

TECHNICAL STRUCTURING OF SECTION 1 OF THE FIRST METRO LINE OF BOGOTA



TECHNICAL STRUCTURING OF SECTION 1 OF THE FIRST METRO LINE OF BOGOTA (PLMB)

EXECUTIVE SUMMARY
Environmental and Social Impact Study

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MARCH, 2018

CONSORCIO METRO BOG

SYSTRA



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ACRONYMS

DAI: Direct Area of Influence

IAI: Indirect Area of Influence

IDB: Inter-American Development Bank

WB: World Bank

BRT: Bus Rapid Transit

CAR: Corporación Autónoma Regional de Cundinamarca (Autonomous Regional Corporation of Cundinamarca)

CONPES: Concejo Nacional de Política Económica y Social (National Advisory on Politics, Economics, and Social Issues)

DBOMT: Design, Build, Operate, Maintain and Transfer

EAB: Empresa de Acueducto de Bogotá (Bogota Water and Sewage Company)

CIAM: Cumulative Impact Assessment and Management

ESIS: Environmental and Social Impact Study

EMB: Empresa Metro de Bogotá S.A. (Bogota Metro Company)

EEP: Estructura Ecológica Principal (Main Ecological Structure)

ICANH: Instituto Colombiano de Antropología e Historia (Colombian Institute of Anthropology and History)

IDEAM: Instituto de Hidrología, Meteorología y Estudios Ambientales (Institute of Hydrology, Meteorology and Environmental Studies)

IDU: Instituto de Desarrollo Urbano (Urban Development Institute)

JBB: Jardín Botánico de Bogotá (Bogota Botanical Garden)

MADS: Ministerio de Ambiente y Desarrollo Sostenible (Ministry of the Environment and Sustainable Development)

OEP: Ocupantes del Espacio Público (Occupants of Public Space)

PLMB: Primera Línea del Metro de Bogotá (First Metro Line of Bogota)

ESMP: Environmental and Social Management Plan

TMP: Traffic Management Plan

POT: Plan de Ordenamiento Territorial (Land Use Planning)

CDW: Construction and Demolition Waste

SDA: Secretaría Distrital de Ambiente (District Secretary of the Environment)

SDM: Secretaría Distrital de Movilidad (District Secretary of Mobility)

IMTS: Integrated Mass Transit System

SITP: Sistema Integrado de Transporte Público de Bogotá (Integrated Public Transport System of Bogotá)

TAR: Traslado anticipado de redes (Advance Utility Diversion)

UE: Unidad Económica (Economic Unit)

UR: Unidad Rentista (Rental Unit)

USE: Unidad Social Económica (Social and Economic Unit)

USH: Unidad Sociales Hogar (Social Housing Unit)

USSE: Unit Social Socioeconómica (Social Socioeconomic Unit)

ZMPA: Zona de Manejo y Protección Ambiental (Environmental Management and Protection Zone)

1 EXECUTIVE SUMMARY

1.1 INTRODUCTION

The Environmental and Social Impact Study (ESIS) is an environmental management tool that allows evaluating the possible negative and positive effects of a project on the environment. This document contains the general description of the project's environmental component (physical, biotic and socioeconomic media). It is important to indicate that this ESIS has been prepared based on the information from the feasibility study and that, for the next phase of the project, which includes making the detailed design, the contractor must carry out the respective adjustments to said study.

Likewise, the ESIS takes into account the national regulatory framework that is applicable to the project, as well as the Equator Principles and the environmental and social performance standards set by the World Bank and the IDB, as a reference for multilateral banking safeguards.

The Technical Structuring Project of section 1 of the First Metro Line of Bogota is located in the city of Bogotá D.C., beginning in the Bosa District and ending in the Chapinero District. The First Metro Line of Bogota will be approximately 24 kilometers long and completely elevated. A travel time of 27 minutes is estimated between the Portal Américas station and the Calle 72 station. Preliminary works associated to Advance Utility Diversion and Property Management will take place during 2018 and 2019. The construction works begin in 2020 and operations are predicted to begin in 2024. The location of the Yard and Shop is the El Corzo property in Bogota D.C., which will continue, becoming the elevated section or railway viaduct called Technical Connection Branch between the Yard and Shop and the Portal de Las Américas station. The section will run from the Portal de las Américas to the Avenida Caracas, along the length of Avenida Villavicencio, Avenida Primera de May, and Calle 1, where it will turn towards the north until Calle 72, with a section for turnaround maneuvers at Calle 76. Furthermore, there has been foresight to allow continuing the line at the Héroes monument for future lines.

The project that is the subject of study provides for building sixteen (16) stations, including the adjustments to where it will share user transfer with current Transmilenio stations. The location of the First Metro Line of Bogota (PLMB in Spanish) project is presented in the following figures.

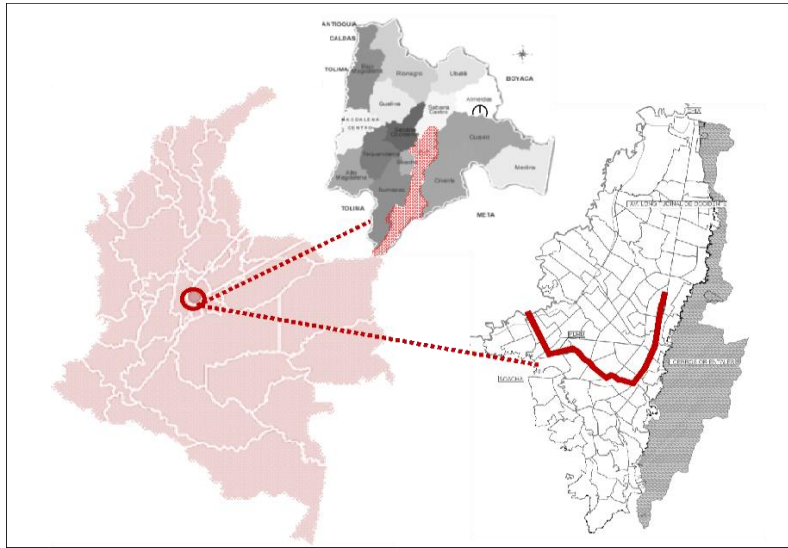


Figure 1.1.1 General Location (Colombia-Cundinamarca-Bogotá DC)

Source: Made by Empresa Metro de Bogotá - EMB

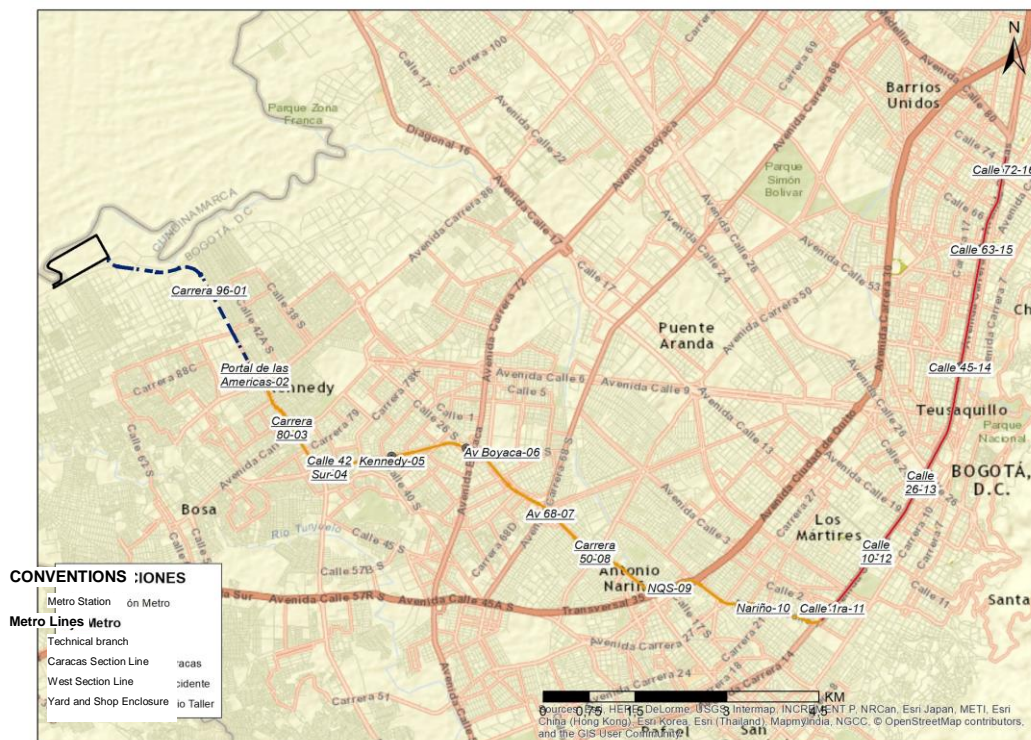


Figure 1.1.2 General outline of the PLMB section

Source: Made by Empresa Metro de Bogotá - EMB

Since the technical studies were prepared by the same consortium preparing the environmental and social studies, an independent review of this study has been commissioned in order to comply with the Banks' Operational Policies, including the adjustments and measures needed to comply with specific requirements of the policies.

1.2 GENERAL OBJECTIVE

To determine the current state of the natural resources, the environment, and the socioeconomic aspects of the project's area of influence for the preconstruction, construction, and operation stages of the First Metro Line of Bogota D.C., in order to identify, define and evaluate the impacts generated by the project to prevent, mitigate, correct or compensate for the effects caused by its advancement, guaranteeing appropriate environmental and social management in the framework of the guidelines established by national regulations and the guidelines of multilateral banking (World Bank, IDB, CAF, Equator Principles and IFC safeguards on the project).

1.2.1 Specific Objectives

- To perform the physical and biotic classification where the project is going to be carried out, identifying the direct and indirect areas of influence.
- To perform the socioeconomic classification of the community located in the project's Direct Area of Influence (DAI), from the different aspects (demographic, spatial, economic, cultural and organizational policy).
- To identify and evaluate the social and environmental impacts the project may generate.
- To classify the natural resources the project will require, which will be harnessed or affected during the PLMB's construction and operation stages.
- To establish the information about the Environmental and Social Management Plan, including programs, indicators, a schedule, and a budget of which the contractor will be in charge and that establishes the measures for preventing, mitigating, correcting, and compensating for the project's impacts during the construction and operation stages, taking into account the different Multilateral Banking Safeguards (WB, IDB, CAF).
- To design an environmental monitoring and follow-up program to verify, monitor and evaluate the activities, allowing an evaluation of the efficacy of the Environmental and Social Management Plan.
- To develop an Occupational Health and Safety Management System (OHS-MS) in the project's construction and operation stages.
- To design an activities schedule for the Environmental and Social Management Plan, the Follow-up Plan and the Monitoring Plan.

1.3 PROJECT INFORMATION

1.3.1 Background

The first feasibility study and design of the mass public transit system, the metro, was carried out by INECO SOFRETU CONSULTORIAS Y SISTEMAS in 1981, in which time a 21.2 kilometer priority line with 23 stations was determined. 35% of the line's layout was on the surface and the rest underground.

In 1996, with financing from the Japan International Cooperation Agency (JICA) for developing Bogota D.C.'s Master Plan for Urban Transportation, the implementation of an integrated mass transit system was recommended to improve transportation conditions in the city.

That same year, the Nation and the District agreed to develop a conceptual study of the Integrated Mass Transit System of the Bogota Savannah with urban, architectural, environmental, technical, and economic dimensioning, among others, in the corridor considered to be optimum for implementing it. This study was developed by the companies INGETEC – BECHETEL – SYSTRA, which presented the pre-designs and the economic, environmental, urban, and financial evaluation of the first metro line. The revision of the request for Bogota D.C.'s integrated public and collective transit system, the Environmental Impact Study and the technical, legal and financial structuring from an urban and architectural point of view can be found within the contracted studies.

Towards the end of the 90s, the district's administration suspended the project's execution, re-directing the existing resources towards the Integrated Mass Transit System (IMTS) to putting in place the flexible component, (Transmilenio System – BRT). This change was approved by the City Council in Agreement No 42 of 1999.

By means of Decree 319 of 2006, the requirement is established for Bogota District Capital to make a *"Mobility Master Plan aimed at attaining integrated, efficient, competitive and environmentally sustainable regional urban transportation that operates on a hierarchical network and aimed at regulating traffic based on the modes of transportation that use it, including the regulation of parking spaces, in order to fix the current mobility issues."*

In 2008, it was decided to begin the construction of the first metro line once again, based on the city's Zoning Model, the Mobility Master Plan, and Decree No 319 of 2006.

By request of the district government, the World Bank and the Inter-American Development Bank supported the financing and defining of the terms of reference for the conceptual design study. Additionally, they participated in the advanced basic design study of the First Metro Line of Bogota D.C. This loan was approved by CONPES 3524 of June 11, 2008.

On November 14, 2008, the contract was signed between the District Secretary of Mobility and the JOINT VENTURE, GRUPO CONSULTOR PRIMERA LÍNEA DEL METRO (UT GC PLM), composed of SENER, INGENIERÍA Y SISTEMAS S.A. (LEADING BUSINESS), ALG ADVANCED LOGISTIC GROUP S.A., TMB TRANSPORTE METROPOLITANO DE BARCELONA, INCOPLAN S.A. COLOMBIA, SANTANDER INVESTMENT VALORES COLOMBIA S.A COMISIONISTA DE BOLSA, and J&A GARRIGUES S.L.P. The conceptual design of the Metro mass transit network was set forth in said contract, as well as the operational financial design and the legal dimensioning of the First Metro Line within the frame of the Integrated Public Transport System (SITP in Spanish) of the city of Bogota, in which, by means of an analysis of multi-criteria alternatives, among others, it evaluated the different connection possibilities for the transportation network, taking into account the current scenario without the project in case the Metro is not built in the city.

Decree 309 of 2009, adopts the Integrated Public Transport System for Bogota, regulating SITP operations, the corporate framework, democratization and provision of the service, the integrated system for collecting, control and information, customer service, graduality, and tariffs, among others.

In 2009, the previously mentioned conceptual design of the Metro of Bogota was begun, advancing Stage 1 (diagnosis baseline and scenario definition), Stage 2 (evaluation of alternatives and priority implementation), Stage 3 (operational design of the First Metro Line) and Stage 4 (technical notes and impact, risks, and benefits analysis).

By means of the CONPES 3677 document of 2010, the PLMB is defined within the Integrated Mobility Program for the Region, Bogota capital city. It also defines the rules and the Nation's economic commitment through the National Government for financing the Integrated Mobility Program.

On May 11, 2011, by means of a statement, Mr. David Sislen, Sectorial Manager of the World Bank's Sustainable Development Department, made known the follow-up carried out on the previous conceptual study on the part of the multilateral organization. Expressed in this way, it established what the First Line should be, complying with the terms of reference, confirming the World Bank's approval of the studies carried out by the JOINT VENTURE, GRUPO CONSULTOR PRIMERA LÍNEA DE METRO (UT GC PLM).

Subsequently, the Economic, Social, Environmental and Public Works Development Plan, 2012 - 2016 period, includes the construction of the railway network and its integration in the public transportation system as a priority project and central structuring component.

By means of contract No IDU 849 of May 9, 2013, signed with the L1 CONSORTIUM composed of EUROESTUDIOS SL, IDOM INGENIERÍA Y CONSULTORÍA S.A and CANO JIMENEZ ESTUDIOS S.A, the design of the First Metro Line was hired in the frame of the Integrated Public Transport System – SITP – for Bogota D.C. This design modifies the lay out between Avenida 68 and San Victorino by means of a study of alternatives that identified a lay out option on Calle 8 and Calle 1. Additionally, it defines the subterranean typology for its entire length.

The technical, legal, administrative and financial supervision is carried out as a result of contract No 1472 of November 18, 2013 between the IDU and the INTEGRAL AYESA CONSORTIUM, composed of AYESA INGENIERÍA Y ARQUITECTURA S.A.U SUCURSAL COLOMBIA and INTEGRAL S.A. On December 17, 2013, the project was announced in Decree 577 of 2013, through which "*Decree 398 of 2009 is modified to specify and adopt the general lay out of the Project of the First Metro Line of Bogota – PLMB – within the framework of the Integrated Public Transport System – SITP of Bogota D.C.*"

On December 30, 2013, IDU and IV INGENIEROS CONSULTORES SUCURSAL COLOMBIA, signed contract No. IDU-2226 of 2013, in order to carry out the consultation of the Environmental Impact Study for the construction and operation of the First Metro Line, the stations and the yard and shops within the framework of the Bogota D.C.'s SITP. Additionally, the IDU signed Interagency Agreement No. 1880 of December 26, 2014 with Financiera de Desarrollo Nacional S.A, for the structuring of the two (2) phases following the initial stage ("Design of the Transaction" and "Integral Structuring").

By means of Interagency Agreement No. 1917 of 2014, the IDU, the Universidad Nacional de Colombia and the Universidad de los Andes (Association Agreement No. 1917 of 2014) brought together technical, human, administrative and financial efforts to generate inputs for the construction of the First Metro Line of Bogota D.C., PLMB, within the framework of the Integrated Public Transport System – SITP.

On October 7, 2014, by means of Decree 425 of 2014, "*District Decree 577 of 2013 is added in order to announce the implementation of the Technical Connection Branch for the First Metro Line of Bogota D.C. project*" within the framework of the Integrated Public Transport System (SITP) of Bogota D.C.

In 2015, the Nation and the District agreed to advance a Value Engineering study in order to find cost savings and try to recover the project's financial viability.

In 2016, the Company, SYSTRA, carried out a comparative study of alternatives¹ to optimize the lay out. As a result of this study, the lay out of the PLMB was modified in the north section, and its typology changed from being subterranean to elevated.

In the CONPES 3882 document of 2017, the national government's support for optimizing the project and adjusting it to the available budget was declared.

By means of contract 02 of 2017, FIRST METRO LINE OF BOGOTA (Interagency Agreement No 1880 of 2014) celebrated between Financiera de Desarrollo Nacional S.A and the METRO BOG Consortium, integrated by the Colombian Company INGENIEROS CONSULTORES CIVILES Y ELECTRICOS S.A., INGETEC S.A and the French Company SYSTRA, aiming to generate the structure, the technical structuring of Section 1 of the First Metro Line of Bogota was carried out.

The CONPES 3900 document of 2017 declares the national government's support for the public transportation system of Bogota, as well as the strategic importance of the First Metro Line of Bogota – Section 1.

Finally, the Nation – District Agreement was signed on November 9, 2017, in which the financing amounts provided by each of the parties for the construction and operation of the First Metro Line of Bogota were agreed upon.

1.3.2 Justification

Within the context of the project, the country strategy projected by the government is associated to Strategic Competitiveness and Infrastructure, which are necessary to encourage the economic growth and human development that come about as a result of great integration and connectivity between the territories and the Nation. Although in recent years the country has made considerable progress on the matter, there is still a significant amount of infrastructure that is obsolete and without maintenance, for which reason the country has fallen behind in comparison to the continent.

As a solution, the national government will make an enormous effort in infrastructure in the next years, continuing with the ambitious transportation infrastructure program of fourth generation (4G) concessions.

Within the national urban mass transportation follow-up Policy, the National Government defined three important aspects by means of CONPES 3368 document of 2005: (i) it defined a fiscal framework for programming the Nation's contributions to co-financing the IMTS; (ii) it defined the Nation's delegates in the managing organizations' boards of directors and established the Ministry of Transportation's responsibility in following up the IMTSs; and (iii) it defined the eligibility criteria for the components of the system that are liable to co-financing from the Nation and established that the additional and derived costs of litigation in developing works and implementing projects will have to be assumed by regional institutions, not the Nation.

Complementarily and for the first time, the National government, by means of article 31 of Law 1753 of 2015, established the possibility for regional institutions and the National Government to make investments in physical infrastructure and acquisition of rolling stock for interurban metro or railway passenger transportation, as well as suburban train systems, during the pre-operative stage.

¹ In Document PLMB-SYS-DOC-TOD-0300-0C-V5 it is concluded that the elevated option presents the best results in terms of risk and appeal of the PLMB. Additionally, from a costs, time, and construction risks point of view, it is a better alternative than the subterranean design.

