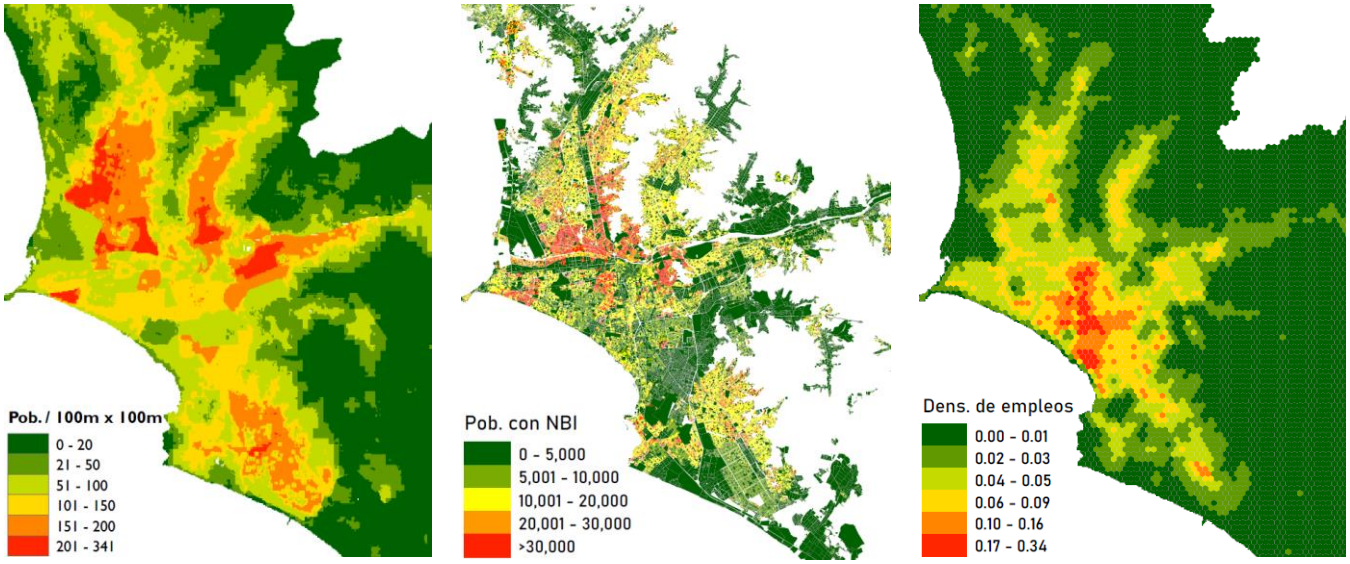
ANNEX 3: Jobs Accessibility Analysis

COUNTRY: Peru
Improving Lima Traffic Management and Supporting Sustainable Transport Project

1. **This assessment estimates changes in job accessibility—by a combination of public transport and NMT—that will result from the interventions in Lima implemented as part of the project.** It describes the methodology and data sources used to calculate job accessibility by public transit and NMT, summarizes the expected changes considered in the accessibility model, and presents the changes that could be expected once the project is fully implemented. Job accessibility for each zone in the area of intervention is defined as the percentage of jobs from the entire region that can be reached from each zone i within a time budget t:

$$Job\ accessibility_{\ i} = {Jobs\ reachable\ from\ zone_i\ within\ t\ minutes}/{Total\ jobs\ in\ the\ region}$$

Figure 3.1. Distribution of Population, Low-Income Population, and Jobs in Lima



a. Population *b. Low-income population* *c. Jobs*

2. **The region considered in the denominator for job accessibility is the province of Lima.** This region was split into a grid of equal-size cells (approximately 100 m x 100 m) to avoid introducing any type of bias in the calculation of accessibility due to the different sizes of census tracts. Job locations were imputed using machine learning methods based on open-source data[62] given that the most recent formal jobs census data for Lima is over a decade old. The source for population data is World Pop (2020), a standard source used in urban accessibility analyses. Given that the accessibility indicator is also derived separately for the low-income population, a separate population layer was needed for this

[62] See the methodology description in Barzin, S., P. Avner, J. Rentschler, and N. O'Clery. 2022. "Where Are All the Jobs?: A Machine Learning Approach for High Resolution Urban Employment Prediction in Developing Countries." *World Bank Policy Research Working Paper*, no. 9979.

purpose; in this case 'low-income' population is defined as households who have at least one unsatisfied basic need according to the analysis by INEI[63] (see figure 3.1).

$$Average\ job\ accessibility = \frac{\sum_{i=1}^{N}(population_i * job\ accessibility_i)}{\sum_{i=1}^{N} population_i}$$

3. **A total of 90 minutes were used as the upper limit for the maximum time that households are willing to spend commuting to work per day (total commute time) or 45 minutes one way**. To get the final, more general measure, a population weighted average of job accessibility was defined. Population-weighted job accessibility for Lima was measured for the baseline and with-project scenarios. In Phase 1 of the MPA, the main interventions defining the 'with-project' scenario for the accessibility analysis are the Component 1 investments in traffic optimization on the nine corridors (expected to improve travel times for public transport).

4. **Both the baseline and the 'with-project' scenarios assume a walking speed of 3.6 km/h and a cycling speed of 16.5 km/h (based on field measurements conducted in January 2023).** The cycling speed is not expected to change as a result of the project, given that the interventions target cycling safety rather than speed. The accessibility analysis assumes a combination of walking, cycling, and public transport for accessing jobs, with a maximum assumed length of walking trip to a transit stop of 20 minutes and a maximum assumed cycling trip to a transit stop of 30 minutes.

5. **The analysis calculates shortest-route travel times between all possible origin-destination pairs of zones and then computes job accessibility for each 100 m x 100 m cell in the region.** The General Transit Feed Specification (GTFS) dataset—in this case including Lima's all current formal and informal public transport routes, up to date as of December 2022—is used as the transport data input, in addition to OpenStreetMap data that define the street network. Formal routes cycling is assumed not to be limited to only the streets that have a cycleway.

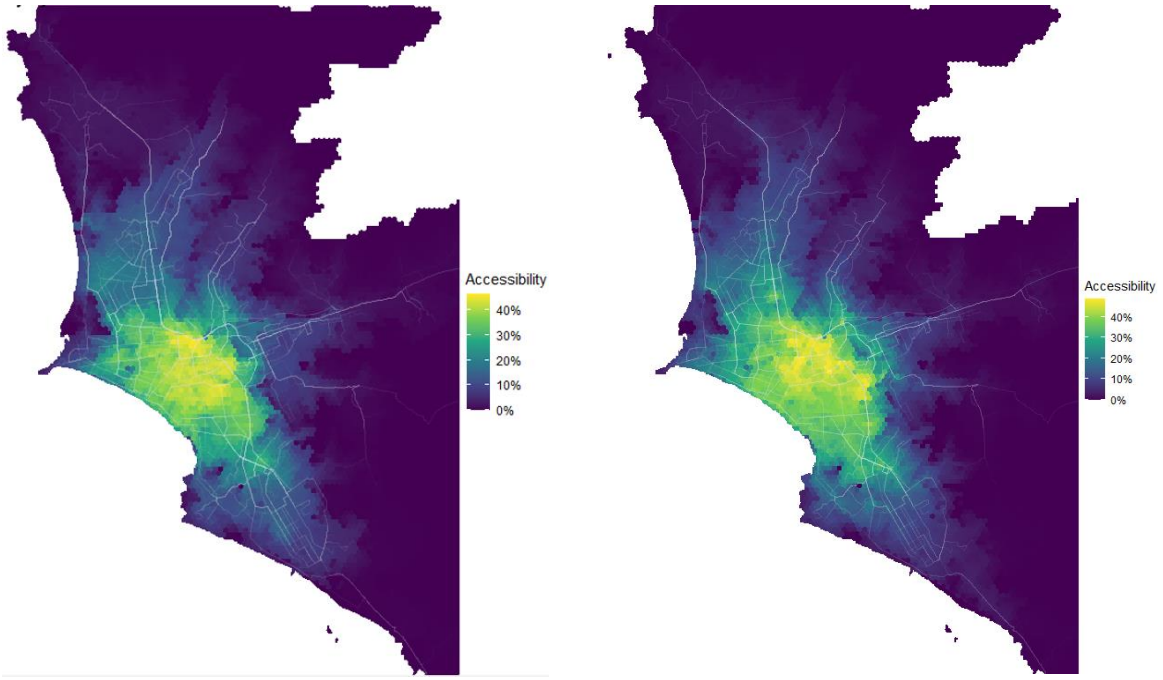
Table 3.1. Jobs in Lima Accessible by Public Transport and NMT in 45 minutes

Population-Weighted Average (percent)				Low-income Population-Weighted Average (percent)			
Baseline	**With-Project**	**Change (pp)**	**Change (%)**	**Baseline**	**With-Project**	**Change (pp)**	**Change (%)**
17.8	19.9	2.1	*11.8*	16.2	19.1	2.9	*17.9*

6. **At baseline, it is estimated that, on average, 17.8 percent of all jobs in Lima are accessible within 45 minutes by public transport and NMT**. As expected, baseline accessibility is highest in central Lima where the road and the public transport networks are the densest. This figure is estimated to increase to 19.9 percent in the 'with-project' scenario, equivalent to 11.9 percent improvement, or about 103,300 additional jobs becoming accessible within the travel time threshold, on average, and with significantly higher gains in individual parts of Lima. The baseline and 'with-project' accessibility for the poor population specifically is estimated at 16.2 percent and 19.1 percent, respectively, equivalent to a 17.9 percent improvement.