In Bogota's particular case, the CONPES 3882 document, Support from the National Government for the mobility policy of the region of Bogota, capital city, Cundinamarca, was approved on January of 2017, as well as the declaration of strategic importance of Phases II and III of the Soacha Integrated Mass Transit System. This document had the objectives to specify the mechanisms and requirements necessary to materialize the National Government's support for strategic projects that contribute to improving the mobility in the region around the capital and, in addition, to identify the projects susceptible to co-financing by the Nation: (i) the First Metro Line of Bogota (PLMB); (ii) the West Regiotram, and (iii) the TransMilenio until Soacha, in phases II and III, which was declared to be of strategic importance.

In this line, the CONPES 3900 document of 2017 – Support from the National Government for the Public Transportation System of Bogota and the declaration of strategic importance of the First Metro Line – Section 1, had the objective to declare the strategic importance of the Section 1 project of the First Metro Line of Bogota (PLMB), and the support for the SITP with the trunk and complementary routes, which was indicated to be susceptible to co-financing by the Nation in the CONPES 3882 document of 2017 and ratified in the CONPES 3899 document of 2017. With the need to complement this strategy and configure an integrated unique network of public transportation, the CONPES 3882 document declared the strategic importance of extending the TransMilenio to Soacha Phase II and III. Additionally, it identified two projects that should technically strengthen their studies to comply with the objective of the ten requirements that were proposed to access co-financing by the Nation.

The CONPES 3899 document updated and ratified the support for continuing the implementation of mobility solutions for the region around the Capital. With that in mind, the National Government recognized the evolution in advancing the structuring of projects prioritized by the region around the capital, Bogota, Cundinamarca, as a strategic complement to the current integrated network of public transportation.

The growth of the population and people's need to commute require constant innovation for generating mobility solutions that facilitate an efficient mode of transportation. The city of Bogota's mobility conditions are characterized by a public offering in transportation that is insufficient for responding to its citizen's commuting needs. In that sense, in order to contribute to improving the conditions of the public transportation of passengers, the implementation of the Environmental and Social Impact Study (ESIA) for the construction and operation of the First Metro Line of Bogota (PLMB), its stations, Yard and Shops, and other related infrastructure for the city of Bogota D.C., was established within the framework of contract No 002 of 2017 celebrated between the National Development Financing Agency (FDN in Spanish) and the MetroBog Consortium.

1.3.3 Characteristics of the Project

1.3.3.1 Description of the Works

The main works of the project, because of their complexity and demand for resources, are divided in two groups for the rail system: main designs, viaduct and stations, railway systems, rolling stock, and tests. The following activities are a priority for the complementary works: designs, construction and adaptation of the Yard and shop, Av. 68 bridge, BRT reconfiguration, road infrastructure, public space, and urban planning reconfiguration. The other works of a smaller magnitude, such as station entrances and central control stations, may be carried out during the terms of the main works.

The total duration of the project, including detail engineering, is five calendar years from the commencement of the project. Six sections of simultaneous work have been proposed for the construction of the viaduct, each approximately four kilometers long with an independent launching crane. The works are organized the following way: first, the preliminary activities that include activities

carried out by third parties, detailed plans, acquisitions, adaptation of the Yard and Shop, advance utility diversion and the adaptation of the precast yard. Second, the works by section, which include: foundations, stacks, panel assembly, stations, access modules between others, and, finally, the tests for commissioning.

The following figure presents the lay out of the PLMB.

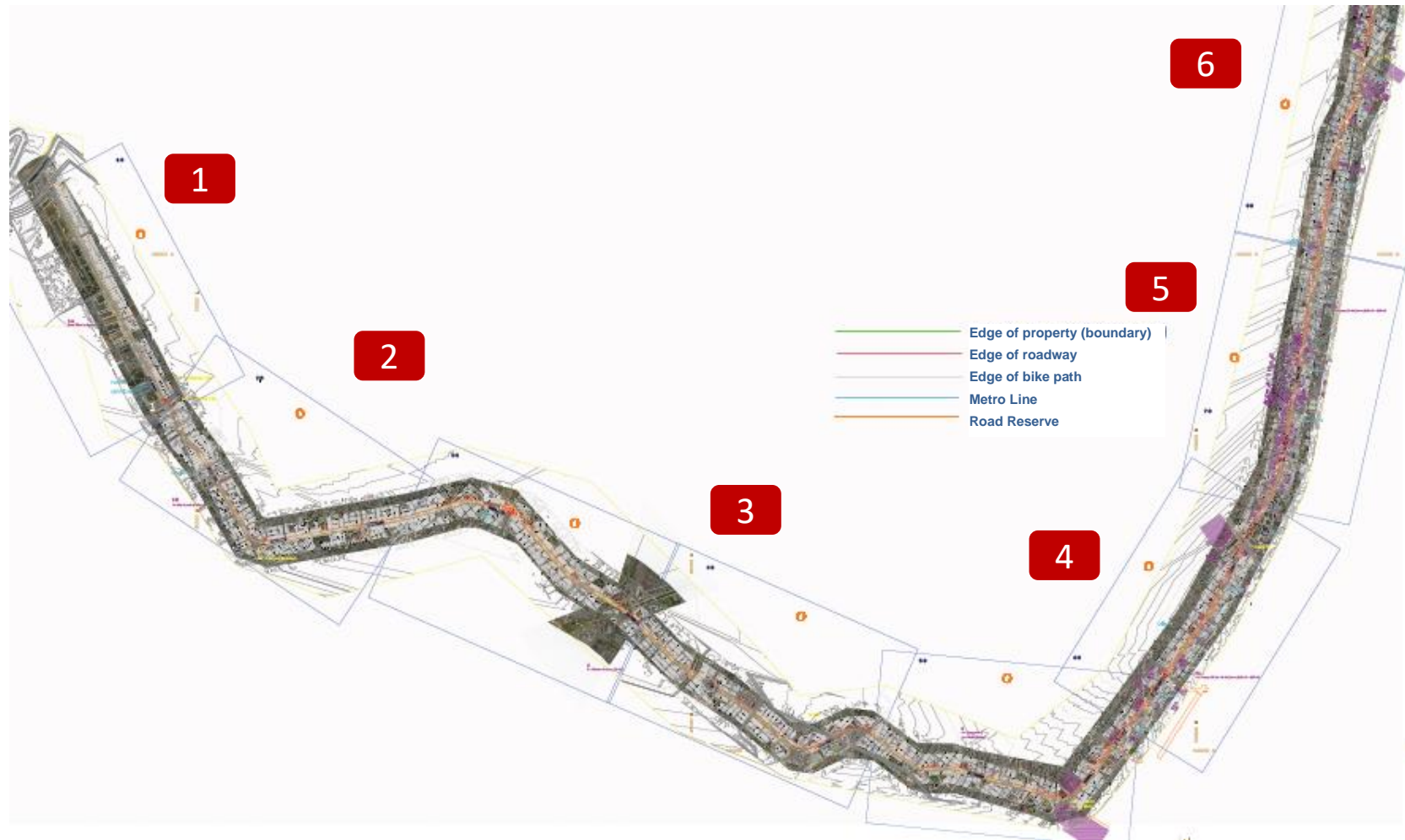


Figure 1.3.1 General outline of the PLMB section

Source: Made by Empresa Metro de Bogotá - EMB

1.3.3.2 Operation Stage

The main actions of the operation stage consist of satisfactorily complying with the following objectives: efficiently adapt the transportation demand in the trains and stations; guarantee passenger and personnel safety at all times, as well as that of equipment and infrastructure; provide a high quality of services to satisfy passengers and to be able to compete with private vehicles: cleanliness, quickness, comfort, consistency, availability, and continuity of the public transportation; integrate the new line in the existing transportation network. To do so, the different services that compose the Integrated Public Transport System of Bogotá (SITP) must be taken into account, particularly the BRT TransMilenio system, the main mode of mass transportation in the Colombian capital; and minimize costs to users.

1.3.3.3 Project Financing

The First Metro Line of Bogotá, PLMB, will be developed through a DBOMT (Design, Build, Operate, Maintain and Transfer) contract, but under a mixed financing method. The company Metro de Bogotá, EMB, will negotiate a financing package to pay the contractor of the DBOMT contract a part of the investments made within the construction stage. On its part, the DBOMT Contractor will carry out capital contributions and will obtain financing resources to finish the investments and purchase the equipment and systems.

Since the PLMB is framed within Bogotá's co-financeable, Nation-District mass transportation projects, 70% of the resources necessary for its execution correspond to contributions from the nation as ordinary forecast budgets between the years 2020 and 2048, and 30% to resources from the District Capital as ordinary forecast budgets between the 2018 to 2041 period.

The execution of all the investments not directly established by the EMB will be the DBOMT contractor's responsibility. The DBOMT contractor's income will be divided in two stages: Construction stage and operation and maintenance stage.

1.3.3.4 Estimated Cost of the Project

The CAPEX structure has been divided in four large sections: civil works, rail systems, rolling stock and other costs (property acquisition, advance utility diversion – TAR in Spanish, PMO Management and supervision). In turn, these sections have been subdivided into other related elements, mainly depending on the type of works involved in each section.

The total CAPEX of the project amounts to 12.5 trillion COP, costs that include reconfiguring the BRT and mixed lanes along the length of the metro line corridor, recovery of public space, metro stations, viaduct, rail systems, rolling stock, property acquisition, and advance transfer of networks (TAR).

The costs are distributed as follows: 53% in civil works, 17% in property acquisition and TAR, 16% in rail systems, 11% in rolling stock and 3% that correspond to other costs (PMO and supervision).

1.4 ALTERNATIVES ANALYSIS

In 2016, for defining the PLMB, Empresa Metro carried out a “Comparative alternative study of executing the first metro line for the city of Bogota (PLMB) by sections and typologies, identifying and quantifying savings that optimize the benefit,” prepared by the company, SYSTRA. Based on an initial project, the study compared different possible lay out and elevated or subterranean construction alternatives in order to identify a project option that brings together the best valuations as per transportation, financial, environmental, and other variables.

The definition of the first metro line for the city is a topic that has been discussed for decades, involving various conceptual and definition studies. The base option of the alternative study had been developed in the Advanced Basic Engineering study for the PLMB, which finished in August of 2015, leading to the design of the First Metro Line of Bogota with a completely subterranean infrastructure. This had to be revised due to its high costs, which were increased by the devaluation of the local currency and because of its construction risks.

The Environmental and Social Impact Study (ESIS) carried out for the PLMB contains a summary of the alternative study carried out by the Company SYSTRA that the District Capital took into account to be able to define the current project. All of the analyzed alternatives has a very similar lay out to the first one, located between the Portal Américas station and the area of Calle 127, with the exception of some specific local variations. The differences of the alternatives were mostly based on the chosen construction process and in the sections identified for each type of construction process. The construction processes may be the elevated kind (viaduct) or the subterranean kind (in tunnels with Tunnel Boring Machines – TBM – or trenches between panels).

The evaluation of the seven alternatives included criteria such as environmental impact, the construction process, the urban landscape component, user experience, social benefits, financial aspects, and risks. Water sources, land, the landscape, noise, and vibrations were taken into account in the environmental impact component.

The evaluation of alternatives concludes that the viaduct alternative is most appropriate because it provides the greatest benefits per perceived demand and improvements to the current network, ease of expansion of the line and greatest construction efficiency, all with less construction risks. When it comes to environmental impacts, the chosen alternative presented an intermediate qualification, with a decrease in impacts from interference with bodies of water and debris generation, but with an increase in urban impact and noise, which can be mitigated. Their level is not considered large-scale or significant. The impacts identified in the chosen alternative can be controlled by means of management measures, which have been considered in the Environmental and Social Management Plan (ESMP) and the ESIS.

1.5 PERMITS REQUIRED FOR THE DIFFERENT STAGES OF THE PROJECT

The following is a list of the required permits, authorizations and requests for the different stages of the PLMB project:

Table 1.5.1 List of environmental permits required for the project

Stage			Requirement	Institution	Party Responsible for the Procedure
Structuring	Construction	Operation			
X			Modification of the Environmental Management and Protection Zone (ZMPA in Spanish) of the Bogota River	CAR	EMB
X			Modification of the ZMPA in the channels intervened by the project	SDA	EMB
X			Request for opinion regarding the competent authority for monitoring and control in the Yard and Shop area.	MADS	EMB
X			Archeological Prospecting License	ICANH	Consultant for the feasibility stage
X			Prospecting Approval and Archeological Management Plan	ICANH	Consultant for the feasibility stage
	X		Silvicultural Resolution	SDA	Concession Holder
	X		Official document reviewing and approving the landscape design	Jardín Botánico José Celestino Mutis (JBB) - SDA	Concession Holder
	X		Permit to move wood	SDA	Concession Holder
	X		Delivery certificate for trees transferred to the JBB	JBB	Concession Holder
	X		Delivery certificate for planted trees to the JBB	JBB	Concession Holder
	X		Permit to move plants and trees	SDA	Concession Holder
	X	X	Traffic Management Plan (TMP)	SDM	Concession Holder

Stage			Requirement	Institution	Party Responsible for the Procedure
Structuring	Construction	Operation			
	X		Environmental and mining licenses for material suppliers	Competent Environmental Authority	Concession Holder
	X	X	Registration of Outdoor Advertising Signs	SDA	Concession Holder
	X	X	Gases and vehicular emissions certification	SDA	Concession Holder
	X		Authorization for work at night	Local Mayor's Office	Concession Holder
	X		Permit for Occupation of Channel	Competent Environmental Authority	Concession Holder
	X		Temporary connection of public utilities	Public Utility Companies	Concession Holder
	X	X	Technical mechanical vehicle inspection certificate	Diagnostics Centers	Concession Holder
	X	X	Discharge Permit	SDA	Concession Holder
	X		Final disposal of DCW	Competent Environmental Authority	Concession Holder
	X	X	Registration as Hazardous Waste Product (RESPEL) producers	SDA	Concession Holder
	X		Compensation for soil compaction in green areas	SDA	Concession Holder
	X	X	Registration of formation of Environmental Management Department	SDA	Concession Holder

Source: Prepared by author

1.6 BASELINE

1.6.1 Area of Influence

The area of influence of the PLMB project, composed of the physical, biotic and socioeconomic media, is presented in the following figures.

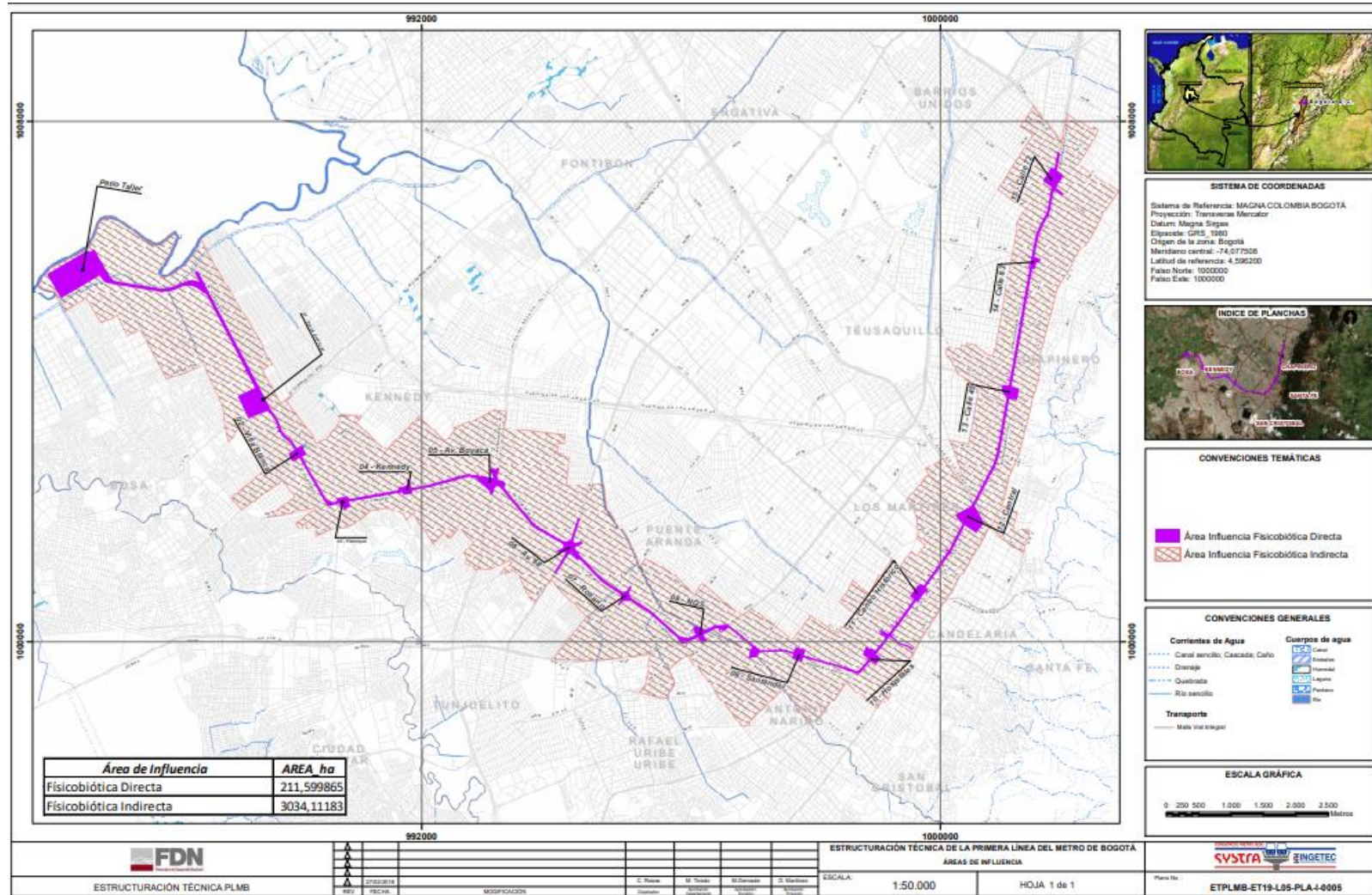


Figure 1.6.1 Area of Influence, biotic and abiotic media (physical biotic)

Source: Prepared by author

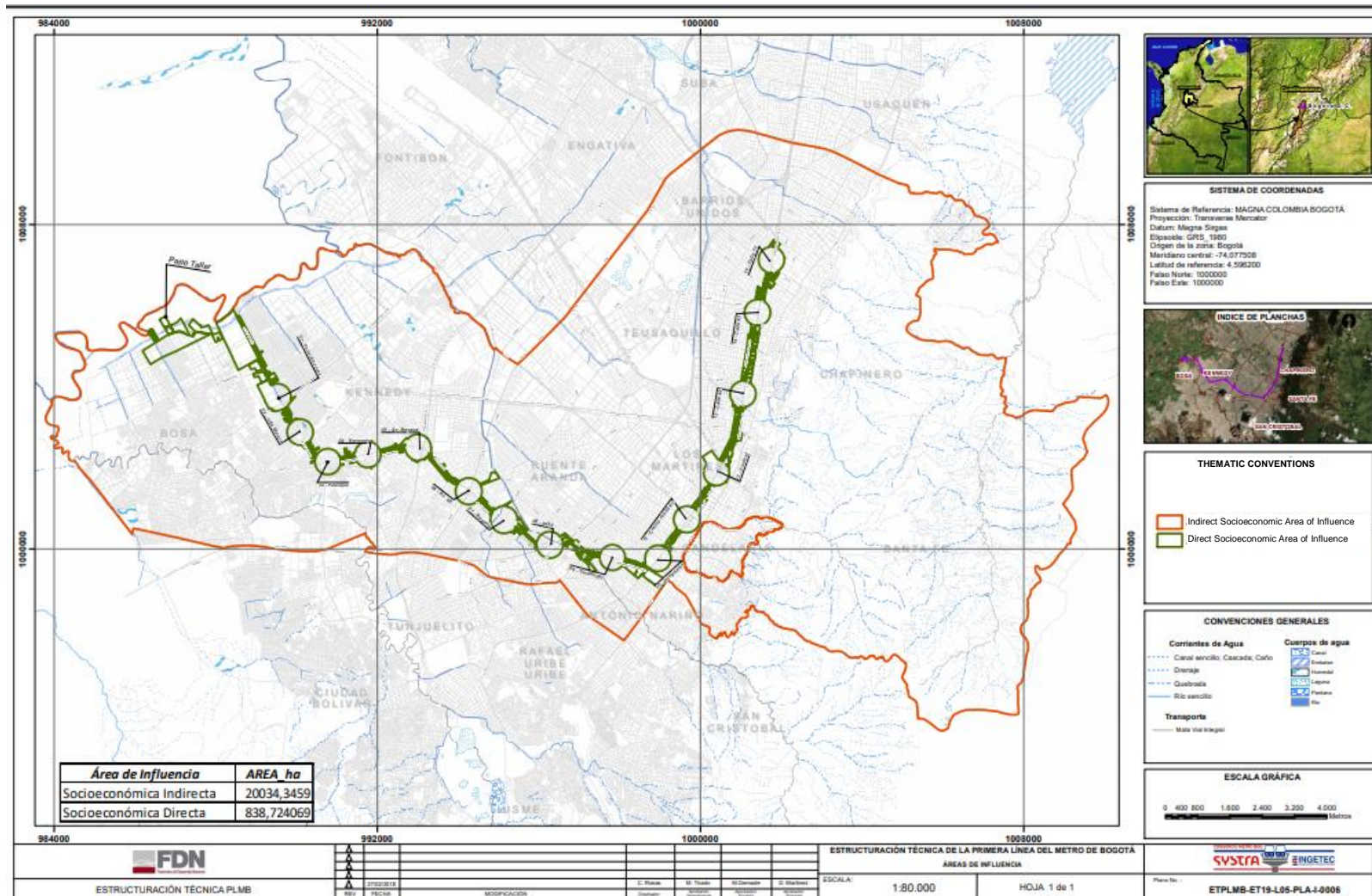


Figure 1.6.2 Area of Influence, Socioeconomic media

Source: Prepared by author

The following aspects were taken into account for defining the areas of influence of the biotic and abiotic media:

- Alteration of the composition and structure of flora and fauna groups
- Riparian buffer strips or watersheds of bodies of water
- Environmental preservation zones
- Special management areas
- Alteration of the physical, chemical and/or biological properties of the land
- Change in current land use
- Riverbeds that cross the lay out
- Potential receptors and sensitive zones

The factors that had greatest or least social impact in defining the socioeconomic area of influence are: physical proximity of the project and operation area, road use and dependence, infrastructure to be used, removed or created in connection with the activity and the direct economic influence of the activities to be carried out for the project.