[63] INEI. 2017. *Población Censada con al Menos Una Necesidad Básicas Insatisfechas*.

Figure 3.2. Accessibility to Jobs Within 45 Minutes by Public Transport and NMT (% of All Jobs Accessible)



a. Baseline *b. With project*

7. **Separate analysis was conducted to assess the accessibility impacts of constructing 50 km of additional cycleways, planned under Component 4, assuming that a person would only choose to cycle if a dedicated cycleway is present.** This represents a more realistic scenario for women's cycling in particular, given their greater aversion to road safety issues and strong preference for dedicated cycling infrastructure as compared to cycling in mixed traffic. The analysis assumes an average walking speed of 3.6 km/h and a cycling speed of 17 km/h. It also assumes that a person will cycle only if there is a cycleway within 250 m of their home (otherwise this option is considered inconvenient); otherwise, he/she will walk. In the 'with-project' scenario, the currently existing cycleways are combined with the 50 km of cycleways to be financed by the project.

8. **Currently (and in the with-project scenario), the average Lima resident can access 2.11 percent of all jobs within 45 minutes if he/she walks.** The percentage is 5.63 percent (so, more than a doubling in access) if he/she bikes using the available cycleways. In the 'with-project' scenario, the average person would be able to access 6.43 percent of all jobs if he/she cycles, which would be more than three times more jobs accessible than by walking. In some parts of the city, especially where accessibility is very low by walking, the advantage of cycling over walking for providing accessibility to jobs is yet several times higher.

Table 3. 2. Jobs in Lima Accessible by Walking versus Dedicated Cycleways in 45 minutes

Population-weighted average (percent)				
By walking	**By Cycling (baseline)**	**By Cycling (with project)**	**Improvement of Cycling (with project) Over Walking (%)**	**Improvement of Cycling (with project) Over Cycling (baseline) (%)**
2.11	5.63	6.43	*204.7*	*14.2*

ANNEX 4: Economic Analysis

COUNTRY: Peru
Improving Lima Traffic Management and Supporting Sustainable Transport Project

1. **Economic feasibility of the Program was assessed through a socioeconomic CBA.** The analysis for MPA Phase 1 covers Components 1, 2, 3, and 4. The benefits quantified in the CBA include (a) travel time savings due to reduced congestion; (b) road safety benefits as a result of traffic lights optimization, implementation of enforcement cameras, intersection hotspot treatments, and speed limit enforcement; (c) GHG reduction benefits as a result of mode shift to public transport and NMT; (d) public health benefits as a result of mode shift to NMT; and (e) urban quality improvements (ambiance benefits). The CBA considers a 14-year horizon and uses a discount rate of 8 percent.

Travel Time Benefits and Disbenefits

2. **Travel time savings for Component 1 were estimated using microsimulation models for the Inca, El Polo, and Riva Agüero corridors, which were extrapolated to the other six corridors based on a typology of intersections**. The estimated time savings are as follows: 12,086 hours on average daily for cars, 7,908 for buses, 6,587 for minibuses, 207 for interprovincial buses, 628 for rural vans, 1,546 for trucks, 70 for trailers, 8,755 for motorcycles, 869 for mototaxis, and 20 for bicycles. These savings were monetized considering the annual expansion factor, value of time for each vehicle group,[64] and vehicle occupancy factors. In the case of Subcomponent 3.1, it is expected that, due to the new traffic signals for pedestrians and bicyclists, there will be total savings of 319 hours on average daily for bicycles and 5,895 hours daily for pedestrians. These savings were monetized considering the annual expansion factor and the value of time for pedestrians and cyclists. In the case of Subcomponent 3.2 (ZTCs), there will be travel time disbenefits for some of the trips. Within the ZTCs, it was estimated that a speed reduction would affect 9,246 automobile and 1,933 motorcycle trips per day on average, with an average estimated delay of 54 seconds.

Road Safety Benefits

3. **The analysis of the road safety benefits of the planned project interventions is based on geospatial data on traffic crashes in Lima which is available for 2019–2021**. In addition, the analysis uses data on the share of fatalities, injuries, and crashes from Lima's Road Safety Plan (2022); distribution of speeds from Bogota as a proxy for Lima's distribution assuming it has a similar trend as in other cities due to the lack of this data in Lima; and Google API data for estimating speeds. To estimate the road safety benefits of traffic lights, enforcement cameras, intersection improvement, and cycle lanes, crash modification factors (CMFs)[65] available for these safety measures were used. In these cases, the CMFs provide the estimated change in the number of victims or crashes based on the implementation measures. To measure the impact of the change of speed limit, the CMF from Elvik's power model[66] was used. CMFs are applied to the expected and/or estimated crash frequencies without treatment to compute the estimated crash frequencies with treatment.

4. **Impact of traffic lights, enforcement cameras, hotspot treatments, and cycle lanes.** Fatalities included in the analysis were identified inside a 100 m buffer from traffic lights, intersections, and cycle lanes (due to the precision of

[64] Research Center (CIUP)|Universidad del Pacífico, 2012, updated to 2022 values.

[65] Elvik R., T. Vaa, A. Hoye, and M. Sorensen. 2009. *The Handbook of Road Safety Measures: Second Edition.* Emerald Group Publishing.

[66] Elvik R. 2009. *The Power Model of the Relationship between Speed and Road Safety: Update and New Analyses.* (No.1034/2009).

fatality data), and a 250 m buffer for cameras.[67] All fatalities within those buffers were aggregated using an appropriate CMF. For injuries and crashes (property damage only) an estimation was made based on Lima's Road Safety Plan (2022), assuming the injuries/fatalities and crash/fatality rates are constant in the city. Lastly, best estimate and the limits of the 95 percent confidence interval CMFs were used to estimate potential lives saved based on each intervention and each level of severity (fatalities, injuries, and crashes). The safety benefits were assessed for five different intervention types: (a) traffic lights, (b) coordinated green wave, (c) enforcement cameras, (d) intersections - hotspot treatment, and (e) cycle lanes. For intervention area buffers where only one intervention is expected to be implemented without geographic overlap with other interventions, only one CMF was applied to the crashes located within these intervention buffers. The lives saved benefits from these stand-alone interventions are later added to lives saved benefits calculated in other locations where there is geographic overlap between other interventions and multiple CMFs are combined. In cases where there is geographic overlap between multiple interventions and multiple CMFs are combined, the Dominant Common Residuals method was used.

Table 4.1. Fatalities, Injuries, and Crashes Reduced Per Year due to Traffic Lights, Cameras, Hotspot Treatments, and Cycle Lanes

	Lower Limit	Potential Impact	Upper Limit
Potential lives saved	26	**30**	31
Potential injuries reduced	976	**1,118**	1,161
Potential crashes reduced	660	**1,577**	2,249

5. Geocoded fatalities were aggregated into each polygon of analysis that covered the main roads, excluding express roads. Injuries and crashes were also estimated based on data available from the Municipality of Lima. Google API speeds for 3 a.m. was used as a proxy for free flow speeds. The two key assumptions for estimating the impact of speed limits on speeds and on road safety are that (a) Lima has a similar speed distribution of Bogota, meaning the relationship of average speeds and speeding is similar and (b) there will be compliance measures that will bring Lima's new speed limit to no one exceeding the speed limit (upper limit), to 39 percent of vehicles exceeding the speed limit (lower limit) and to 20 percent of people exceeding (middle value).

Table 4.2. Fatalities, Injuries, and Crashes Reduced Per Year as a Result of Speed Limits and Compliance Measures

	Lower Limit (39% speeding)	Potential Impact (20% speeding)	Upper Limit (0% speeding)
Potential lives saved	5	**12**	59
Potential injuries reduced	99	**247**	1,214
Potential crashes reduced	133	**336**	1,669

6. **Total road safety benefits.** Overall, the planned project interventions are expected to result in 42 lives saved per year, in addition to 1,365 less traffic injuries and 1,913 less crashes. Depending on the assumptions used, the range of expected reductions in traffic fatalities is between 31 (lower limit) and 90 (upper limit) (table 4.3). It should be noted that, in the CBA, road safety benefits are assumed to remain constant over the evaluation period rather than grow at the rate of traffic growth.

Table 4.3. Total Potential Fatalities, Injuries, and Crashes Reduced per Year as a Result of the Project

	Lower Limit	Potential Impact	Upper Limit
Potential lives saved	31	**42**	90

[67] Martínez-Ruíz, D. M., et al. 2019. "Impact Evaluation of Camera Enforcement for Traffic Violations in Cali, Colombia, 2008–2014." *Accident Analysis and Prevention*, 125: 267–274.