The total areas of the areas of influence of the various media are presented in the following Table.

Table 1.6.1 Areas of Influence

Areas of Influence	Area (Ha)
Direct Area of Influence, Physical – Biotic Media	211.6
Indirect Area of Influence, Physical - Biotic Media	3,034.1
Direct Area of Influence, Socioeconomic Media	838.7
Indirect Area of Influence, Socioeconomic Media	20,034.3

The geographical location of some activities and works associated with the project that are part of the project's area of influence may be adjusted during the detailed design phase. Areas that are more suitable for the sources of construction material, construction and demolition waste removal and the precast plant have been identified in this study. The final selection of the location/provider will be approved by the EMB, with the condition that it complies with environmental and social criteria established in this ESIS.

1.6.2 Aspects Related to the Physical Media

1.6.2.1 Geology and Geomorphology

This section establishes the description of the geological units, as much for the indirect as for the direct area of influence.

The Bogota Savannah is composed of a fluviolacustrine quaternary deposit on the order of 400 meters thick, supported discordantly on a sequence of sedimentary rocks from the Cretaceous and Tertiary ages (Paleocene and Neogene). There are sporadic outcrops of basement rocks throughout its mountainous system.

There are outcrops of rocks from the later Cretaceous, Paleocene and Neogene eras in the central and southern sectors of the city of Bogota and in the mountains that border it on the east and south of the Bogota Savannah, differentiated in the Arenisca Dura, Plaeners, Labor-Tierna, Guaduas, Cacho, Bogotá, Regadera and Usme formations. The area corresponding to the Bogota Savannah's flat surface is established on quaternary deposits differentiated in Complejo de Conos, Sabana Formation, Flood plain deposits and colluvium deposits.

According to the general guidelines of the Proposal for the Standardization of Geomorphological Cartography in Colombia (Carvajal, 2011, published by the Colombian Geological Service), which are followed for describing the geomorphological aspects of the project's indirect area of influence, it is located in the morphostructure corresponding to the Eastern Mountain Range in the geomorphological province known as the Cundinamarca-Boyaca High Plain, within the region of the Savannah of Bogota. The general and specific information about the geological and geomorphological attributes of the Savannah of Bogota are detailed accurately in Chapter 5 Section 5.2.1.2 and 5.2.1.3.

1.6.2.2 Surface-water Hydrology and the Quality of Surface-water

The city of Bogota is flanked by three large water sources that basically divide it into three drainage basins: Salitre, Fucha and Tunjuelo, each with a differing degree of urban development. Due to the high potential for intervention and the anthropogenic aspects of large cities, it can be concluded that these bodies of water are in generalized conditions of deterioration and intervention, in addition to contamination by the presence of domestic and/or industrial wastewater. The general and specific information about the hydrological attributes of the Savannah of Bogota are detailed accurately in Chapter 5 Section 5.2.1.13.

The PLMB's layout crosses channels (canal in Spanish), collectors (colector) and interceptors (interceptor), as presented in the following table (Chapter 5, Section 5.2.1). For channels, it is pointed out that the points where the layout crosses do not interfere with these bodies of water's watercourse.

Table 1.6.2 Points where the PLMB crosses channels, collectors and interceptors

No	Name of the network	Location	Type of drainage
1	Canal Cundinamarca	Av. city Villavicencio (AC 43 S) with KR 100	Permanent
2	Canal Tintal II	Av. Ciudad Villavicencio (AC 43 S) from Av. Ciudad de Cali (AK 86) until KR 100	Intermittent
3	Canal Río Seco	Av. Primera de Mayo with KR 51	Permanent
4	Canal Albina	Av. Primera de Mayo with KR 39	Permanent
5	Canal Río Fucha	CL 12A S from Av. Jorge Gaitán Cortés (KR 30) until Av. Ciudad de Quito (NQS)	Permanent
6	Canal Arzobispo	Av. Caracas with DG 40A Bis	Permanent
7	Colector Pastrana Section 1	Av. Ciudad Villavicencio (AC 43 S) from Av. Primera de Mayo with KR 80D	Intermittent
8	Colector Pastrana Section 2	Av. Primera de Mayo from CL 38B S until Av. Ciudad Villavicencio (AC 43 S)	Intermittent
9	Interceptor Qda. Las Lajas	Av. de la Hortua (CL 1) from KR 13A until KR 18	Permanent
10	Colector Calle 3	Av. Caracas with CL 3	Permanent

No	Name of the network	Location	Type of drainage
11	Interceptor Comuneros	Av. Caracas with Av. Los Comuneros (CL 6)	Permanent
12	Colector Calle 22	Av. Caracas with CL 22	Permanent
13	Colector Galerías	Av. Caracas with CL 55	Permanent
14	Colector Sears	Av. Caracas with CL 59	Permanent
15	Colector Las Delicias	Av. Caracas with CL 61A	Permanent
16	Interceptor La Vieja	Av. Caracas with CL 69	Permanent

1.6.2.3 Hydrogeology

The PLMB's hydrogeological study includes the definition and description of the types of aquifers, the identification of the recharge and discharge zones, the direction of the water flow and the hydrogeochemical characterization of the subterranean water, the determination of the piezometric levels along the length of the PLMB, the definition of aquifers' interconnection with special water sources, the definition of aquifers that will be affected by the PLMB works and these aquifers' vulnerability to contamination by its construction and operation.

This study was performed with hydrogeological information from the Bogota Savannah, and includes descriptions of the aquifers, the definition of recharge and discharge zones, the direction of the water's flow, the quaternary aquifer's hydraulic parameter values and hydrogeochemical characteristics of subterranean water, among others. The general and specific information about the hydrogeological attributes of the Savannah of Bogota are detailed accurately in Chapter 5 Section 5.2.1.16.

As a general conclusion, it can be inferred that the Savannah's fluvio lacustrine filler constitutes a large, superficial, free, and semi-confined aquifer, with a not well known interconnection between its own different levels.

1.6.2.4 Climate, Air Quality, Noise Level, and Vibrations

1.6.2.4.1 *Climate*

Regarding the climate variables analyzed in creating this study, it is pointed out that the variables are in accordance with the national environmental requirements and regulations. The analyzed data and information proceeds directly from the organizations created to this end, such as the Institute of Hydrology, Meteorology and Environmental Studies – IDEAM, the Empresa de Acueducto y Alcantarillado de Bogotá – EAAB, and the District Secretary of the Environment - SDA. The analyzed variables are: precipitation, temperature, sunshine, relative humidity, evaporation, pressure, cloudiness, dew point, vapor pressure, velocity and direction of the wind, and solar radiation.

The main results obtained from the registers at the meteorological station in Bogota are related hereunder:

- January registers as the month with the most sunshine.
- The times of the year with the most rain are March-May and October-November.
- The maximum temperature is registered in February and the minimum in January.
- The highest registered wind speed was in August, in Bogota's Southwest area.

This information is detailed in section 5.2.1.18.2.

1.6.2.4.2 Air Quality

To learn of the current state of the air quality in the project's area of influence, an air quality monitoring network composed of 18 monitoring stations was installed for 18 days. The measured parameters were Particles Smaller than 10 microns (PM10), Particles Smaller than 2.5 microns (PM 2.5), Sulfur Dioxides (SO₂), Carbon Monoxide (CO) and Nitrogen Dioxides (NO₂).

Additionally, in Chapter 5, Section 5.2.1.20, the scenarios for modeling each one of the project's stages (construction and operation) were defined, developed from identifying the project's processes or activities that are likely to generate atmospheric emissions. To do so, the time of duration for each one of the project's stages expressed in years established by Empresa Metro de Bogota was considered. The following modeling scenarios were defined from the abovementioned:

- **Scenario 1: Baseline:** Simulates the dispersion of gases and particles for a normal, current time (without a project) in the area of influence, only taking into account observed road traffic in 2017.
- **Scenario 2: Construction (critical):** Simulates the dispersion of gases and particles emitted during the execution of construction activities befitting the project (day and night shifts), taking into account all the work sites simultaneously (Yard and Shops, Stations, Viaduct) independently from the moment the activity is executed, modeling the most critical condition.
- **Scenario 3: Operation of the project:** Considering that the metro's operating system does not generate any kind of atmospheric emissions, this scenario simulates the dispersion of gases and particles over the project's corridor, only taking into account the projected road traffic in the study site. The projection was made from the city of Bogota's average growth rate.

In every scenario, the modeling was carried out under the most critical possible conditions in each of the project's stages, taking the execution of activities simultaneously along the length of the lay out.

In order to simulate the dispersion of PM10, PM2.5, CO, NO_x, SO_x and COV and determine their concentrations at specific points over the PLMB's lay out in relation to the project's different stages, the modeling was performed with the Gaussian AERMOD software, which is endorsed by the EPA (United States Environmental Protection Agency) and the Ministry of Environment and Sustainable Development.

Criteria such as the presence of neighboring communities, the wind rose (direction and speed of the wind), the location of infrastructure to be built and topographical conditions were taken into account for determining the locations of the air quality measurement stations. The following were the main results of the measurements:

- The concentrations of PM10 particles are below the required acceptable limits, complying with the limits established in Resolution 610 of March 24, 2010 of the Ministry of Environment, Housing and Territorial Development (MAVDT in Spanish).
- The most elevated levels of PM10 concentration registered by the eighteen stations occurred on days: four (4) at the Calle 45 station (99.80 µg/m³), ten (10) at the NQS station (99.65 µg/m³), and (1) at the Portal Américas station (97.16 µg/m³).

- When comparing the average values of the data obtained, with the annual standard of 50 $\mu\text{g}/\text{m}^3$, it was detected that five (5) of the eighteen (18) stations exceeded the acceptable annual limit. Nevertheless, it is important to highlight that these concentrations are only compared as an illustration to establish an air quality trend during the considered part of the year and determine the percentage of decrease or increase as regards the standard.
- 98.8% of the concentration of PM_{2.5} particulate matter does not exceed the daily air quality standard established in Resolution 610 of 2010 (50 $\mu\text{g}/\text{m}^3$) of the MAVTD, which is now the Ministry of Environment and Sustainable Development (MADS in Spanish). Only four (4) concentrations (1.2%) exceed the standard. They registered at the Portal Américas (75.78 $\mu\text{g}/\text{m}^3$ on day 1), NQS (57.65 $\mu\text{g}/\text{m}^3$ on day 10) and Hospitales stations (57.80 $\mu\text{g}/\text{m}^3$ and 58.99 $\mu\text{g}/\text{m}^3$ on days 1 and 2, respectively).
- When comparing the concentration defined for PM_{2.5} by the annual standard (25 $\mu\text{g}/\text{m}^3$) with the average concentrations from the obtained consolidated data, it was evident that six (6) of the eighteen (18) monitoring stations exceeded the annual acceptable limit. These stations are: Patio Taller (31.00 $\mu\text{g}/\text{m}^3$), Portal Américas (38.06 $\mu\text{g}/\text{m}^3$), Kennedy (28.63 $\mu\text{g}/\text{m}^3$), Avenida Boyacá (29.02 $\mu\text{g}/\text{m}^3$), NQS (28.11 $\mu\text{g}/\text{m}^3$) and Hospitales (34.38 $\mu\text{g}/\text{m}^3$). Nevertheless, these concentrations are only compared as an illustration to establish an air quality trend during the considered part of the year and determine the percentage of decrease or increase as regards the standard.
- The concentrations of NO₂ and SO₂ obtained at the eighteen monitoring stations did not exceed the daily standard (150 $\mu\text{g}/\text{m}^3$ for NO₂ and 250 $\mu\text{g}/\text{m}^3$ for SO₂), and therefore comply with the guidelines established in Resolution 610 of 2010 of the MAVDT, which is now the MADS.
- The average hourly concentrations of CO obtained at each one of the eighteen stations do not exceed the hourly standard of 40,000 $\mu\text{g}/\text{m}^3$ established for CO in Resolution 610 of 2010.
- According to the air quality conditions obtained during the sampling period, it was observed that 72% (233 out of 324 logs) of the estimated concentrations corresponded to the green-colored strip, which indicates "Good Air Quality" and 28% (91 out of 324 logs) of the concentrations corresponded to the yellow-colored strip, which indicates "Moderate Air Quality." This representation indicates that the actual health risk to communities in the study area from air quality is low to nonexistent.
- The Portal Américas station reported the greatest amount of concentrations (17 out of 18 logs) in the "Moderate Air Quality" category. On the other hand, the Santander station reported all of its concentrations (18 logs) in the "Good Air Quality" category.
- In this study, it was determined that the Air Quality Index (ICA in Spanish) calculated for the PM₁₀ parameter in the project's area is classified between "Good Air Quality" and "Moderate Air Quality." Comparing that to the 2016 ICA presented in the "ANNUAL REPORT OF THE AIR QUALITY IN BOGOTA"² document prepared by the Air Quality Monitoring Network of Bogotá, it shows consistency in reaffirming said classification.

² BOGOTA AIR QUALITY MONITORING NETWORK (RQMN). ANNUAL REPORT ON BOGOTA'S AIR QUALITY. 2016. Page 97.

Modeling of Air Quality:

- In every simulated scenario, the concentrations predicted about the discrete receptors through the dispersion model of the activities that would take place in the project demonstrate the compliance with the air quality standards established for nitrogen dioxide (NO₂), sulfur dioxide (SO₂) and carbon monoxide (CO) in the different applicable exposure periods. The information about air quality measurements allowed considering annual background concentrations (indicative) for the PM₁₀, PM_{2.5}, NO₂, SO₂ and CO contaminants.
- The particulate matter emissions (PM₁₀ y PM_{2.5}) and the presented Operation and Construction scenarios exceeded the annual and 24-hour regulatory standard at Portal Américas, Kennedy, Av. Boyacá and Hospitales stations. The exceedances were between 14% and 74%.
- According to the obtained results, the maximum simulated concentrations in the Baseline Scenario with respect to the concentrations obtained in the monitoring campaign for a 24 hour exposure represents a deviation less than and equal to 22% for PM₁₀ and 58% for PM_{2.5}, which represents a 50 – 78% reliability.
- The gas emissions on the baseline have the greatest concentrations in the NQS, Santander, and Hospitales sectors, while the modeling's contribution with respect to air quality is different for each contaminant. The greatest contribution of NO₂ is in Santander, with 26.8%, the greatest of SO₂ is in Hospitales, with 2.66%, the greatest of CO is in the Avenida 68 station, with 94.2%, and, lastly, it is not possible to compare VOC to air quality because it is expressed as BTX.
- Scenario 3 (operation), presents the modeling results in which the highest contributions are in the NQS stations for particulate matter, the Hospitales station for gases (NO₂, SO₂ and VOC) and in Santander for CO.
- The atmospheric emissions obtained in the models of the three scenarios are mainly attributed to external sources, which is to say, vehicular traffic in the study area.
- Results for (NO₂ and SO₂) gases, including the background concentration, do not exceed the standards established in Resolution 610 of 2010.
- The particulate matter and gas emissions generated by vehicular traffic and the project's activities have the greatest influence on the Kennedy, Avenida 68, Hospitales and Calle 52 stations.
- It is recommended to continue with a second dispersion model and an air quality monitoring campaign in the project's construction stage. This will allow verifying air quality and the implementation of the atmospheric emissions control and mitigation measures during the construction stage for complying with the standards.

1.6.2.4.3 Noise

An ambient noise monitoring campaign was carried out during the day and during the night for an ordinary day and a Sunday at 18 points, which were selected according to the sensitive areas (inhabited areas) and the classification of land use where the PLMB's lay out is projected (Chapter 5,

Section 5.2.1.21). The K2 INGENIERIA S.A.S laboratory, which is accredited by the IDEAM, as the current environmental regulations require, carried out the measurements.

The sectors are identified below according to the noise levels defined in Resolution 627 of 2006.