	Lower Limit	Potential Impact	Upper Limit
Potential injuries reduced	1,075	**1,365**	2,375
Potential crashes reduced	793	**1,913**	3,918

7. **The planned project interventions are predicted to have a similar impact in terms of the share of different modes among the lives saved, predominantly favoring pedestrian and motorcycle safety.** For cyclists, as expected, cycle lanes have the highest share of potential impact, followed by intersections improvements (table 4.4). However, it is important to note that the implementation of the protected cycle lanes is expected to improve the safety of all road users, with motorcycle drivers and pedestrians accounting for the largest share of beneficiaries.

Table 4.4. Share of Different Types of Road Users in the Total Expected Reduction in Fatalities from Project Interventions

	Share of Fatalities (%)				
Road User	**Traffic Lights**	**Enforcement Cameras**	**Intersection Improvements**	**Speed Limit**	**Cycle Lanes**
4-wheeled	6	6	10	14	9
Bus	0	0	2	0	0
Cyclist	3	6	12	5	18
Motorcycle driver	32	31	22	24	36
Pedestrian	58	56	55	57	36

GHG Emissions Analysis

8. **The GHG reductions are expected to result from mode shift from private motorized vehicles to public transport (Component 1) and to NMT (Components 3 and 4).** To estimate the modal shift from Component 1, a modal choice model was used to calculate the probability that a person would choose any transportation alternative based on the characteristics of the trip and the attributes of each mode (travel times, cost, and so on). Given the lack of information on overall demand, a simulation was made for 100 people, assuming a probability distribution for each of the attributes of the alternatives (auto, metropolitan, bicycle, bus, and walking) and an average savings per intersection was assumed,; based on the above, a minimum and maximum share of users that are presently transported in private vehicles and could migrate to public transportation is obtained. With the time savings for public estimated to result from Component 1, it is estimated that 617,128 car users circulating on the network now prefer to use public transport. Therefore, the same number of cars would no longer circulate on the network. Such a reduction in car trips with an average travel distance of 4.5 km and an average speed of 20 km per hour results in a reduction of about 843 tCO_2eq per year or 11,804 tCO_2eq for the 14-year evaluation period.

9. At the same time, the modal shift implies an increase in the demand for public transport to serve the trips that will no longer be made by car. This additional demand is calculated by multiplying the 617,128 cars leaving circulation by the occupancy factor assumed in the study (1.38), resulting in 851,637 new trips by public transport. The report by *Lima Cómo Vamos* indicates that the fleet of public transport buses in the Javier Prado-La Marina corridor is 156 buses, and they served a total of 21.5 million trips during 2021. Thus, on average, each bus served 135,637 trips per year. Based on this, it was estimated that, to serve the 851,637 new public transport trips, 6.4 additional buses are required. The circulation of those 6.4 buses is expanded annually with the expansion factor to total 3,711 bus trips per year, associated with 6.5 tCO_2eq emitted per year. Thus, the overall net emissions associated with Component 1 are estimated at negative 836.5 tCO_2eq per year or negative 11,711 tCO_2eq over the evaluation period.

10. **As a result of the PAITs (Subcomponent 3.1), a modal shift from private cars to non-motorized modes is expected.** Conservatively, the modal shift is estimated only for intersections where new traffic lights for cyclists or new

signalized crosswalks are proposed, since these are the type of interventions that have the greatest impact on pedestrian or cyclist travel time and also on road safety for these modes. To estimate modal shift, a modal choice model was used as in Component 1, which calculates the probability that a person will choose any transport alternative based on the characteristics of the trip and the attributes of each mode (travel times, cost, among others). Since road safety improvements are not directly considered in this model, these are proxied by assigning slightly higher travel time savings for bicycle trips to reflect these improvements. A 1-minute saving for walking trips was assumed as a result of a new traffic signalized crosswalk resulting in a 0.2 percent increase in walking demand, and a 2-minute saving was assumed for cycling trips as a result of new traffic signals for cyclists resulting in a 0.28 percent increase in cycling demand. In total, 321,898 trips annually are estimated to shift from motorized modes to walking and bicycling described above, resulting in a reduction of about 440 tCO_2eq per year, on average, or 6,157 tCO_2eq during the analysis period.