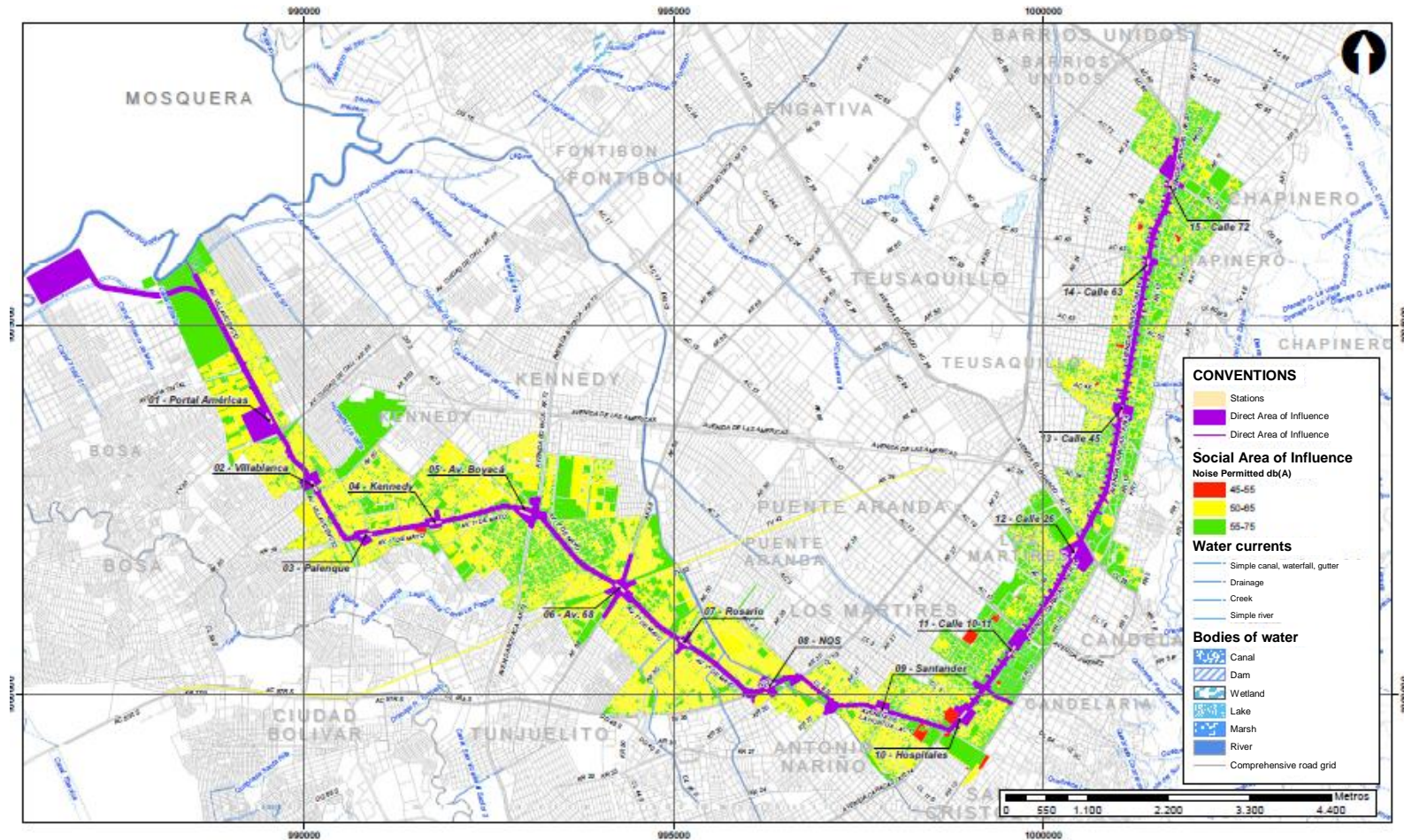


Figure 1.6.3 Sectors by allowed sound pressure level – PLMB Lay Out

Source: Prepared by author

The results obtained in the monitoring campaign are presented according to the classification of sectors and subsectors assigned to each one of the evaluated points, concluding the following:

- The point classified as sector D, rural land use areas: P1_Patio Taller presents levels greater than the maximum acceptable values established in Resolution 627 of 2006: the highest level presented itself on Sunday. The sources identified on site for this point were: Birdsong, insect noise, dogs barking, airplane flyovers and passing vehicles.
- The points classified as sector D, Calm and Silence: P4_Kennedy and P11_Hospitales present exceeding levels in the results obtained during the monitoring day as regards the standards of Resolution 627 of 2006.
- The points classified as sector C, intermediate restricted noise, presented levels above the maximum limits allowed by Resolution 627 of 2006 (75 dB during the day and 70 dB during the night) at most of the points. For this sector, the points maintain a similar trend, which brings to the conclusion that noise conditions are not variable in the area. The main noise generation source is passing vehicles on main roads and commercial activities. With this, it is evident that the area classified in sector C stays in continuous commercial activity, which leads to a constant flow of vehicles on the main roads of the area of influence that contribute a considerable amount of noise.
- The points classified as sector B, Calm and Moderate Noise, points that are mostly located close to universities and residential areas, present the greatest compliance with the maximum limits allowed by Resolution 627 of 2006 (70 dB during the day and 55 dB during the night).
- Based on the results, the stations that presented high noise levels and greatly exceeded the maximum acceptable levels established by environmental regulations were the stations located in residential areas, specifically P2_Portal Las Américas, P11_Hospitales and P13_Calle 45, where noise levels remained close to 74 dB(A), making it evident that said levels were caused by sound energy flux due to constant vehicular traffic and airplane flyovers.
- The point classified with rural land use also presented exceedances due to the severe restrictions established by Resolution 0627 for rural areas and because airplanes take off near this point.
- The stations located in residential areas presented greater compliance during the ordinary day. Nevertheless, during the night, all of them presented levels that exceeded the acceptable standard for that time, and when comparing the levels obtained by these stations, it can be deduced that the exceedances could have possibly been caused by sources inherent to the area such as vehicles, people, and commercial establishments that contribute to the increase of sound energy flux and, inherently, to the acceptable limits being surpassed.

Subsequently, and in order to identify and estimate the noise contributions (Ld, Ln and Ldn) generated in the First Metro Line of Bogota (PLMB) project's area of influence, noise modeling in the area of influence was performed under three modeling scenarios (baseline, construction and operation). The software used to perform the noise propagation prediction was CadnaA version 2017 (64 Bit) (build: 159.4707), DataKustik GmbH.

The modeling results for each one of the scenarios are:

- Once the results for the noise modeling for the baseline scenario were analyzed, it was concluded that the points that generate the greatest noise levels were identified as calle 52, calle 45, Hospitales and Portal Américas. These level were between 55 and 80 dB (A). It is worth highlighting that there are vehicular traffic sources, which are possibly catalogued as the greatest noise generators within the project's area of influence, near these areas.
- In the project's construction scenario, the area of influence with noise level over 35 dB(A) up to 75 dB(A) during the day correspond to the roadways where the metro of Bogota would operate. Within this area of influence, housing that is closer to the project may be affected.
- According to the operation scenario (iii) results, it was evident that the noise contributions from the metro would not represent a significant contribution in relation to the other modeled scenarios. It is important to highlight that with the three evaluated indicators (Ld, Ln y Ldn), the metro's operative contribution levels would not surpass 65 dB(A).
- With the results from the contributions that background noise is made of, the levels that could de present in the two projected scenarios were made known, which would be composed of levels from 50 dB (A) up to over 80.1 dB (A). The maximum levels would present themselves at the receptors called Portal de las Américas, NQS, and Hospitales, which are close to avenida 43 and the intersection of carrera 14 and calle 10 until calle 76, all of which comprise the lay out of the first metro line of Bogota. It must be considered that the presented results are indicative, for which reason the ambient noise measurements may vary from one hour to another, or from one day to another in the same place. Nevertheless, these levels may be taken into account to indicatively evaluate the possible noise levels that would present themselves in a determined place.
- The land use conflict would present itself in the construction scenario during the day at Patio Taller, Portal America, Avenida Boyacá, Rosario, and Calle 45, among others, and in the operation scenario during the night at Rosario and NQS. These conflicts were determined based on the results of the model and the ambient noise threshold established by means of Resolution 0627 of 2006.
- Finally, it is concluded that the greatest noise generating source in the three evaluated scenarios is road traffic, affirming that the metro's operation does not contribute significant noise levels. Nevertheless, it is necessary to highlight the increase in noise levels that could present themselves from one operation scenario to another, mainly in the sectors called Patio Taller, Calle 45 y 52, Portal America and Villa Blanca.
- It is recommended to carry out periodic noise measurement that gets closer to reality, allowing, this way, to refine the model and obtain more precise results. Furthermore, it is important to carry out an adequate characterization of the noise generating sources in order to complement and identify the areas that are most affected and individualize the types of existing sources to determine which ones are the most relevant.
- Additionally, It is recommended to continue with a second noise model in the project's construction stage. This will allow verifying noise emissions and the implementation of the control and mitigation measures during the construction stage for complying with the standards.

1.6.2.4.4 Vibrations

A vibrations monitoring was carried out in the First Metro Line of Bogota project's study area in order to establish a baseline for current vibrations that exist along the length of the corridor that will allow establishing the impact during the construction and then the operation of the First Metro Line (Chapter 5, Section 5.2.1.22). It is important to mention that the baseline vibration levels in some sectors are in the range of being perceivable and easily perceivable to people.

The particular scopes of the characterization of vibrations in the study area activity include:

- Characterizing the acceleration level in the frequency spectrum (1Hz to 100Hz) in focus for the different components of movement in order to determine the acceleration and velocity units of the natural and environmental vibrations on housing in the current conditions within the project's area of influence.
- Characterize the vibration levels associated to current traffic on the roads that make up the study corridor and, with this, establish the project's baseline characteristics in order to estimate the relationship between the construction and operation stages and the DAI.

The methodology established for the vibrations study was performed taking into account the following activities:

- Evaluation of vibration level in a natural state in reference areas such as the source, propagation areas, receptors, and (existing) roads.
- Consolidation of the results, analysis of the information and projection of the impacts on properties selected as being of environmental interest, using mathematical calculations.

Estimation of Effects During the Project's Construction

The construction activities that generate the greatest vibration level correspond to the use of explosives for excavating in rock or pile-driving foundational elements (piles) or containment elements (bulkhead beams). The use of explosives or pile-driving steel or concrete elements are not planned to be implemented in building the First Metro Line of Bogota, with which any type of effect by vibrations is minimized. Deep cementing that is necessary for the viaduct and the stations' foundations is planned. They will be built with pre-excavated piles, a technique that, as defined by English regulation BS7385-2 (1993), is a pile construction method that generates low vibration levels and will only generate vibration levels that can be characterized as intense to people and have the capacity to produce some impact on structures if very long steel cylinders are installed.

Even in the case that the vibrations associated to construction processes do generate levels of 1 mm/s (vibration levels far higher than those associated with pre-excavated pile construction), the vibration level on the sidewalks of the roadway corridors would be below the 7.6 mm/s threshold. What is more, and as is presented by the following Figure, even at the point with the greatest vibration level (Centro Histórico), the effect of an additional 1 mm/s of vibration would not change the classification of the vibration levels.

It is noted that the 1 mm/s level is considered to be a higher vibration level than is expected to be generated by the viaduct and the stations' construction activities that are a part of the First Metro Line of Bogota, corresponding to a conservative analysis.

Additionally, another possible source of vibrations that is identified during the construction stage is heavy vehicle traffic required for ground movement associated with the project. The vibration levels that can be induced by heavy vehicle traffic are characterized by being less than or equal to those that TransMilenio traffic generates and are limited and controlled in the Traffic Management Plan (TMP).

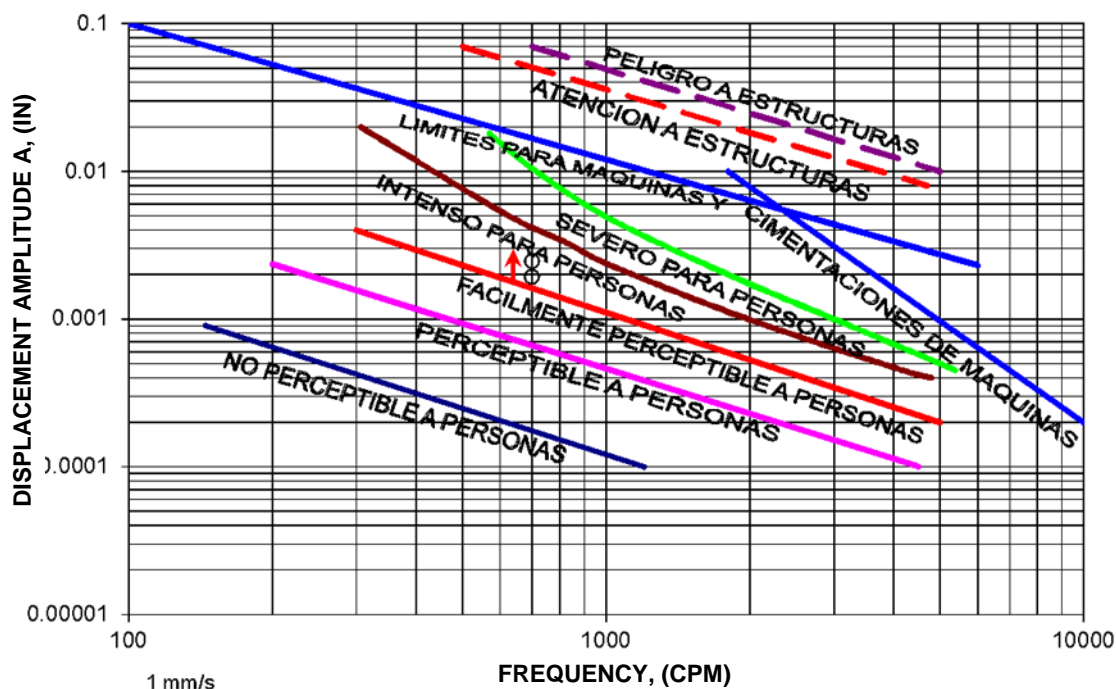


Figure 1.6.4 Effect of additional vibrations with a PGV of 1 mm/s during construction.

Source: Universidad de los Andes (2001)

Estimation of Effects During the Project's Operation

The definition of the braces and connectors of the rolling stock on the viaduct and Metro station's structures minimizes vibrations by having elements that dissipate energy in the connection between the rolling stock's rails or roads and the Metro structures. The following figure shows the maximum vibration limits that could be generated during the First Metro Line's operation. Based on the above, there are no identified impacts due to vibration that could affect structures during the project's operation.

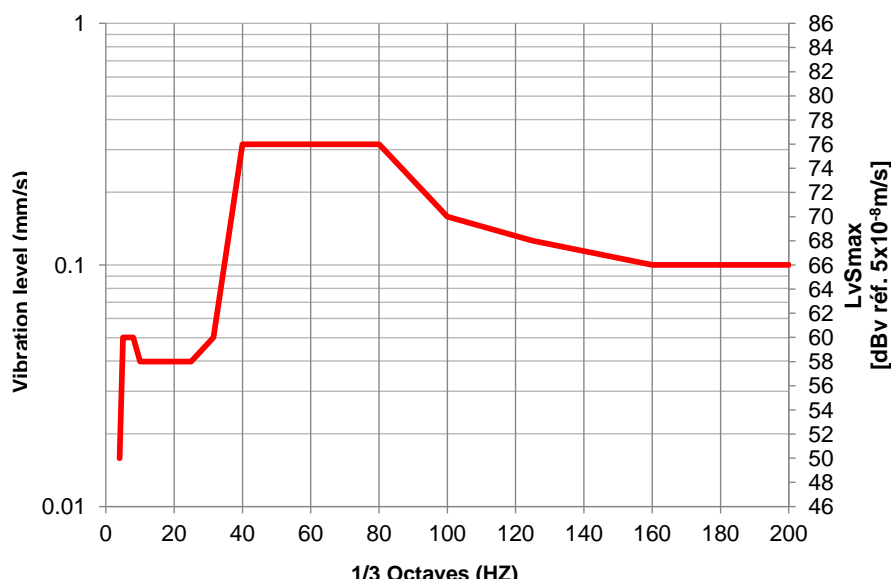


Figure 1.6.5 Levels of vibration expected at the foot of the piling of the Metro.

As was previously mentioned, it is not expected for vibration levels throughout the First Metro Line's corridor to be significantly modified during the project's construction and operation stages, for which reason no potential impact to structures is identified.

In the next Figure, it is observed that the acceleration levels registered at the point that presents the greatest vibration levels are much lower than the requirements of Decree 523 of 2010 for the seismic design of structures.

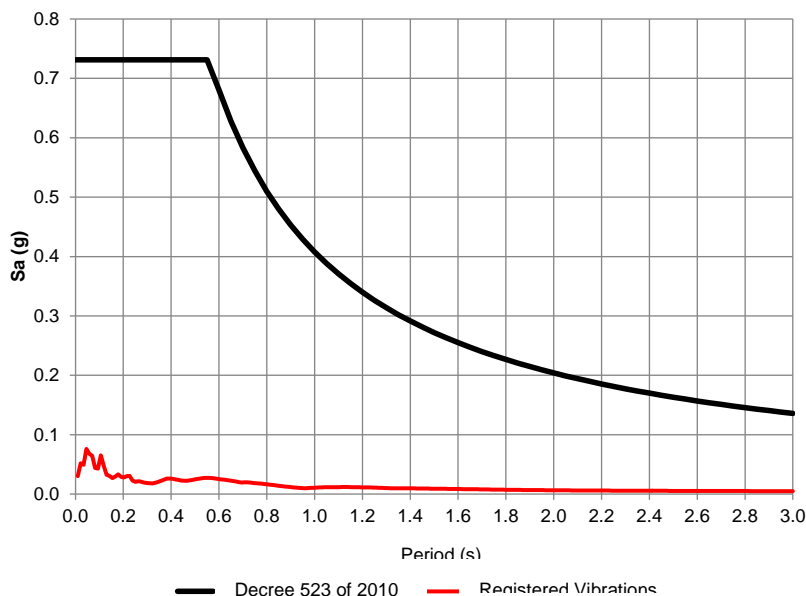


Figure 1.6.6 Comparison of response spectra

1.6.2.5 Landscape

The PLMB's landscape is inherently urban and in it, the perception of the environment is not centered on the physical characteristics of the medium in which humans live, but the social component and mainly the social relationships, since it includes a significant evaluation of these elements, which are important for the well-being and habitability of the territory, mainly in places with prominent modifications to the medium and in which it is not common to observe natural elements as does occur in the rural landscape.

The urban landscape is mainly evaluated based on six elements: contact with nature, aesthetic preference, recreation, social interaction, citizen participation and community identity (Matsuoka & Kaplan, 2008). For characterizing the visual quality of the project's area, these elements were evaluated and specialized according to the obtained results of the social characterization and tours of the study area. The definition of these elements are presented here below:

- **Contact with nature:** This is related to the presence of local, zonal, or metropolitan parks, urban reserves and the ease of access to these places. The presence of trees and urban gardens are also included in this category, since they reduce modifications to the medium on an aesthetic level.
- **Aesthetic preference:** This corresponds to the elements defined by human perception through the intrinsic beauty of the shapes of the earth, such as the presence of historical and architectural resources that are of great importance, the presence of trees or gardens and, in some cases, natural covers or rocky outcrops.
- **Recreation:** This references the availability of green areas and parks in which inhabitants can interact with their families. Metropolitan parks, zonal parks and local parks present in the area of influence are taken into account for this case.
- **Social interaction:** The link or bond that exists between people and is essential for groups in such a way that society would not function without it. The social relationships and modes of interaction are not limited to the level of family or kinship. It also includes labor or political relationships, or those associated with a specific place such as educational centers, etc.
- **Citizen participation:** Citizen participation is a set of mechanisms for the population to gain access to the government's decisions independently and without having to be a part of the public administration or a political party. For this study, this information is related to the presence of groups and organizations that interact with each other in order to come to a common objective, which, in this case, is the well-being of the community in which they live.
- **Community identity or sense of belonging:** It is defined as a person's satisfaction when he/she feels like an integral part of a group, which is characterized and different from the rest because of its traditions, preferences or knowledge.

Based on the previously identified elements, an analysis was carried out according to the segmentation of the layout's socioeconomic component into six (6) areas. The following figure presents the result of the evaluation of the PLMB's landscape.

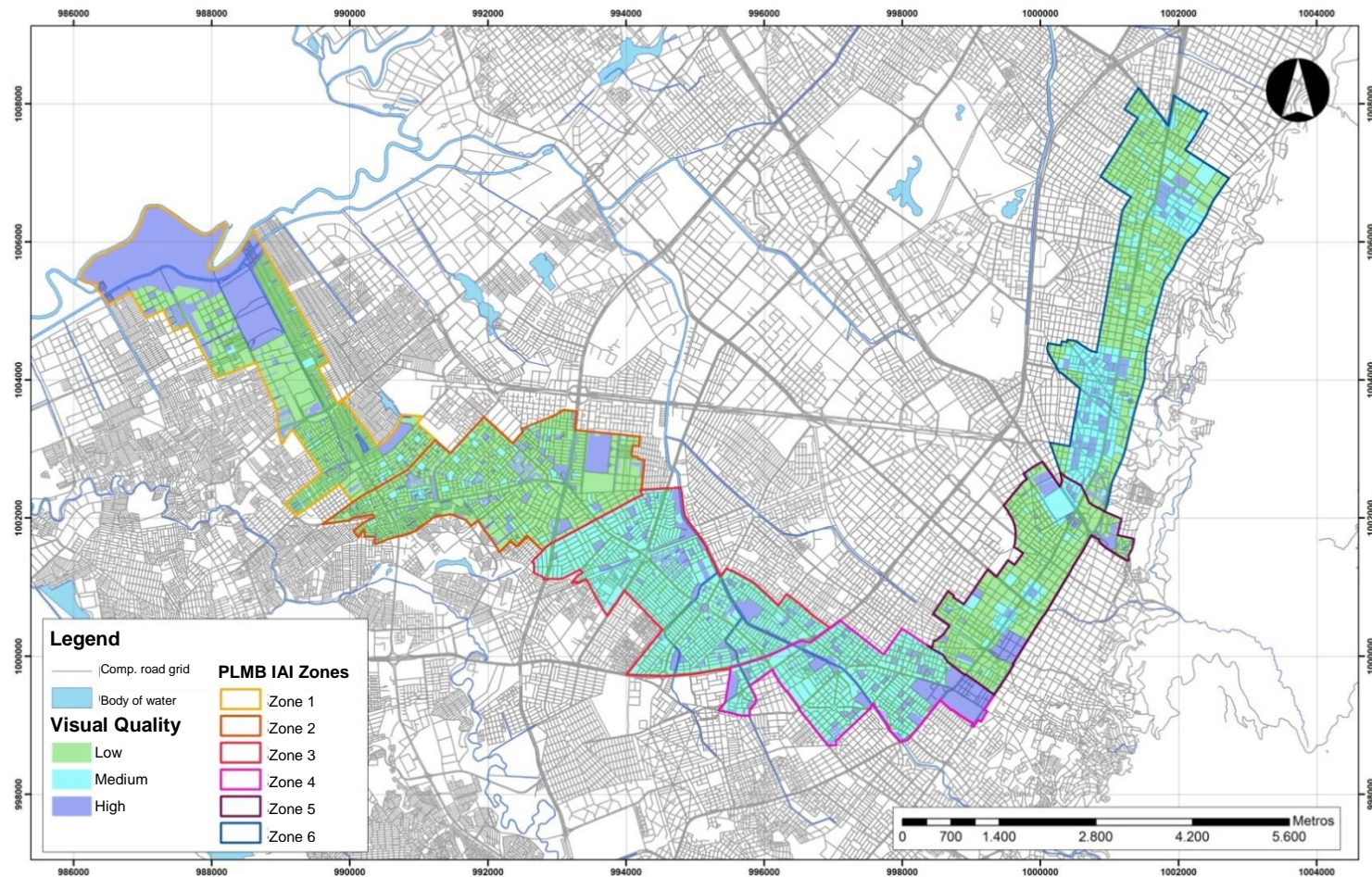


Figure 1.6.7 Distribution of the PLMB's visual quality

Source: Prepared by author

The quality of the landscape in the scenario without the project in the Metro project's area of influence has a public space infrastructure that is deteriorating in a large part of the corridor and, in some cases, is nonexistent. Furthermore, unsafe pedestrian crossing points without infrastructure are identified, and the bike trail system has not been integrated for the most part.