11. **ZTCs to be implemented in Subcomponent 3.2 seek to improve walking and cycling and thus promote a modal shift.** The analysis used international references of similar projects to estimate the impact on traffic levels and modal shift to walking and cycling. To be conservative, the benchmark values were adjusted, assuming a 5 percent increase in vehicular traffic on the boundary roads and a 45 percent decrease on the internal streets, and an increase in pedestrian and cyclist trips of 10 percent and 50 percent, respectively. The interventions in the five ZTCs involve 28,303 automobiles and 6,320 motorcycles ceasing to circulate due to the modal shift, translating into a reduction of 9,576 tCO_2eq during the project analysis period (684 tons per year, on average).

12. **The 50 km of cycle lanes to be implemented under Component 4 will promote a shift to cycling from private motorized modes and public transport.** First, an area that would potentially generate or attract trips that could have a modal shift to cycling (1 km around the future cycling lanes) was defined. With information from the 2017 Census, the resident population between 15 and 59 years were determined as was the share of households in each district that own a private vehicle. This information was key for identifying the target population (668,000) that could switch to cycling. An origin-destination matrix of the trips made in the study area was obtained from Veraset GPS data, weighted by real population data. February 2022 was defined as the modeling period. A previous modal choice model developed for Lima was used; the model was calculated with information from preference surveys (2021) implemented across the Lima Metropolitan Area. For the application of this model, the attributes of the trips in each available transport mode were determined based on various data sources, such as Google API queries of times and distances by car and public transport for each origin-destination pair in the study area and the average cost of public transport obtained from the expanded GTFS dataset recently collected across Lima. Using this information and the distribution of trips in the Lima Centro area from the *Lima Cómo Vamos* 2021 survey, a pseudo-calibration of the modal constants of the modal choice model was performed. The availability of cycle infrastructure is estimated to increase the demand for bicycles in the study area by approximately 72 percent, compared to the base scenario (increasing the modal share of bicycles from 8.2 percent to 14.2 percent), with the greatest demand expected to come from public transport users, followed by car and motorcycle users. As a result of the modal shift, 413,643 motorized vehicles (318,469 cars, 95,166 motorcycles, and 8 buses) would no longer circulate in the year in which Component 4 is implemented, translating into a reduction of 7,172 tCO_2eq during the analysis period (512 tCO_2eq, on average, per year).

13. **Overall, the project is expected to save 34,104 metric tons of CO_2 over the evaluation period or 2,436 $tCO2_{eq}$ per year on average.** The NPV (benefits) of the net decrease in GHG over the evaluation period ranges from US$2.34 million in a low-value scenario for the shadow price of carbon and up to US$4.67 million in a high-value scenario.

Public Health Benefits

14. **Health benefits are expected in the case of Component 3 and Component 4 interventions as a result of increased use of active modes of transport and reduced exposure to traffic emissions.** These health benefits were quantified using

the World Health Organization's Health Economic Assessment Tool. The analysis suggests that 4.8 premature deaths per year would be avoided in the base year as a result of the interventions planned in Subcomponent 3.1, while 12.6 lives in the base year would be saved as a result of Subcomponent 3.2, and 0.9 lives as a result of Component 4.

Urban Quality Improvement Benefits

15. **Proposed intersection interventions of Subcomponent 3.1 will significantly improve conditions for pedestrians and cyclists.** The benefits of these improvements to the urban environment were estimated for pedestrians and cyclists using Transport for London's 'Ambience Benefits Calculator' tool,[68] adjusting the results to Lima based on the average wage and working hours. The same tool and approach were used to quantify the urban quality benefits resulting from the proposed interventions in the ZTCs (Subcomponent 3.2), such as widening of sidewalks, resurfacing, at-grade crossings, incorporation of green elements, and so on. The benefits of these improvements for pedestrians and cyclists were specifically estimated for the 'Miraflores-La Mar' ZTC, for which a detailed design is available,[69] subsequently extrapolating to the other four ZTCs based on their relative population and area.

Summary of Economic Benefits

16. **In the base scenario, the overall project NPV is US$3,669.7 million in constant 2022 prices, with an EIRR of 145.3 percent.** Travel time and road safety benefits represent the vast majority of overall economic benefits.