A tendency to increase the deterioration of the infrastructure is observed due to the non-existence of contingent improvement plans for pedestrian and vehicular mobility infrastructure and the non-existence of the bicycle infrastructure.

1.6.3 Aspects Related to the Biotic Media

1.6.3.1 Main Ecological Structure

Derived from the cartographic review and verification of the information from the National System of Protected Areas and the National Environmental Information System of Colombia, the following information is obtained related to the areas of influence crossing protected areas and Main Ecological Structure (EEP in Spanish) areas:

The DAI and IAI do not cross Natural National or Regional Parks, National or Regional Integrated Management Districts, Soil Conservation Districts or Civil Society Nature Reserves.

The DAI and IAI do not cross Proposals for New Areas and Expansions of National Natural Parks, Definitive Subtractions to Protective National Forest Reserves, areas catalogued as Reserves by Law 2 of 1959, or with RAMSAR Sites.

Components and elements of the Main Ecological Structure – EEP - are found in the project's Direct Area of Influence (DAI), namely: Riparian Ecological Corridors, Riparian Buffer Zones and Environmental Management and Protection Zones (ZMPA). In the project's DAI there are 85.25 Ha that belong to the EEP, of which 42.80 Ha are in Riparian Ecological Corridors, 6.02 in Riparian Buffer Zones and 36.43 in ZMPA. As is shown is the following table:

EEP Element / Name	Area (Ha)
Riparian Ecological Corridor	42.80
Canal Albina	0.20
Canal Arzobispo	0.19
Canal Cundinamarca	41.11
Fucha or San Cristóbal River	1.30
Riparian Buffer Zone	6.02
Canal Río Seco Sector 1	0.07
Canal Tintal II	5.78
Bogota River	0.17
ZMPA	36.43
Canal Río Seco Sector 1	0.11
Canal Tintal II	5.01

EEP Element / Name	Area (Ha)
Bogota River	31.31
Total	85.25

In the IAI there is a District protected area (Humedal la Vaca), four riparian ecological corridors, four Riparian Buffer Zones and four ZMPA zones. No works or activities related to the project will be carried out at the Humedal la Vaca. It is important to mention that this wetland has been intervened and has illegal fillings. The accumulation of sediments has also caused a significant decrease in its water storage capacity. Measures to prevent any effect on the Humedal de la Vaca will be included in the ESMP according to what is established in Empresa de Acueducto de Bogotá's Environmental Management Plan. Its monitoring and protection correspond to the Secretary of the Environment in Bogota. It is important to mention that the Humedal La Vaca is not catalogued as a RAMSAR wetland.

The Yard and Shop and the Technical Branch are located in the area defined as Management and Protection Zone of the Bogota River (ZMPA) - referred to in articles 109 and 110 of District Decree 190 of 2004 (Land Use Planning) – which makes it necessary to modify said ZMPA to be able to install the Yard and Shop in this area. Accordingly, the EMB requested the modification of the Bogota River ZMPA before the CAR, which is the environmental authority over the Bogota River and it will be pronounced by means of an administrative order indicating the change of the ZMPA, as well as the guidelines and environmental protection measures that may be necessary.

The characterization and current state of each of these areas can be found in Chapter 5.2.2: Biotic Baseline.

1.6.3.2 Vegetation

In accordance with the requirements defined by each Competent Environmental Authority with jurisdiction over the project area (CAR and SDA), a forest inventory of 100% of the Direct Area of Influence was carried out, including the El Corzo property. The latter was specified for the construction and operation of the yard and shop. Within the silvicultural assessment carried out on each arboreal individual, the entirety of the dasymetric, physical condition, sanitary, intervention causes, and location variables requested in the "Collection of silvicultural information form for every individual" of the District Secretary of the Environment was taken. The inventoried individuals were marked with yellow oil-based paint.

For the case of the silvicultural assessment carried out for the individuals located in the El Corzo property, for which a permit for harnessing isolated trees will be processed before the CAR, the photographic records and dasymetric variables were taken, without producing predetermined formats.

As a result of the silvicultural assessment done in the project's biotic DAI, a total of 3229 individuals was obtained in the tree, shrub, and palm strata. In the relative abundance obtained to abundant species can be appreciated relative to the total group. In the first place is the rubber savanna (*Ficus soatensis*) with 17% and the American pepper (*Schinus molle*) with 16% of the total inventory. The forest inventory carried out on the property destined for the Yard and Shop produced an assessment of 58 individuals distributed among 6 species, of which the dominant species is the Australian Blackwood (*Acacia melanoxylon*), with 44 individuals.

Of all the inventoried individuals, and in accordance with the current regulations, 91 individuals from 4 species were identified in the corridor. They present regulatory restrictions, for which reason none of them will be felled.

When it comes to herbaceous vegetation distributed in the green zones along the length of the PLMB's corridor, coverage of green graminoids of the Kikuyu grass (*Pennisetum clandestinum*) species predominates. The inventory carried out presents a total of 247,742 m² of green zones distributed in 12 constituent elements of public space for public use. The compaction of the total green areas inventoried was calculated to be 138,824 m².

1.6.3.3 Fauna

The results of greatest importance with respect to the studies carried out to characterize the fauna of the project's area of influence are presented. It must be clarified that the studies are directed to the group made up of birds, since it is the best represented group in urban environments due to their mobility, adaptability and capacity to develop in this environment. Moreover, these characteristics make this group a good indicator of the state of the terrestrial ecosystems in urban zones that have been altered due to these zones' infrastructure characteristics.

The Bogota Savannah has approximately 18 orders of birds, with an average of 50 families, which corresponds to around 269 species and subspecies (including two that are extinct), of which close to 100 of them permanently reside in the city of Bogota. One fourth of the birds are migratory birds: these species use the resources and habitat availability in vegetation in parks, wetlands, the Botanical Garden, roadway corridors, canals and creeks, public wooded areas and others of the city's green zones, including private gardens. (Zerda 1992, Molina & Osorio 1996, Molina et al., 1997, ABO & CAR 2000 and Andrade & Benitez 2005).

In the monitoring carried out on the group of birds in the project's DAI, there were 28 species of birds identified, belonging to nine orders and 19 families. The best represented order, when it comes to families, is Passeriformes (passerines, birds, songbirds) with nine families. The other eight orders are represented by one or two species.

Records of species that are mostly "common," "general" and "opportunistic" stand out, such as the domestic pigeon or the rock pigeon (*Columba livia*). 18% of the species are primary consumers (frugivorous, granivorous and nectarivorous) that eat fruit, seeds, nectar, leave, and other vegetable products. 72% of the species are secondary and tertiary consumers, since their diets are made of invertebrates (mostly arthropods), some vertebrates such as small mammals, reptiles and even other birds, and also carrion.

None of the registered species are endemic, almost endemic, or have some restriction on their distribution, according to the cited authors.

According to Renjifo et al., (2014) and Renjifo et al., (2017), none of the registered species is included in a local and/or global threat list as per the Red Book of Birds of Colombia, Resolution 0192 of 2014 of the Ministry of Environment and Sustainable Development and the International Union for Conservation of Nature – IUCN – (BirdLife, 2016).

Two registered species have migratory behaviors. These are the *Bubulcus ibis* and *Ardea alba* herons. However, that does not exclude the presence of boreal and austral migratory birds during the season, although most are registered in wetlands and district parks. (ABO & CAR, 2000)

1.6.3.4 Hydrobiological Communities

The characterization and diagnosis of the hydrobiological communities of the bodies of water present in the project's area of influence was carried out and sampling points selected and located in the canals the PLMB crosses. These communities were analyzed: periphyton, benthic macroinvertebrates and macrophytes.

The biotic indexes calculated based on hydrobiological communities suggest the presence of contaminated water, which in many cases (except for the canal Albina) is coherent with what the bioindicators express. This is due to a significant organic load, as well as waste originating from housing and the anthropic activity that was observed.

The periphyton community is the most diverse. The organic load of the system favors this group's development. In addition, when it is on the shores, for example, the periphyton, it receives a greater amount of sunlight. Meanwhile, the materials in the canals (mostly concrete) prevent the Benthos community from developing normally, since it does not allow many species to settle because of its hardness.

The physical state of the water systems suggests high contamination (muddy colors, fetid smells, trash and domestic waste water discharges).

The majority of the monitored bodies of water indicated a high degree of contamination, always with a common cause, which is the anthropic activity in their surroundings and the discharges made to them. It is important to monitor the state of the water sources at each one of the stations, in order to be able to propose management and improve the health status of the bodies of water.

1.6.4 **Aspects Related to the Socioeconomic Media**

This section presents the information of the characterization of the IAI in which the areas that will have impacts related to mobility, the topic of landscape, the vibrations during the construction stage, visual and noise pollution, among others, are contemplated. The data presented here is a part of a characterization of secondary sources and population estimates of socioeconomic diagnoses that have been developed by different institutions in this territory.

When it comes to the characterization of the DAI, the social units that will be involuntarily displaced because their properties are required for the PLMB's construction are contemplated. Subsequently, a version of the preliminary resettlement plan of the properties is presented with information taken from primary sources (Chapter 5.2.3).

1.6.4.1 Components or Dimensions

When it comes to the socioeconomic media, the indirect area of influence was defined as the nine districts (Bosa, Kennedy, Puente Aranda, Antonio Nariño, Mártires, Santa Fe, Teusaquillo, Chapinero and Barrios Unidos).

The direct area of influence was identified, delimited and defined drawing from the criteria such as the impacts caused by the project on components such as air, noise, vibrations and vehicle detours caused the traffic management plans, establishing a direct area of influence on the socioeconomic media on a block, side by side along the entire lay out and three hundred meters in the stations.

The characterization was built as of the identified area, and it was structured in dimensions or components in which the characteristics of the indirect and direct area of influence are described. The objective of this structure is to identify the cross-cutting impacts on the component, which is to say, to learn of the impact on the economic activities in the corridor and on the existing infrastructure, in order to propose measures that apply to the entire corridor from an equality and equity approach.

The DAI's information is presented for each one of the six areas in which the corridor was segmented for advancing social management.

Table 1.6.3 DAI areas of Section One of the First Metro Line of Bogota

Area N.	Address	Districts it covers
1	From canal Cundinamarca, Portal Américas until Carrera 80 (Av. Abastos)	Kennedy
2	From Av. Carrera 80 (Av. Abastos) until Av. Carrera 68	Kennedy
3	Avenida Carrera 68 until Av. NQS	Kennedy, Puente Aranda and Antonio Nariño
4	From Av. NQS, Avenida Caracas with Calle 8ª sur until Avenida Calle 1ª	Antonio Nariño, Santa Fe, Mártires
5	Avenida Calle 1ª with Av. Caracas until Calle 26	Santa Fe and Mártires
6	Avenida Caracas from Calle 28 until Calle 80	Barrios Unidos, Chapinero and Teusaquillo

Source: Metro BOG Consortium, 2017

The dimensions by which the characterization was performed contain the following information and main characteristics:

Demographic dimension: Population dynamics, historical facts, population trends; population structure by gender, age (age groups), population trends and other data that allow getting to know population dynamics and population structure. In the results of the data, it was identified that Kennedy and Bosa and the largest districts. The former hosts 15% of the city's total population and the latter 9.1% of the city's total population, while Santa Fe and Los Mártires hold 1,2% of the total population.

Spatial dimension: Describes the characteristics of the provision of public services in terms of coverage and quality, and shows the conditions of the provision of social services such as education, health and recreation, describing the existing infrastructure in the area and the population's bond with it.

When it comes to public services, Bogota has a public services coverage of almost 100% in almost every neighborhood (Bogotá como vamos, 2015). In correspondence with the areas where the PLMB lay out is found, public services have coverage of around 95%.

With respect to social services, as they relate to health services, the affiliation percentage to the contributory regime has stayed relatively constant. Nevertheless, there was a significant increase in 2015, achieving 77% affiliation. The affiliation to the subsidy regime has stayed constant, at 16%, while 3% of the population is affiliated to some exceptional regime, and it is estimated that the remaining 4% are not linked to any system (Bogotá como vamos, 2015). When it comes to the health infrastructure, 30 healthcare facilities can be identified in the Kennedy District and 24 in the Mártires District, among them the San José Hospital, the La Misericordia Hospital and the Mederi Hospital.

The educational offer at a local level is very extensive between private and public schools. Some districts have become educational sectors in which the dynamics of the area have been reconfigured.

Housing data shows that the Kennedy District has 276.800 homes, twice as many as Bosa and three times the number of homes in Puente Aranda.

Economic dimension: Aspects such as territorial planning and land use, the job market, productive processes, development hubs and the dynamics of public space occupants are presented and analyzed, making the formal and informal business conditions evident.

The districts with the greatest number of registered businesses as at May 31, 2017 are Kennedy, Chapinero, Barrios Unidos and Puente Aranda, representing 62% of the companies located in the First Metro Line of Bogota's indirect area of influence. The districts with the smallest number of companies are Bosa and Antonio Nariño.

Cultural dimension: This dimension describes the historical background and relationship with the environment for the IAI and the DAI, identifies National and District Places of Cultural Interest and the historical places and milestones that are a part of the population's cultural structure within the DAI. In this dimension, a cultural diagnosis is addressed from the aspects that relate to the project, such as mobility and civic culture. The latter is one of the axes of the Development Plan and seeks to generate a transformation of the citizenry and its relationship with the city. Furthermore, it approaches the city's cultural heritage with special relevance for that which is located within the DAI.

The following places of cultural interest were identified in the main characteristics of this dimension: National Places of Cultural Interest: 6, District Places of Cultural Interest: 461, Sectors of Cultural Interest: 5, Personal Property: 36. For the project, it is identified that the only place of cultural interest (BIC in Spanish) that will be affected is the Héroes monument. The construction of the maneuvers queue is planned for this area.

The Héroes monument has been declared two things: first, as a National Place of Cultural Interest by means of Resolution 395 of March 22, 2006, for the bronze sculpture; while the rest of the monument has been declared a District Place of Cultural Interest. The Places of Cultural Interest (BIC in Spanish) are found in Chapter 7, which is about Evaluation and Environmental Risks, Section 7.1.4.3.12.

Organizational policy dimension: It describes the general panorama of the organization and institutional and communal presences related to the project. The structural projects are presented at a local level and the actors and social networks of the territories to be intervened are described, as well as their dynamics and relationships.

The 13 sectors of the District Administration or secretaries are present with their respective entities in all of the city's districts, including the nine that are a part of the study's IAI: Environment, Culture and Recreation, Economic Development, Education, Mobility, Women, Government, Habitat, Treasury, Legal, Planning, Health, Social Integration and Security.

On a communal level, 368 Community Action Boards are present in these districts. On top of that, there are 24 neighborhood associations in Chapinero.

Archeological aspects: In this item, the certificates of delivery are annexed before the Colombian Institute of Anthropology and History - ICANH, of the preventive archeology program, in accordance with what is established in Law 1185 of 2008.

The archeological works of the First Metro Line of Bogota were divided into two phases. The first one consists of an archeological diagnosis of what will be the Metro line from Portal de Las Américas until

Calle 72 with Av. Caracas. A zonification and an Archeological Management Plan, which must be implemented at the time of construction of the works, were carried out in said diagnosis.

Conclusions of archeological prospecting: According to the Archeological Management Plan delivered to the ICANH and before beginning construction, test wells must be dug at the points where the viaduct's pilings will be located. During the construction stage, the Archeological Management plan will implement archeological support during the intervention and excavation activities, with the objective of archeological monitoring.

A prehispanic ridge registered at the Yard and Shop area during the archeological prospecting stage, similar to those registered in archeological studies of the Bogota Savannah. For the construction stage, three stratigraphic cuts will be made in the Archeological Management plan that must be done before the Works begin.

When it comes to areas that were not prospected because they are intervened areas with buildings, the Archeological Management Plan will implement prospecting activities before beginning the works.

Development Trends: The trends and visions for the future are described according to the different planning instruments, carrying out an analysis from the city of Bogota a region that takes into account the intervention projects, plans and programs projected by the District Planning Office.

The objective in Bogota and the region is to generate territorial, environmental and sustainable food development emanating from competitiveness and innovation. (Secretaria Distrital de Planeación, 2016)

13 projects are planned for the project area's area of influence, in which is the TransMilenio project on Carrera 7, the extension of Avenida Ciudad de Cali into the TransMilenio system, between avenida circunvalar in the south and avenida calle 17, Expansions to the Yards and Trunk TransMilenio System Portals and Troncal Av. 68 from NQS until Av. Suba.

1.7 ENVIRONMENTAL AND SOCIAL ASSESSMENT

Environmental assessments identify, describe and evaluate the environmental impacts generated by the project, for which two scenarios have been analyzed: a) the scenario without the project and b) the scenario with the project.

The scenario without the project corresponds to the current state of the media (abiotic, biotic and socioeconomic) and the current alteration indicators that will interact with the impacts that the project will generate. The scenario with the project evaluates the effects and impacts caused by the project in its construction and operation stages on the components of each media.

The "ad hoc" methodology of environmental assessment that was used contains the criteria and indicators used in various environmental and social studies in response to the requirements of national, regional, local and online environmental authorities with international trends, in which the analyses of the cumulative impacts, the regional impacts, and their synergistic effects are included, among others.

The results obtained from the environmental and social assessment process are the following:

In relation to the Abiotic Media, the main identified impacts come from the alteration of the landscape, modification of ambient noise levels and alteration of air quality. These are the main negative impacts

from the construction activities to be performed. These impacts are classified as significant in the scale developed in the construction stage. In the operation stage, these impacts change their character to positive due to the inclusion of the metro in the transportation system and the landscape adjustments made throughout its lay out.

The rest of the impacts related to this component are moderately significant and slightly significant except for the positive impact that harnessing construction materials involves, due to the reduction and reutilization of demolition and construction waste.

In relation to the Biotic Media, the main identified impact corresponds to the impact on plant cover. Said significant impact is due to an intervention for silvicultural management (felling or transfer) of the individuals located on median strips in the roadway corridors associated with the PLMB, as well as the entirety of the individuals located on the El Corzo property (Yard and Shop area). The loss of plant cover due to civil work activities for stations and the Yard and Shop is also qualified as a moderate impact.

With respect to the Socioeconomic Media, the following main impacts have been identified:

- The involuntary move of the population during the construction stage due to the purchase of properties required for the project's construction. Social units of different types will be moved: social housing units (USH in Spanish), Social Socioeconomic Units (USSE) and economic units (UE). Therefore, it will be necessary to formulate and implement a resettlement plan.
- Impact on heritage. This impact is directly related to the impact on the Los Héroes Monument located on Calle 80 with Av. Caracas. Due to the construction of the maneuvers queue, this monument must be relocated.
- The change in formal business dynamics due to activities of the work such as closing sidewalks and public spaces, and the difficulty of pedestrian and vehicular access, which may come into play by discouraging buyers from passing through the sector.
- The change in informal business dynamics that take place in the public space and do not have the respective authorization from the competent institutions, is generated by closing sidewalks and public spaces during Project execution. The description of this impact will consider the forms of occupation by informal vendors (stationary, semi-stationary or mobile) who we will herein call Occupants of Public Space (OEP in Spanish).
- The alteration of pedestrian and vehicular mobility. According to what communities have expressed and has been observed during field tours, the roadways through which the Metro is projected to pass currently have significant mobility issues, especially at rush hours. For this reason, the impact on mobility represents one of the greatest concerns among the communities in the PLMB's difference layout areas.
- Impact on the infrastructure and damage to third parties associated with possible changes to the structural characteristic of properties, facades, internal and external components, among other things, generated by the project's activities in the use of machinery, as well as the mobilization of large scale vehicles for transporting cargo. There may also be impacts on adjacent properties during structure demolitions.

The environmental assessment process that was carried out allows reaching the fundamental conclusion that the project does not produce any critical impact during either the construction or the operation stage. Therefore no environmental or social effects have been identified that would make the project non-viable. The assessment identifies significant impacts that with the application of management measures that are established in this Environmental and Social Impact Study mitigate and correct the impacts caused by the construction of the project.

Furthermore, the implementation of the PLMB will generate positive impacts associated to mobility, urban designs, rebuilding public space and the use of an electronic mass transit system. The positive

impacts identified in the preconstruction and construction stages are: Temporary job creation, change in citizen participation for building urban life, change in occupational dynamics and land use value and the reconfiguration of the interinstitutional network for building urban life around the First Metro Line.

The ranking of environmental and social impacts for the preconstruction, construction and operation stages of the PLMB are in the following tables.

Table 1.7.1 Ranking of environmental impacts for the preconstruction and construction stages

Ranking of the project's environmental impacts (preconstruction and construction)	Qualification		
Impact on heritage	-6.48	Negative	Significant Impact
Involuntary transfer of population during construction stage	-6.37	Negative	Significant Impact
Landscape alteration	-6.13	Negative	Significant Impact
Generation of expectations and conflicts	-6.07	Negative	Significant Impact
Alteration of pedestrian and vehicular mobility	-5.98	Negative	Significant Impact
Modification of ambient noise levels	-5.98	Negative	Significant Impact
Impacts on plant cover	-5.91	Negative	Significant Impact
Alteration of land quality	-5.88	Negative	Moderately Significant Impact
Alteration of air quality	-5.86	Negative	Significant Impact
Impact on urban green zones	-5.26	Negative	Moderately Significant Impact
Impact on wildlife habitats associated with plant cover	-5.24	Negative	Moderately Significant Impact
Alteration of the main ecological structure	-5.01	Negative	Moderately Significant Impact
Change in the economic dynamics of formal business	-5.01	Negative	Moderately Significant Impact
Impact on infrastructure and damage to third parties	-4.93	Negative	Moderately Significant Impact
Change in the economic dynamics of informal business	-4.72	Negative	Moderately Significant Impact
Cultural and urban renovation	-4.52	Negative	Moderately Significant Impact
Settlement impacts	-3.95	Negative	Moderately Significant Impact
Modification of vibration levels	-3.46	Negative	Slightly Significant Impact
Impact on endemic, protected, or threatened plant species	-2.64	Negative	Slightly Significant Impact
Alteration of the quality of subterranean water	-2.2	Negative	Slightly Significant Impact
Temporal decrease of piezometric levels	-1.66	Negative	Slightly Significant Impact

Ranking of the project's environmental impacts (preconstruction and construction)	Qualification		
Harnessing of construction materials through diminishing and reusing construction and demolition waste	3.74	Positive	Slightly Significant Impact
Temporary job creation	4.55	Positive	Moderately Significant Impact
Change in citizen participation for building urban life	4.93	Positive	Moderately Significant Impact
Change in occupational dynamics and land value	5.04	Positive	Moderately Significant Impact
Reconfiguration of the interinstitutional network for building urban life around the First Metro Line	5.44	Positive	Moderately Significant Impact

Table 1.7.2 Ranking of environmental impacts for the operation stage

Ranking of the project's environmental impacts (operation)	Qualification		
Modification of ambient noise levels	-5.87	Negative	Slightly Significant Impact
Settlement impacts	-4.65	Negative	Moderately Significant Impact
Modification of vibration levels	-3.48	Negative	Slightly Significant Impact
Reduction of GHG emissions	5.32	Positive	Moderately Significant Impact
Change in the economic dynamics of formal business	5.34	Positive	Moderately Significant Impact
Landscape alteration	5.58	Positive	Moderately Significant Impact
Cultural and urban renovation	5.64	Positive	Moderately Significant Impact
Alteration of air quality ³	5.96	Positive	Significant Impact
Alteration to pedestrian and vehicular mobility	6.24	Positive	Significant Impact

Cumulative impacts are those that result from successive, incremental and/or combined effects of an action, project or activity. In this way, Cumulative Impact Assessment and Management (CIAM) is essential to risk management due to the increasing pressure from systemic risk factors such as climate change, scarcity of water, the decline in the biodiversity of species, the deterioration of ecosystems and the modification of socioeconomic and population dynamics, among others.

In said analysis, the projects defined in the Economic, Social, Environmental and Public Works Development Plan 2016 - 2020 "*Bogotá Mejor para Todos (A Better Bogota for Everyone)*" (District Agreement 645 of 2016), the Bogota Land Use Plan (District Decree 190 of 2004) and the Mobility Master Plan (District Decree 319 of 2006) were contemplated, in which the need to create an Integrated Public Transport System – SITP – that completes the city's network of trunk corridors,

³ Alteration from atmospheric emissions.

taking the best element of each one of the current designs and improving the coverage, accessibility, cost, safety, connectivity, and social benefit conditions for citizens was proposed. The studies that were taken into account in the analysis are presented in the following table.

Table 1.7.3 Implemented and planned projects

Project	Estimate at the beginning of construction			
	Current	Short-term (< 2 years)	Medium-term (Between 2 and 10 years)	Long-term (> 10 years)
Transmilenio Transportation System, Avenida Caracas	X			
Modal Interchange Stations in the Norte, Calle 80, Calle 13, NQS, and Usme accesses			X	
Expansions of the TransMilenio Trunk System's Yards and Portals			X	
Transmilenio Zone System Yards			X	
Existing Operational Trunk Turnarounds and Connections			X	
Avenida Boyacá Trunkline from Yomasa until Av. Guaymaral			X	
Carrera 7a Trunkline from Calle 32 until Calle 170		X		
Extension of the 80 Trunkline from Portal Calle 80 until the District's Border with Funza – Cota				X
Extension of the Caracas Trunkline from Molinos to Yomasa			X	
Av. 68 Trunkline from NQS until Av. Suba			X	
Avenida Villavicencio Trunkline form NQS until Av. Boyacá				X
Extension of Calle 26 from the Portal Dorado			X	
Extension of the TransMilenio system in Avenida Ciudad de Cali between avenida circunvalar del sur and avenida calle 17.		X		

In accordance with the analysis carried out and taking into account the project's projections to be executed in the short, medium and long-term, it can be concluded that said projects and activities associated to said projections would have a greater impact regarding the additional relative portion that the PLMB Project would generate, which is less in every case. This way, it can be said that the greatest risks from cumulative impacts in the study area are associated with the city's current conditions, and are not specifically caused by the PLMB project.

The cumulative impacts will present themselves if these projects are materialized before or during the PLMB's construction and operation, as well as other projects related to the transportation sector.

The activities for improving relations with the communities of the area of influence can include actions to improve their quality of life - even more if they are associated with the PLMB project construction and operation's direct impacts within the framework of applicable environmental regulations.

1.7.1 Benefits of the Project's Environmental and Social Impacts

The following is an analysis of the benefits associated with the project's positive environmental and social impacts at a country, department, local, and neighborhood level. An evaluation of those benefits looks at the management plans associated with the project, which generate environmental and social benefits in the project's direct area of influence.

In addition, it presents the opinion that the PLMB is environmentally and socially sustainable, in line with the socioeconomic evaluation for the First Metro Line of Bogotá, presented on September 13, 2017, by the companies Deloitte Consulting SLU, Spain, and Deloitte Asesores y Consultores Ltda. Colombia, contracted in January 2017 by the Inter-American Development Bank (IDB). This was done in the framework of the technical cooperation for the *"Socioeconomic Evaluation and Cost-benefit Analysis of the First Metro Line of Bogotá, Review and Evaluation of the First Metro Line of Bogotá - PLMB project,"* as part of the documentation indicated in CONPES 3882, that is necessary for the First Metro Project to be eligible for financing by the Nation.

The assessment of the impacts is associated to guarantee in one way or another environmental and social sustainability in the short, medium, and long run. Given this, as a result of the PLMB project there are a series of environmental and social benefits associated with the project's positive impacts:

- The reconfiguration of the inter-institutional network for building urban life around the First Metro Line is the largest Moderately Significant positive impact in the pre-construction and construction stages. This impact is related to the goal of positioning the Metro project at the district level and for it to be articulated with the different district institutions for promoting, developing, and executing urban projects, especially urban renovation, as well as with the construction and improvement of public spaces in the areas of influence of the Metro line, with sustainability in order to generate urban life. Also in the generation of a Metro culture to foment recognition and appropriation of the Bogotá Metro by citizens.
- The change in the occupation dynamics and land value, the assessment of the impact focuses on possible effects of the project of this magnitude on occupation dynamics and land value in the neighborhoods located in the area of influence. Expectations are high on the part of the public relative to the purchase of properties and the appreciation or depreciation of property values. Although it is not possible to predict with certainty what the effect of the construction and operation of the project will be, it is expected it can be validated based on other experiences. With the construction and operation of the PLMB, an increase in the price of land can be expected, taking into account the system's capacity to significantly reduce users' travel time, which translates into well-being for the owners of properties located in the zone of influence. This change, however, will only be seen at such a time as properties are bought and sold in the real estate markets.
- The impact related to change in citizen participation is related to the way in which citizens organize and the mechanisms they use to participate in and influence government decision. The forms of citizen organization are seen in the different sectors according to their economic, demographic, and social conditions.
- The formation of citizen committees is related to the creation of new arenas for participation and expressing opinions within the community, including citizens that were previously not involved in scenarios such as this.
- During the technical structuring of the PLMB, the community organizations in the corridor have mobilized to participate in the processes for sharing information. Likewise, several of

these community organizations have become involved in zonal citizen committees to produce proposals that will benefit the communities. For that reason, during the pre-construction, construction, and operation stages, it is expected that this participation will be more constant and active along the length of the corridor.

- Job creation refers to direct and indirect jobs that will be created by the construction and operation of the First Metro Line of Bogotá. Although activity requires labor, it is through contracting that jobs are created. It can be said that this cuts across all phases of the project and will be continuous, bearing in mind the frequent rotation of personnel in major infrastructure works.
- The environmental and social benefit is associated with the positive impacts coming from operating an electric transportation system, which are related to improved travel times for people, attention to the city's mobility problems, cultural and urban renovation, and improvement of air quality by reducing local pollutants (NO₂, CO, SO₂, PM₁₀, PM_{2.5})
- It is important to highlight that one of the greatest environmental benefits generated in the operation stage of the PLMB is the reduction in Greenhouse Gas Emissions (GHG), estimated at 1.8 million tCO₂e during the first 30 years of operation, according to the study done in the year 2016 by the IDU related to the *"Environmental Benefits of the Project for the First Metro Line of Bogotá, Reduction in Greenhouse Gas Emissions."* This is articulated with the National and District Policy on Climate Change.

1.7.2 Analysis of Possible Environmental Liabilities

Considering the activity to acquire the properties that will be intervened to build the PLMB, it is important to highlight that three properties were identified whose current use is the provision of automobile services (service stations that supply fuels) and that could have environmental liabilities, and for which it would be necessary to establish, assign and/or assume said liabilities through the measures established and required by the current environmental legislation. A program for environmental liabilities was therefore formulated that forms a part of the ESMP and that establishes measures and actions for controlling, preventing, and mitigating the impacts or the environmental liabilities generated by the project's intervention in the service stations and related facilities that will be intervened. The details on managing the environmental liabilities are found in Chapter 8 of Environmental and Social Management, article 8.1.6.6.

1.8 DEMAND FOR, USE AND USUFRUCT OF AND/OR IMPACT ON NATURAL RESOURCES

1.8.1 Surface Water and Groundwater

Project development in the construction and operation stage does not require the uptake of water from surface water courses or natural groundwater.

Water will be provided for the development of the project's activities from the uptake and distribution infrastructure already installed at the Empresa de Acueducto, Aseo y Alcantarillado de Bogotá E.S.P. in the area of influence.

1.8.1.1 Human Consumption during the Construction Activities

To estimate the provision of water by the number of users, data has been used from "Technical Regulations for the Drinking Water and Basic Improvements Sector. RAS-2000," Section II, Title B,

Water Supply Systems, Republic of Colombia, Ministry of Economic Development, Drinking Water and Basic Improvements Division.

According to the average value considered, in the case of the PLMB the number of estimated workers during the entire execution of the work is as follows:

Table 1.8.1 Estimated water consumption during the construction of the works

WATER CONSUMPTION DURING THE CONSTRUCTION PROCESS								
Section	# of workers	Daily provision (l/worker/day)	Consumption (l/day)	(Consumption m ³ /day)	Days of the month worked	Time for the development of works (months)	Annual water consumption (m ³)	Total consumption expected (m ³)
1	4000	41.7	166800	166.8	26	48	52041.6	208166.4
2	2000	41.7	83400	83.4	26	48	26020.8	104083.2
Total	6000	41.7	250200	250.2	26	48	78062.4	312249.6

Source: CONSORCIO METRO BOG, 2017

If needed, water can be purchased using water trucks or bottles for the project activities.

1.8.1.2 Industrial Consumption of Water

The estimated water consumption for the development of the PLMB will be required by the following activities:

- Estimated volume for producing concrete: 192,835 m³
- Estimated volume for fill: 211,815 m³
- Estimated volume for piles: 907,368 m³

The total water required is 1,312,018 m³

1.8.2 Discharges

In the stages of the construction and operation of the project, domestic and industrial wastewater will be generated that must be discharged into the general sewage system, along with wastewater coming from the construction processes.

1.8.2.1 Calculation of the Domestic Effluent of Workers

- Construction Phase

Clause **¡Error! No se encuentra el origen de la referencia.** Surface Water and Groundwater estimated the consumption of water associated with the workers in the construction phase, equivalent to 312,249.6 m³ (78,062.4 m³/year).

Assuming an average return flow of domestic wastewater of 80% of the total consumed, a total volume is established of 249,799.7 m³ (62,449 m³/year; 1.98 l/second).

1.8.2.2 Industrial Discharge

In the operation phase it will be necessary to take out an industrial discharge permit for the discharge generated by the industrial activity in the yard and shop. These discharges must be within the maximum parameters permitted defined in the current laws in effect.

1.8.3 Occupation of the Channel

According to the project designs, a permit must be requested to occupy a channel when the layout of the PLMB intersects with bodies of water, namely: Canal Tintal II (Av. Villavicencio between Av. Ciudad de Cali and Av El Tintal). In the framework of the Advance Utility Diversion, it will be the Empresa de Acueducto de Bogotá that will process this permit, since it will be in charge of the construction of the box culvert over the mentioned canal.

It should be noted that if in the final design phase the designs for the works include interference with a channel, the contractor of the work in the preliminary stage should carry out the process to request a permit to occupy a channel, in accordance with the criteria established by the competent environmental institution.

1.8.4 Atmospheric Emissions

In accordance with the construction process, increases in air pollution levels are associated with earth movements in the work (excavation of material, loading and transportation).

Materials will be obtained from plants near the project, and those plants must have the necessary permits according to the current environmental regulations at the time of project execution. The providers of materials will be those certified in the IDU directory.

Based on the above, no permit for atmospheric emissions is required for the execution of the First Metro Line of Bogotá. If the contractor must install concrete or asphalt plants or crushers, however, it will have to engage in the corresponding procedures for atmospheric emissions with the competent environmental authority, as applicable.

1.8.5 Construction Materials

The construction of the First Metro Line of Bogotá does not require Contractors of the works to go directly to the sources of materials. These will be provided by providers who have environmental management plans approved by the corresponding environmental authority and with current mining permits.

Among the materials required for the construction works are fill and rock aggregates for concrete. The providers of these materials may be found in the directory of providers of rock aggregates and rubble yards authorized by the IDU.

Table 1.8.2 Estimate for materials to be used in the PLMB

DESCRIPTION	QUANTITY m ³
Concrete	1,424,985
Asphalt	65,572
Paving stones	628,397
Aggregates for concrete	2,138,000

DESCRIPTION	QUANTITY m ³
Granular material fill	4,707,000
TOTAL	8,963,954

1.8.6 Solid Waste Products

1.8.6.1 Conventional Solid Waste

With the purpose of establishing the production of conventional waste products to be generated by the project from the activity of the different work fronts, waste production was estimated for each section of approximately 300 kg/day. This takes into account a per capita production of 0.30 kg/inhabitant/day (data based on what is stipulated in the Technical Regulations for the Drinking Water and Basic Improvements Sector - RAS of 2017, title F, Urban Cleanliness Systems), and a population of 1000 workers for the development of the activities.

Table 1.8.3 Estimate of conventional waste

Description	Unit	Value
Rate for production of solid waste products	kg/inhab/day	0.30
Number of workers	Person	1000*
Production of waste products	kg/day	300

(*) Number of workers estimated per section

1.8.6.2 Construction and Demolition Waste - CDW

Building the First Metro Line will generate waste coming from the excavation and demolition activities – CDW - in each of the stages for developing the project. The following results were obtained as the basis for calculating the estimated values in the feasibility phase.

Table 1.8.4 Quantities of excavation and demolition waste.

Project Stage	Activity	Quantity	Unit
Pre-construction	Demolition coming from current infrastructure	95,566	m ³
	Demolition coming from properties	562,175	m ³
	Stripping the yard and shop area	340,914	m ³
Construction	Pre-excavation	407,040	m ³
	Excavations yard and shop	606,193	m ³
	Excavations stations	218,687	m ³
	Excavations viaduct	962,539	m ³
Total		3.193.114	m ³

Source: Calculated by CONSORCIO METRO BOG

1.8.7 Silvicultural Treatment

The treatments recommended in this feasibility phase are based on the assessment of physical and sanitary conditions, the interference with project designs at the feasibility level, the landscape value, and the species. Of the total of 3,287 trees, 1,914 trees will receive conservation treatment, root pruning, or transplanting, and 1,363 trees will be cut down. Moreover, the landscaping design proposes planting 2,920 trees along the length of the corridor. Therefore, the inventory will go from 3,287 trees without the project to 4,834 trees with the project. It is important to indicate that the silviculture intervention permits, authorizations, and compensations are established by the environmental authority, the District Secretary of the Environment (SDA for the acronym in Spanish.)

1.9 ENVIRONMENTAL AND SOCIAL MANAGEMENT

1.9.1 Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) contained in this study has been prepared based on the feasibility study for the project and the Contractor will be responsible for updating the ESMP based on the final designs and before beginning the construction phase. This update will integrate monitoring, follow-up, and supervision measures so that the project is carried out under best national and international engineering practices.

This section contains the general guidelines for the contractor to prepare the specific management plans and programs that meet multilateral banking requirements, following the environmental regulations and policies established. Those programs were developed with the purpose of complying with best practices for the different project stages (pre-construction, construction, and operation).

The following table contains the management programs developed in the ESIS to control the impacts identified.

Table 1.9.1 Environmental Management Programs for controlling the impacts identified.