Table 4.5. Summary of Monetized Project Benefits, by Category, over the 14-year Project Period

Benefit Category	NPV of Benefits (Constant 2022 US$, millions)	Share of all Benefits Over Evaluation Period (%)
Travel time savings	2,583.26	68.1
Road safety benefits	997.45	26.3
Urban quality benefits	103.39	2.7
Public health benefits	104.69	2.8
GHG mitigation benefits (middle shadow price of carbon)	3.50	0.1
Total benefits	**3,792.3**	**100.0**

Table 4.6. Key Indicators of the Economic Analysis, Including Sensitivity Analysis, over the 14-year Project Period

Scenario	NPV (Constant 2022 US$, millions)[70]	EIRR (%)
Base scenario (8% discount rate)	3,669.7	145.3
12% discount rate	2,744.8	145.3
20% increase in CAPEX and OPEX	3,642.6	131.7
50% lower travel time savings	2,377.3	121.9
50% lower road safety benefits	3,171.0	131.0
20% increase in CAPEX and OPEX + 50% lower travel time savings and road safety benefits	1,851.5	93.2

[68] F5807: Ambience Benefits Calculator v3.01 - Issued August 2022, Transport for London.
[69] Plan Urbano Distrital de Miraflores.
[70] Using the 2022 Sol to USD exchange rate of 3.857.

ANNEX 5: Congestion Analysis

COUNTRY: Peru
Improving Lima Traffic Management and Supporting Sustainable Transport Project

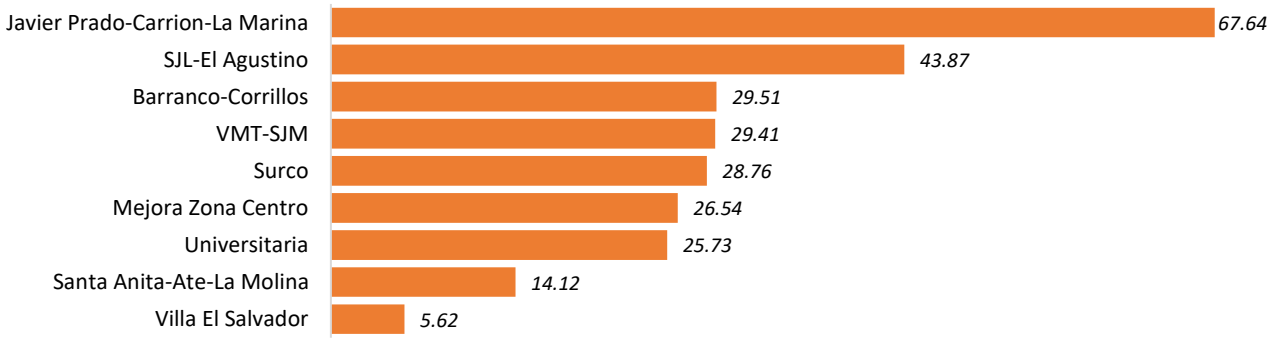
1. **In 2021, according to the TomTom Traffic Index, Lima ranked as Latin America's second most congested city (and the world's 19th most congested)**. On average, travel times were 42 percent longer than during the baseline non-congested conditions. To monitor the impact of the project over time on congestion at the corridor level, the World Bank leveraged high-frequency, high-spatial-resolution congestion data from Waze for Cities, available through the Development Data Partnership.

2. **Waze data, generated through an app on smartphones on an opt-in basis, is generally considered to be robust because it is generated by many users, and it captures a wide range of real-time traffic data**. The representativeness of Waze data depends on the number of users, but comparisons with official datasets suggest that it captures a significant share of traffic participants, at least in large cities (approximately one-third of the 'real' flows).

3. **The analysis focused on the nine corridors to be intervened under Component 1 of the project, given that the optimized traffic lights system is expected to significantly improve traffic fluidity.** Congestion was analyzed based on the congestion severity classification used by Waze, on a scale from 1 (uncongested) to 5 (complete gridlock). Thus, 1 km of level 1 congestion would be considered to add 1 km to total congestion, while 1 km of level 2 congestion would add 2 km to the total, and so on. To calculate the average level of congestion at the corridor level, the sum of the congestion length was normalized by the corridor area. Thus, the 'average congestion' indicators across the corridors (and graphs in figure 5.2) are directly comparable since the scale and unit of measurement are the same. It is evident that the most congested corridor is Javier Prado-Carrion-La Marina, followed by SJL-El Agustino, while Villa El Salvador is the least congested.

4. **The calculation of the 'average congestion' at the corridor level for the project excludes both very light congestion and extreme congestion which is equivalent to road closures due to construction work or government orders.** Thus, only congested sections with level 3 and level 4 are retained. As shown in figure 5.1, average congestion in September 2022 (project baseline) was by far the highest on the Javier Prado-Carrion-La Marina corridor, reaching 67,600 km per km^2 of area, while Villa El Salvador was by far the least congested of the nine corridors. Congestion on five of the nine corridors was very similar.