Media	Environmental Impact	Environmental Management Program	Data Sheet ⁴
ABIOTIC	Socio-environmental management	Compliance with environmental obligations	PM_GA_01
		Management for efficient use of water	PM_GA_02
		Program for supervision and monitoring of public utilities companies	PM_GA_03
	Usufruct of construction materials through diminishing and reusing construction and demolition waste	Management and disposal of surplus excavation materials	PM_AB_01
	Alteration of soil quality	Management of construction materials and equipment.	PM_AB_02
		Management of yard and shop	PM_AB_04
		Management of domestic, industrial, and special solid waste products.	PM_AB_03
		Environmental liabilities program: polluted soil, recommendation for remediation techniques (service stations)	PM_AB_06

⁴ The data sheets were named in the following manner:
PM: Management Plan; AB: Abiotic; B: Biotic; SE: Social

Media	Environmental Impact	Environmental Management Program	Data Sheet ⁴
		Preparation of the Plan for Comprehensive Management of Hazardous Wastes (PGIR RESPEL for the Spanish) for the work.	PM_AB_05
		Management of spills or leaks of liquid fuels.	PM_AB_07
		Management of used oils in the Capital District	PM_AB_13
		Program for managing temporary facilities	PM_AB_15
	Impacts on the landscape	Compensation program for the biotic media due to landscape impacts	PM_B_02
		Management and removal of plant cover and stripping	PM_B_03
		Management program for the biotic media due to impacts on the visual quality of the landscape.	PM_B_05
		Management of riparian buffer zones and surface bodies of water	PM_AB_14
	Alteration of air quality	Management of atmospheric emissions sources: air.	PM_AB_08
	Modification of ambient noise levels	Management of atmospheric emissions sources: noise.	PM_AB_09
	Vibrations	Management of atmospheric emissions sources: vibrations.	PM_AB_10
Reduction of greenhouse gases	Program for adaptation to climate change	PM_AB_12	
	Reduction of greenhouse gases	PM_AB_11	
BIOTIC	Impacts on plant cover	Management and removal of plant cover and stripping	PM_B_03
		Silvicultural management	PM_B_04
		Compensation for the biotic media due to landscape impacts	PM_B_02
	Impact on the habitat of wildlife associated with the plant cover	Management of urban land fauna	PM_B_01
SOCIO ECONOMIC	Generation of expectations and potential conflicts	Program for providing information and encouraging participation by stakeholders.	PM_SE_01
	Change in public participation in order to build urban life	Program for citizen strengthening for the construction of urban life of the First Metro Line of Bogotá	PM_SE_02
	Reconfiguration of the inter-institutional network for the construction of urban life around the first Metro line	Program for inter-institutional articulation for the construction of urban life around the first Metro line	PM_SE_03
	Alteration of pedestrian and vehicular mobility	Program for a sustainable culture of mobility	PM_SE_04
		Traffic management plan	PM_SE_01 3
	Impact on infrastructure and damages to third parties	Program for attention to impact on infrastructure and damages to third parties	PM_SE_05
	Temporary job creation	Program for social and employment inclusion	PM_SE_06

Media	Environmental Impact	Environmental Management Program	Data Sheet ⁴
	Change in the economic dynamics of formal trade	Program for economic sustainability. Plan to strengthen local development.	PM_SE_07
	Change in the economic dynamics of informal trade	Program for economic sustainability. Comprehensive plan for occupants of public space.	PM_SE_08
	Change in occupation dynamics and land values	Program for the Observatory on occupation and land values	PM_SE_09
	Cultural and urban renewal	Program for weaving the urban fabric of the First Metro Line of Bogotá	PM_SE_010
	Impact on cultural heritage	Management program to protect cultural heritage	PM_SE_011
		Management program for the Los Héroes Monument	PM_SE_012
	Involuntary movements of people during the construction stage	Resettlement program	PM_SE_013
	Impact on pedestrian and vehicular mobility	Traffic management plan	PM_SE_014

Source: METRO BOG Consortium, 2017

1.9.2 Occupational Health and Safety

The Occupational Health and Safety Plan was prepared as a guideline for the Contractor in order to guarantee the implementation of requirements in Occupational Health and Safety (legal, contractual, and all others that apply) in the construction stage of the PLMB.

This document does not limit the Contractor's responsibilities, but rather orients it on some specific topics. The clarification is made that in the case the requirements described in this document apply, they will not be the only responsibilities that must be met. The Contractor will fulfill the object of the contract ensuring safety for its personnel, equipment, and resources. It is the responsibility of the Contractor to engage in general and specific actions in the area of Occupational Health and Safety.

In addition, there is a Risk Management Plan (RMP), which is a tool to be used in the case of any emergency or threat that materializes during the construction of the Metro transportation system in the city of Bogotá. The RMP is part of a process of knowledge based on an analysis of threats, vulnerabilities, and risk assessment, and a subsequent definition of the response levels and organizational arrangements for the construction activities for the First Metro Line of Bogotá project.

During the construction stage, the following risks were defined, for which prevention and control programs were oriented: biomechanical (repetitive movements, posture, and manual load handling), physical (non-ionizing radiation, noise, and vibration), safety conditions (mechanical, on-site, confined spaces, work at heights, oxy-fuel cutting, technological, welding, and public), psychosocial (characteristics of the organization of the work, work day, job conditions), biological (bacteria, viruses, fungi), chemical (gases, vapors, and liquids), and natural phenomena. For the operation stage, the contractor must update the table with hazards and define the corresponding controls, according to the activities inherent to operating the transportation system (which should consider, among others: accidents with trains and with workers, accidents on the platforms, sexual harassment, and others).

In addition, the risks related to the operation of the PLMB have been identified. The risks were classified as having a natural, man-made, technical, logistical, or political origin. Natural risks consider

these three: seismic threats, mass wasting threats, and flood threats. In none of those three cases is the PLMB located in a zone of high risk.

1.9.3 Environmental Monitoring and Follow-up Plan

The Monitoring and Follow-up Plan includes monitoring and follow-up programs oriented toward evaluating the efficacy of the management measures established for attending to the physical, biotic, and social impacts of the project, and having the basic tools for determining in a timely manner any adjustments required to the established management measures, in line with the results obtained.

These plans must be adjusted to new conditions that arise during the construction stage of the works and the operation of the project.

1.9.3.1 Programs for Monitoring the Abiotic Media

- Program for comprehensive management of solid wastes – CDW
- Program for managing atmospheric emissions and noise control
- Program for controlling vibrations
- Program for Follow-up and Monitoring of water resources – crossings of bodies of water

1.9.3.2 Programs for Monitoring the Biotic Media

- Program for follow-up on vegetation

1.9.3.3 Programs for Monitoring Socioeconomic Media

- Program for providing information and encouraging participation by stakeholders.
- Program for citizen strengthening to build urban life around the First Metro Line of Bogotá
- Program for inter-institutional articulation for building urban life around the first Metro line
- Program for providing information and attending to pedestrian and vehicular mobility
- Program for attention to impact on infrastructure and damages to third parties
- Program for social and employment inclusion
- Program for economic sustainability
- for formal businesses
- Program for economic sustainability for occupants of public spaces
- Program for the Observatory on occupation and land values
- Program for weaving the urban fabric of the First Metro Line of Bogotá

1.9.4 Resettlement Plan

The resettlement process to be implemented has the main objective of mitigating and compensating impacts generated for population groups subject to the intervention, based on involuntary displacement or total or partial impacts on the properties required for the development of the First Metro Line of Bogotá.

This being the case, the layout of the First Metro Line of Bogotá will require a total of 1,462 properties, which are distributed in the nine districts through which the PLMB will pass: Bosa, Kennedy, Puente Aranda, Teusaquillo, Mártires, Santa Fe, Antonio Nariño, Barrios Unidos and Chapinero.

With the goal of having an approximation of the universe of people subject to resettlement in the 1,462 properties, a preliminary characterization was done, using non-participant observation. This, using a worksheet, permitted establishing 899 Social Housing Units - USH for the Spanish (exclusively), 343 Social Economic Units - USSE for the Spanish (exclusively), and 1,449 Socioeconomic Social Units⁵ – USSE for the Spanish, for a total of 2,691 Social Units that need to be moved.

Relative to the above results, it can be seen that in the western section of the corridor, from the yard and shop to av. Caracas with Calle 1ª) residential use predominates, while in the corridor of Av. Caracas (from Calle 1ª. to Calle 72) greater commercial and institutional use can be observed.

In the same way, and in accordance with the observation exercise, preliminary results were obtained relative to the estimated number of buildings, the type of building, type of use, identification of social units (housing and economic units), identification of economic activities, and fixtures.

In this sense, the following table shows that, of the buildings identified along the corridor, 547 are houses, 112 are buildings, 90 are lots without construction, 47 are warehouses, 19 are parking lots, 12 are house lots, and 5 are horizontal properties. Relative to the use of these buildings, 243 are for residential use, 168 are commercial, 331 are for mixed-use, and 90 are not in use.

Table 1.9.2 Distribution of type of construction

Type of Construction	Number
Building	112
Horizontal Property	5
House	547
Lot for a house	12
Lot	90
Warehouse	47
Parking lot	19
Total	832

Source: Calculated by EMB – Department of Communications and the Public, 2018.

Currently, through Agreement 1021 of 2017, the IDU conducted the socio-demographic study of the first 129 properties that form a part of the 1,462 properties mentioned, those identified as priority one, that are necessary for freeing up the land for building the viaduct for the First Metro Line of Bogotá – PLMB. Those 129 properties are located in the four main curves of the layout (Curve one, 1 property; Curve two, 76 properties; Curve three, 18 properties, and Curve four, 34 properties). For their acquisition, the corresponding technical inputs have been prepared (topographic surveys, title studies, and commercial appraisals), as well as the formulation of the Partial Resettlement Plan.

In those 129 properties, 252 social units were identified, of which 38.0% correspond to the economic units, 29.9% to housing units exclusively, and close to 11.8% correspond to households that are engaged in some sort of commercial activity on the property or that generate an income, classified as socioeconomic units. Lastly, close to 20% of the social units identified act as landlords. Relative to the form of holding, 60.02% corresponds to renters, followed by 34.6% who are owners, and then possessors, holders, and sub renters are distributed in smaller percentages.

⁵ With residential and economic activity at the property.

The units mentioned above will be subject to resettlement. In this sense, the table below presents a synthesis of the Resettlement Plan, structured by the types of property impact, impacts generated on USH, USE and USSE⁶⁶, and the programs to mitigate said impacts.

Table 1.9.3 Resettlement and social management plan

RESETTLEMENT AND SOCIAL MANAGEMENT PLAN		
Direct Area of Influence		
Type of property impact	Impacts on USH, USE and USSE	Programs for mitigating the impacts
Total	<p>The population groups located in the areas of direct impact experience impacts and consequences on their habitat and their daily socio-relational and socioeconomic dynamics, given the definitive loss of their home or property in which they develop their economic activities.</p> <p>They must also face a process of reestablishing social fabric in their new living environment and adaptation to their new home, or reestablishing commercial networks (in the case of USE or USSE)</p>	1. Program for Communication and Dissemination
		2. Program for Social Advising
		3. Program for Technical Advising and Assistance for Units that develop economic activities
		4. Program for consulting on property management
		5. Program for Legal Advising
		6. Program for Financial Considerations
		7. Program for Follow-up and Monitoring
Partial	<p>The population groups located in the areas of direct impact experience impacts and consequences on their habitat and their daily socio-relational and/or socioeconomic dynamics, given the definitive loss of part of their home or property in which they develop their economic activities.</p>	1. Program for Communication and Dissemination
		2. Program for Social Advising
		3. Program for Technical Advising and Assistance for Units that develop economic activities
		4. Program for consulting on property management
		5. Program for Legal Advising
		6. Program for Financial Considerations
		7. Program for Follow-up and Monitoring

⁶⁶ USH: Housing Social Unit
 USSE: Socioeconomic Unit
 UE: Economic Unit
 UR: Rental Unit

Source: Calculated by EMB – Department of Communications and the Public, 2017.

In conclusion, the Resettlement Plan has the purpose of mitigating and compensating impacts on population groups subjected to the intervention, based on involuntary displacement or partial impacts on the properties required for the construction of the First Metro Line of Bogotá.

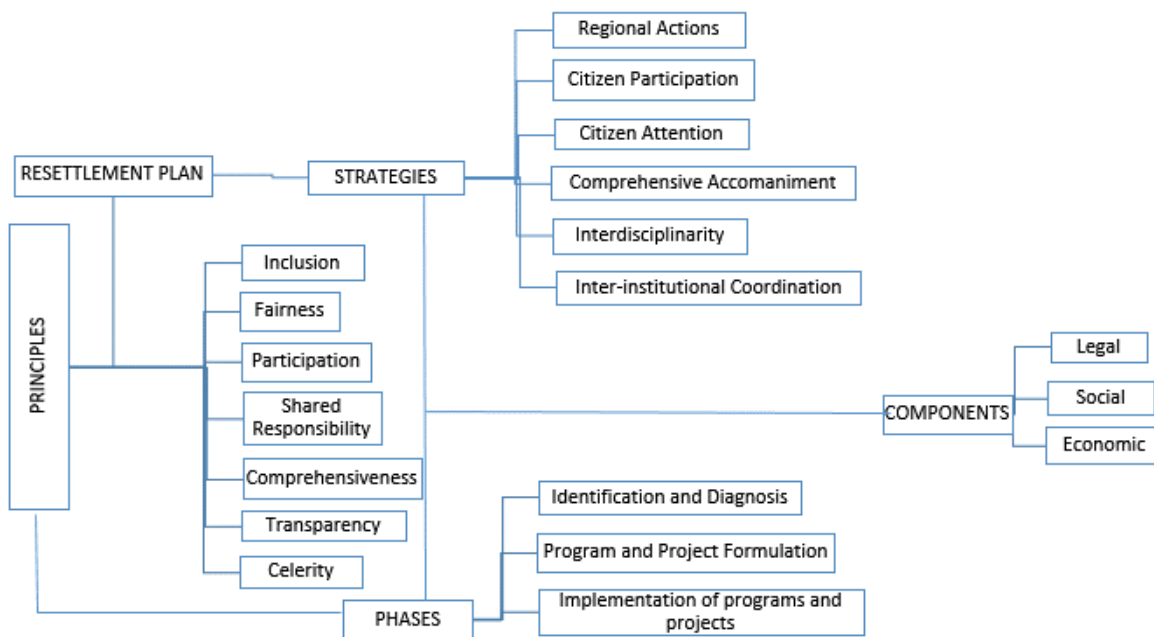


Figure 1.9.1 Resettlement Plan Flowchart, 2018

Source: Empresa Metro de Bogotá, S.A

To date, and in accordance with the proposed methodology, proper intervention with the population in need of resettlement is expected to be carried out in accordance with the type of impact and level of vulnerability. Along this line of thinking, the EMB has begun the characterization of the social units located in the direct area of influence of the PLMB that will be subject to resettlement (excluding the 252 resident social units or users of the 129 properties that have already been characterized). This information will be used to formulate the General Resettlement Plan for the PLMB project.

1.9.5 Comprehensive Management Plan for Occupants of Public Space

In compliance with what is established in Resolution 1023 of 2017 issued by the Ministry of Transportation with respect to managing Occupants of Public Space (OEP for the Spanish), and more specifically informal vendors located temporarily in the public space existing immediately around the PLMB, it has been determined that, based on the diagnosis⁷, a plan will be formulated and implemented for comprehensive attention to them. The attention will have the purpose of improving the living conditions of the social units identified in the mentioned diagnosis that are dependent on

⁷ The diagnosis includes location habits, schedule for the economic activities exercised, socioeconomic conditions, level of vulnerability, and other aspects.

exercising informal economic activities. This plan will include programs for formalization, training, employability, and relocation of activities in spaces managed by the Capital District.

Table 1.9.4 Comprehensive plan for occupants of public space for the DAI

Comprehensive Plan for Occupants of Public Space for the DAI		
Affected Population Group	Impact	Programs for mitigation and management
Occupants of public spaces in the component of informal vendors	Permanent loss of informal manner of working as a source of income. Informal vendors must be included in a process to reestablish commercial alternatives under new ways of exercising their economic activity.	1. Comprehensive program for entrepreneurialism and business strengthening
		2. Program for training and support for getting a job.
		3. Program for associative marketing
		4. Project for relocation by sectors and improvement of rental conditions.

Source: Calculated by EMB based on information from the Institute for the Social Economy – IPES

The Comprehensive Plan for Occupants of the Public Space of the PLMB will be developed in these three phases:

1. Plan to implement during the stages prior to the construction of the PLMB.
2. Plan to implement during the construction of the PLMB.
3. Plan to implement during the operation stage of the PLMB.

According to the report presented by the Institute for the Social Economy – IPES, informal street vendors were identified at the intervention points of the area of influence of the First Metro Line – PLMB in the districts of Kennedy, Los Mártires, Puente Aranda, Santa Fe and Chapinero. On a preliminary basis 1,104 informal street vendors were identified at nine (9) points where they conglomerate, as follows:

Kennedy District:

1. Kennedy Hospital: 14 vendors identified, equivalent to 1.26% of the vendors found in the area of influence of the First Metro Line.
2. Avenida Primero de Mayo between Carrera 10 and 80 Sur: 80 vendors identified, equivalent to 7.22%.

Puente Aranda District:

3. Transition Zone Ciudad Montes: 12 vendors identified, equivalent to 1.08%.

Mártires District:

4. Central Cemetery: 11 vendors identified, equivalent to 0.99%.
5. La Estanzuela: 351 vendors identified, equivalent to 31.68%.

Santa Fe District:

6. International Center: 123 vendors identified, equivalent to 11.10 percent.
7. San Victorino: 242 vendors identified, equivalent to 21.84% percent.

Chapinero District:

8. Calle 72: 232 vendors identified, equivalent to 31.22%.

9. Avenida Caracas between Calle 45 and Calle 72: 43 vendors identified, equivalent to 5.79% of the vendors found in the area of influence of the First Metro Line.

Table 1.9.5 Summary of identification of street vendors located in the section of the PLMB

VARIABLE	NUMBER
Informal Vendors in the Identification	1,104
Vendors with Individual Vendor Registration, or RIVI in Spanish	0313
Vendors not registered in RIVI	0791
Vendors who accepted IPES offer	0848
Vendors who did not accept IPES offer	0053
Vendors that did not provide information on the IPES offer	0203
Vendors who are senior citizens	0203
Vendors belonging to ethnic groups	0024
Men/women vendors who are sole heads of household	0144
Vendors victims of armed conflict	0103
Vendors with disabilities	0019
Vendors belonging to LGBTI population	0006
Vendors who are caretakers of disabled persons	0002
Vendors who are demobilized persons	0002
Vendors belonging to sex worker population	0001
Vendors who are minors	0001
Vendors who are foreigners	0016

Source: Mission Tool – HEMI as of 02/feb/18

1.10 PROCEDURES AND PROGRAMS ASSOCIATED WITH THE CONSTRUCTION STAGE TO BE REQUESTED FROM THE CONTRACTOR

The following are the procedures and programs to be incorporated during the next stage that should be done by the Project Contractor.

Contractor Management

- Supervision and inspection procedure
- Contracting for goods and services procedure
- Subcontractor management procedure
- Procedure for internal supervision by the contractor
- Document preparation and control procedure.

Environmental Management

- Procedure for reporting findings and nonconformities
- Procedure for protecting rivers and water channels during the construction
- Best environmental practices procedure
- Program for monitoring implementation of the waste management plan
- Program for monitoring implementation of the plan for rehabilitation of affected areas
- Program for monitoring implementation of the closing and abandonment plan
- Program for monitoring and control of landscape impacts

Industrial Safety

- Procedure for bringing visitors to the works
- Procedure for building and installing screening walls around the work
- Procedure for building and installing piling
- Procedure for organizing materials
- Safe stacking procedure
- Procedure for work in confined spaces
- Procedure for issuing work permits
- Procedure for high risk work
- Procedure for certifying load lifting equipment
- Procedure for certifying construction equipment such as scaffolding and ladders, among others
- Procedure for personnel induction
- Procedure for document management and control
- Audit procedure
- Procedure for responding to hydrocarbon and chemical substance spills
- Program for monitoring the implementation of the contingency and emergency response plans

Occupational Health

- Vaccination and prevention procedure
- Procedure for investigating incidents and accidents
- Procedure for health inspections of the work and temporary camps
- Procedure to avoid use of alcohol and drugs
- Medevac medical emergency procedure

1.11 BUDGET

The consolidated environmental budget is \$135,173,037,794 pesos and the social budget is \$133,576,176,214 pesos. It is also necessary to mention that the social budget does not include the costs of the resettlement program and the archaeology program. The latter is not included because the Management Plan needs to receive approval from the ICAHN. Moreover, the budget does not include mitigation, control, and compensation measures derived from the updating of the Environmental and Social Management Plan and the Occupational Health and Safety Management System Plan, which should be adjusted in the next phase of the project.