Figure 5.1. Average Congestion of Levels 3–4 as Defined by Waze in September 2022, by Corridor (thousands of kmper km^2)



ANNEX 6: Project Climate Co-Benefits

COUNTRY: Peru
Improving Lima Traffic Management and Supporting Sustainable Transport Project

Table 6.1. Overview of the Climate Co-benefits Expected from the Project Interventions

Component	Cost (US$, millions)	Contribution to Mitigation		Contribution to Adaptation
		Eligible Activity	Details on Mitigation Impacts	
Component 1: Traffic lights system	**93.0**	8.1: Transport demand management policy or associated intelligent transport systems (ITS)	60% of C1.1 will finance NMT specific traffic lights (direct and indirect installations) and another 20% for public transport priority traffic lights (direct and indirect installations). Based on a mode choice model, with the time savings for public expected to result from the traffic lights system, over 617,000 car users would shift to public transport. The interventions are estimated to save 11,711 tCO_2eq over the evaluation period. The upgrade of the TCC (C1.2) will meet best practice energy-efficiency standards (in line with EDGE-level certification to ensure a reduction of energy use of at least 20%).	The improved traffic conditions and traffic management in Lima will help improve disaster and emergency response by helping direct traffic and evacuation efforts (for example, during natural disasters) and thus contribute to climate adaptation.[71]
Centralized traffic lights network	85.6			
Traffic Control Center	7.4			
Component 2: Automated traffic violation detection system	**7.2**	8.1: Transport demand management policy or associated intelligent transport systems (ITS)	The improved traffic rule enforcement is expected to lead to increased safety for all traffic users, including cyclists and pedestrians. Some modal shift toward these low-carbon modes is therefore expected as a result of these interventions. Energy-efficient equipment and technologies will be used throughout the Traffic Violation Detection and Control Center (C2.2), with an expected EDGE certification.	

[71] During project preparation, the World Bank financed a consultancy to analyze global best practices (from Japan and Chile) in leveraging traffic lights systems for disaster risk response, and how these could be adapted by ProTransito.

Component	Cost (US$, millions)	Contribution to Mitigation		Contribution to Adaptation
		Eligible Activity	Details on Mitigation Impacts	
Component 3: Safe intersections and neighborhoods	**44.3**	8.2: Non-motorized transport (NMT) or electric personal mobility	The measures focus on improving the safety and infrastructure for NMT, through heavy, medium, and light intervention 'packages', thus promoting mode shift from private motorized modes.	
3.1. Immediate Traffic Actions Plan	21.3		According to a mode choice model, nearly 322,000 trips annually are estimated to shift from motorized modes to walking and cycling, resulting in a reduction of about 6,157 tCO_2eq during the analysis period.	The engineering designs of the PAIT intersections will include climate resilience considerations in terms of the materials used and the implementation of nature-based solutions to cope with higher volumes of stormwater runoff.
3.2. Traffic Calming Zones (Supermanzanas)	23.0		Based on international references of similar projects, the measures will result in a 5% increase in vehicular traffic on the boundary roads and a 45% decrease on the internal streets, and an increase in pedestrian and cyclist trips of 10% and 50%, respectively. The interventions in the 5 ZTCs will lead to ~28,300 automobiles and 6,320 motorcycles ceasing to circulate due to the modal shift, translating into a reduction of 9,576 tCO_2eq during the project analysis period.	The design of the ZTCs will include measures to ensure resilience to climate change impacts, such as through permeable surfaces and green infrastructure to reduce the impact of extreme precipitation and flooding associated with the El Niño phenomenon.

Component	Cost (US$, millions)	Contribution to Mitigation		Contribution to Adaptation
		Eligible Activity	Details on Mitigation Impacts	
Component 4: *Cycle-infrastructure and complete streets*	**19.5**	8.2: Non-motorized transport (NMT) or electric personal mobility	Based on a mode choice model, the increased availability of cycle infrastructure is estimated to increase the demand for cycling in the study area and increase the modal share of bicycles from 8.2% to 14.2%. As a result of the modal shift, 413,643 motorized vehicles (318,469 cars, 95,166 motorcycles, and 8 buses) would no longer circulate in the year in which Component 4 is implemented, translating into a reduction of 6,660 tCO_{2eq} during the analysis period.	The engineering design of the cycleways will include climate resilience considerations in terms of the materials used and the implementation of nature-based solutions to cope with higher volumes of stormwater runoff. The maintenance plans for the cycleway network will consider the additional stress on the infrastructure associated with climate hazards.
Component 5: Project management and capacity building	**16.8**			Protocols and capacity building will be developed for PROTRANSITO to leverage the traffic management solutions implemented under C1 for improved disaster risk response.