The detailed budget by program is indicated in the following tables.

Table 1.11.1 Consolidated environmental budget

CONSOLIDATED ENVIRONMENTAL BUDGET	
Program	Total Amount
Program for compliance with environmental obligations	\$ 36,418,649,107
Program for managing temporary facilities	\$ 12,070,437,424
Program for management and disposal of surplus excavation materials	\$ 30,510,852
Program for managing industrial and special solid waste products.	\$ 5,554,045,337
Environmental liabilities program: polluted soil, recommendation for remediation techniques (service stations)	\$ 6,450,330,000
Program for managing spills or leaks of liquid fuels.	\$ 471,178,800
Program for managing atmospheric emissions sources: air and Program for managing noise and vibrations	\$ 68,771,021,204
Program for Follow-up and Monitoring of water resources – crossings of bodies of water	\$ 133,405,902
Program for silvicultural management	\$ 3,839,470,333
Program for managing urban fauna	\$ 105,140,001
Compensation program for the biotic media due to landscape impacts	\$ 1,328,848,833
Total	\$ 135,173,037,794

The costs associated with the following programs form a part of the overall project budget.

- Management program for efficient use of water
- Program for supervision and monitoring of public utilities companies
- Program for managing construction materials and equipment.
- Program for preparing the comprehensive plan for managing hazardous wastes from the works.
- Program for managing used oils in the Capital District
- Program for adaptation to climate change

In addition, in the next phase of the project, the cost of the following programs should be estimated:

- Program for managing the Yard and Shop Facility.
- Program for reducing greenhouse gases – GHG.

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Table 1.11.2 Consolidated social budget

CONSOLIDATED SOCIAL BUDGET	
PROGRAM	Total Amount
Program for community information and relations	\$47,341,452,000
Program for citizen strengthening to build urban life around the First Metro Line of Bogotá	\$ 6,469,332,043
Program for inter-institutional articulation for building urban life around the first Metro line	\$ 3,690,651,621
Program for providing information and attending to pedestrian and vehicular mobility	\$ 21,686,664,086
Program for attention to impact on infrastructure and damages to third parties	\$ 12,398,012,464
Program for social and employment inclusion	\$ 5,168,236,800
Program for economic sustainability for formal trade	\$ 11,555,952,000
Program for economic sustainability for occupants of public spaces	\$ 9,275,980,800
Program for the Observatory on occupation and land values	\$ 4,805,990,400
Program for weaving the urban fabric of the First Metro Line of Bogotá	\$ 6,539,942,400
Program for managing the cultural heritage program	\$ 4,643,961,600
Total	\$133,576,176,214

1.12 SCHEDULE

The Environmental Impact Study for the PLMB includes a schedule that specifies the program for the environmental measures included in the Environmental and Social Management Plan and the Monitoring and Follow-up Plan. Said schedule includes the phases of pre-construction, construction, and operation. To prepare the Schedule, the time for the development of the works has been estimated under simultaneous execution of the six sections that constitute the layout, with a total duration of the work of 60 months.

Therefore, the Environmental Impact Study Schedule is made up, in reality, of two schedules: one for the construction phase, and the other for the operation phase. The schedule that has been developed for the construction phase covers a 60-month period, which is the duration estimated for the construction of all the sections of the work in their schedules. The schedule for the operation period was programmed using a Gantt diagram for an initial five-year period, despite the fact it is thought that the operation will continue until the year 2050.

1.13 OPERATIONAL ORGANIZATION OF THE ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN - ESMP

The following is a description of the role of the parties participating in the execution of the Environmental and Social Management Plan or ESMP:

- Empresa Metro de Bogotá -EMB-: has the role of planning, coordinating, and providing guidelines and directives for the execution of the PLMB project, including the Environmental and Social Management Plan - ESMP - that forms a part of the Environmental and Social Impact Study - ESIS - as well as requirements established by multilateral banking.
- Auditor: responsible for doing follow-up and verification of the execution of the ESMP. In addition, it must ensure the quality of the information. Will report directly to the EMB.
- Contractor: responsible for executing the ESMP, and therefore has the function of implementing the prevention, control, mitigation, compensation, enhancement and/or correction measures in each program. The contractor will report directly to the auditor.

In this sense, developing the environmental and social management process, while guaranteeing compliance with the proposed objectives and optimum use of resources, the administration and coordination of the actions of the Environmental and Social Management Plan will be handled by an interdisciplinary team that executes, determines, and evaluates socio—environmental aspects during the pre-construction, construction, and operation processes of the Project. It will do this by forming an Environmental and Social Management Unit - ESMU, which will depend on the Contractor as the executor of the project's constructive and operative activities. It will be responsible, among other aspects, for continuous relations with the community and the execution of the Environmental and Social Management Plan in the different zones of the work and operation.

The ESMU team will be interdisciplinary and conceived of as a system for administering, operating, planning, executing, managing, and following up on the entire process in accordance with the Environmental and Social Management Plan (ESMP). It will have a director who will report directly to the PLMB project auditor, supported by an assurance group for quality and auditing, and will lead two action groups: a social management action group and an environmental management action group. All of this forms a part of the Contractor's organizational structure.

Based on the above, the environmental and social leadership teams will be from the contractor and will form an environmental works committee. The main environmentally and socially responsible parties will be on the committee, together with subcontractors and people from the environmental auditing team. During project operation, follow-up of the Environmental Management Plan will be handled by the auditor, who will report directly to EMB.

1.14 WORLD BANK AND IDB ENVIRONMENTAL AND SOCIAL SAFEGUARDS

The project has been classified by the WB and the IDB as an Environmental category A project, in consideration of the scale and magnitude of the environmental and social impacts. The Environmental and Social Safeguards activated by the World Bank are: Environmental Assessment, OP/BP 4.01; Natural Habitats, OP/BP 4.04; Test Management, OP/BP 4.09; Physical Cultural Resources, OP/BP 4.11; and Involuntary Resettlement, OP/BP 4.12. The requirements of these Safeguards have been duly considered in the Environmental and Social Impact Study.

Relative to the IDB, the environmental and social safeguards activated are: OP-102 Access to Information Policy, OP-703 Environment and Safeguards Compliance Policy, OP-704 Disaster Risk Management Policy, OP-710 Involuntary Resettlement Operational Policy and OP-761 Operational Policy on Gender Equality in Development.

1.15 STAKEHOLDER CONSULTATIONS AND INFORMATION SESSIONS

In the framework of the World Bank's and the Inter-American Development Bank's environmental and social safeguards, the First Metro Line of Bogotá - PLMB project is classified as category A, and therefore requires two consultations at a minimum with the stakeholders. The first consultation was oriented toward sharing information on the scope of the Terms of Reference (technical specifications 19 and 20). The community from the PLMB's area of influence and the zone where the yard and shop will be set up participated in it, along with multilateral banking, and representatives from the academic world and environmental organizations (NGOs).

In the framework of this consultation, EMB moved ahead with the program for disseminating information to the community in the direct area of influence, for which purpose the layout of the PLMB was divided into six zones, taking into account its length and the residential, commercial, or industrial vocation of each area. A total of fifteen meetings were held, with the participation of around 1,203 citizens. The scope of the technical structuring, the location of the project, the expected schedule, the products of the structuring, the property acquisition process, and the scope of public participation were presented at these meetings. Information was also shared on the scope of the environmental and social impact study, which included characterization of the baseline, identification of the impacts for each stage of the project in the area of influence, proposals for managing impacts, and identification of citizen recommendations related to the public space and elements of identity, among other things.

It is important to mention that the different district, local government, academic, organizational, and NGO actors located along the length of the PLMB have been involved in the ESIS consultation process, along with local social organizations through the leaders and representatives of Community Action Boards, and the citizens residing in the project's area of influence, which is the population group directly affected.

1.16 NEXT STEPS

Empresa Metro de Bogotá will continue working on preparing activities that have the purpose of meeting the requirements for presenting the project to the decision-making boards at the World Bank and the Inter-American Development Bank in the month of July 2018. The following are the activities to be developed:

- Second consultation: This will take place once the EMB publishes the first version of the ESIS document on its webpage. In addition, the results obtained from the dissemination of information about the ESIS will be considered in the final version of the document.
- Resettlement Plan:
 - Formulation of the Resettlement Plan:
 - Survey for socioeconomic characterization (census) of the social units that should be resettled as a result of the project.

- Analysis of the information gathered in the surveys.
 - Identification of the impacts generated by the project on said social units.
 - Preparation of the Resettlement Plan document.
- Meetings organized to share information on the Resettlement Plan, including presentations to the social units to be resettled on topics such as: i) the property acquisition process; ii) financial considerations to which they have a right; iii) mechanisms made available by the EMB for attending to complaints, petitions, claims, and recommendations.
 - Progress on the contractual process for preparing technical and legal inputs for property acquisition: topographic surveys, title studies.

1.17 CONCLUSIONS

- The contractor awarded the contract will have to update the respective environmental, social, and occupational health and safety management plans, depending on the result of the final design studies. This update will integrate monitoring, follow-up, and supervision measures so that the project is carried out under best national and international engineering practices.
- The ESIS is a dynamic study that permits updating the ESMP as things are further defined, and also permits updating the baseline throughout the entire cycle of the project. The study also indicates the processes to undertake corresponding to the environmental permits required for the construction and operation phases, in alignment with the programs and processes established at the time by the Mayor of Bogotá and Empresa Metro de Bogotá.
- The quality of the landscape in the “without” project scenario includes some public space infrastructure in the area of influence of the Metro project, but in most of the corridor its condition is deteriorated. Unsafe pedestrian crossings were also identified (without fixtures, with deteriorated fixtures, or without any kind of signage) and most of it is not integrated in the bike route system. A trend can be seen toward increased deterioration of infrastructure due to there being no contingent projects for improving the infrastructure of pedestrian and vehicular mobility and the nonexistence of bike routes. At the level of vegetation, there are individual trees located on the median strip that have been impacted by the pollution generated by vehicles in circulation. Tree species will tend to deteriorate due to the increase of particulate matter coming from mobile sources.
- Regarding the status of air quality in the city of Bogotá, according with the monitoring done, there are pollutants such as PM10, PM2.5, NOx, SOx and CO in the PLMB corridor. At stations where industries, hospitals, and commerce are present, the presence of contaminants of particulate matter and gases exceeds the threshold permitted according to Resolution 610 of 2010. Based on the information obtained during the sampling period, it was observed that 72% (233 of 324 readings) of the estimated values correspond to the green band which represents “Good Air Quality” and 28% (91 of the 324 readings) of the values were found in the yellow band which corresponds to “Moderate Air Quality.” This representation indicates that the current risk to health for the people in the area of study due to air quality is low to null.
- The levels of ambient noise present in the PLMB's area of influence are produced by commercial activities, road traffic, daily urban activities, urban community activities, public works, etc., which affect environmental conditions and human health. It was identified that the noise levels present in the zones are between the 55 to 70 dB established for sectors for moderate noise and intermediate restricted noise.

- Relative to vibrations in the PLMB's area of influence, they are produced by road traffic, daily urban activities, urban community activities, and public works, which affect environmental conditions and human health. Although the vibration levels recorded at some points can be perceived by human beings, and in the case of the point with maximum vibration levels (Historic Center) the level is classified as easy perception to intense for people, they do not exceed the limits for affecting structures, even for structures classified as being architectural heritage.
- During the construction stage, the different activities will modify the landscape and cause high and medium changes to visual quality as a result of the presence of temporary items such as machinery and equipment, as well as the enclosures that must be put in place to protect people in the intervention zone.
- Urban plan cover consists of the collection of individual plants placed in urban spaces that provide a series of landscape and environmental benefits to the city on a daily basis, but in turn require proper planning and technical management in order to settle conflicts with the dynamics of urban growth and the demands of public space to which cities are subject in their constant expansion. Although the number of trees in Bogotá is not sufficient according to standards defined at the urban level, their total has been slowly increasing year by year, which indicates that in a "with-project" scenario the impact on plant cover will be positive, bearing in mind that there will be plantings on the roads impacted by the project that will increase the current stock of individuals.
- In the direct area of influence – DAI - components of the Main Ecological Structure are found corresponding to Riparian Ecological Corridors and the Special Management Area of the Bogotá River. In addition to the areas of the Zone for Environmental Management and Preservation (ZMPA for the Spanish) and the Riparian Corridor of the Bogotá River required in the area of study for setting up the yard and shop, there are other elements of the Main Ecological Structure that are crossed by the viaduct, such as Canal Tintal II, Canal Fucha, Canal Albina, Canal Cundinamarca, Canal Arzobispo and Canal Río Seco Sector 1.
- The Yard and Shop and Technical Branch, since they are located inside the zone set aside as the Zone for Management and Preservation of the Bogotá River (ZMPA) referred to in articles 109 and 110 of District Decree 190 of 2004, require a modification of said ZMPA, given that it currently represents an environmental restriction.
- For the "with-project" scenario in the pre-construction and construction activities, the excavation and demolition activities that take place during the construction of the PLMB will use 30% of the CDW, pursuant to what is established in Resolution 472 of 2017 by the Ministry of the Environment and Sustainable Development, which corresponds to 957,935 m³.
- There is a negative impact in terms of alteration of air quality caused by the pre-construction and construction activities, which represents an impact on the population directly exposed to the emissions. The alteration of the air quality in the area of study is related to the duration of the works to be executed, and is therefore temporary. The contributing emission sources are the operation of the machinery to be used in the processes for stripping, movement and transportation of materials, as well as the combustion of heavy machinery and vehicles existing in the area of study.
- The ambient noise levels generated by the project's pre-construction and construction activities will represent a modification of the acoustic parameters in the area of influence, due to the introduction and temporary operation of equipment and machinery such as bulldozers, backhoes, compactors, tank trucks, dump trucks, loaders, cranes, and others. The sources of the emissions are the machinery used for each of the activities mentioned during specific days of work, in

addition to the vehicle flows projected in the area of influence. The modification of noise levels in the project's area of influence is temporary, bearing in mind that the emission sources are found in the machinery used to develop each of the construction activities, which have a specific days for their operation and work.

- The impact generated by the project's footprint (DAI) on the different components of the Main Ecological Structure - EEP for the Spanish, is understood as an intervention by an urban development on an area already delimited by a district environmental authority. It is defined as an invasion of the space already granted through a legal administrative order currently in effect. This intervention does not imply the occupation of a channel in the majority of the cases given by the piling of the project's works, but it must be reiterated that Empresa Metro de Bogotá has good arguments for requesting a pronouncement by the competent environmental authorities (District Secretary of the Environment - SDA, CAR and Empresa de Acueducto y Alcantarillado de Bogotá -EAAB), for an indication or a description of the environmental impacts generated by the intervention in the DAI of the Bogotá Metro Project.
- The impact on plant cover is associated with the results of the silvicultural assessment done in the project's biotic DAI, where a total of 3,229 individual plants was obtained in the corridor and 58 in the Yard and Shop Facility, in the tree, shrub, and palm strata. In the relative abundance obtained, two abundant species can be appreciated relative to the total group. In the first place is the rubber savanna (*Ficus soatensis*) with 17% and the American pepper (*Schinus molle*) with 16% of the total inventory. The impact on the resources is temporary, since silvicultural treatments will be carried out including root pruning, logging, and transplanting. Another number of individuals will be conserved and new individuals will also be planted, resulting from the implementation of the landscape design.
- For landscape management, a landscape proposal concept was developed, defining general criteria on multiple scales. It was approached in an interdisciplinary manner, guaranteeing it will be a comprehensive and well-structured strategy. Some of the criteria are: the vegetation must be adapted to the region, and to the needs of the site and the project. The second criteria takes into account the visual relationships determined by the construction parameters in the immediate surroundings versus the profile available and the overall visuals at the site. Lastly, the urban context in which the textures, materials, buildings, and other elements can be appreciated that make up the urban context.
- The viaduct will generate a change in the landscape due to its elevated structure, modifying and renewing the landscape in abandoned sectors of the city, and intervening in residential sectors of the city.
- The environmental and social management process will guarantee compliance with the proposed objectives, as well as optimal use of resources, and the administration and coordination of the actions in the Environmental and Social Management Plan.
- The study includes the consolidated environmental and social budget for the project. These resources form a part of the CAPEX and will be assured in the works contract resulting from the project. On the other hand, the budget does not include mitigation, control, and compensation measures derived from updating the Environmental and Social Management Plan and the Occupational Health and Safety Management System Plan, which should be adjusted in the next phase of the project.
- The bid packages and the works contract will establish what type of bank guarantees are required for compliance with the environmental, safety, and social obligations, bearing in mind the new framework for acquisitions from the World Bank for category A environmental projects.

- The bid package and works contract will establish who will be responsible for assuring and/or reviewing and/or following up and auditing the update of the ESMP, which will have to be updated by the contractor awarded the works.
- It is expected that the increase in circulation of people using all transportation modes will make the diverse sectors of the economy more dynamic along the layout.
- The articulation of the PLMB with the Transmilenio system will permit improving travel times, decreasing the accident rate, and providing transportation under safe and optimum conditions, among other benefits, having a significant impact on the quality of life of citizens. The project will also reduce greenhouse gases – GHG by improving the efficiency of the city's public transportation system with the operation of an electric transportation system. Based on a study done by the Urban Development Institute - IDU in the year 2016, the reduction in GHG for the PLMB is estimated on the order of 1.8 million tons CO₂e in a 30-year period of operation, which indicates a highly positive impact at the local and national level.
- It is important to point out that the analyses done for the construction and startup of the PLMB considered the most relevant manifestations of climate change such as the intensification of dry and rainy seasons, as well as their effects in the region: heat waves, hailstorms, flash floods, pooling of water, and flooding. Based on the recognition of those effects, diverse adaptation measures were proposed to be included in the design of the infrastructure and the architecture of the viaduct and the stations, as well as the design for urban planning. Relative to the measures proposed that have an impact on urban planning designs and storm drain networks (Urban Storm Drainage Systems), they should be shared with the District Secretary of the Environment and Empresa de Acueducto de Bogotá, to guarantee they are in harmony with the guidelines or directives those institutions have formulated in this area.
- Building the Metro will contribute to the planned development, rehabilitation, renewal, and densification of the city, attracting domestic and foreign investment, creating incentives for economic growth, and contributing to the growth of domestic GDP.
- The project will produce an involuntary move of people due to the purchase of properties required to build the line and the stations. This impact will be created in a corridor that is diverse in use, in types of buildings, in urban quality, and has the presence of different population groups with their interests and relationships with the territory.
- The impact produced by the involuntary move of approximately 2,500 social units (including owners, tenants, and subtenants) implies a high social risk for the project, which could mean delays in the construction. Reduction of this risk and diminished opposition to the project depends on the correct and proper implementation of the programs and actions defined in the Resettlement Plan.
- Communication channels will be promoted in order to provide clear and transparent information to the people to be resettled and to the public in general.
- Due to the impacts that will be generated on people in the direct area of influence during the construction stage, conflicts could be generated if an efficient process for direct, timely, and clear communication is not established with the community and with the general public. By reason of the above, the resettlement plan will consider programs for communication, information, and attention to claims, complaints, and petitions, in addition to comprehensive social accompaniment of the social units to be resettled.

- Temporary jobs will be created as part of the development of project activities in the different phases, benefiting both the people hired and those located in the area of influence, to the degree that it will improve the income levels of families, promoting an improvement in their quality of life and increasing the demand for goods and services.
- There will be an impact on the Los Héroes Monument, located at Calle 80 adjacent to the TransMilenio station, which will generate public discontent. A specific program should be applied to this impact.
- The Metro project will provide occupants of the public space and those currently engaged in informal sales, opportunities for formal work, and workshops and training in formalizing their businesses and business management in order to improve the quality of life of this population group.
- Arenas for public participation will be promoted in the different stages of the project in order to involve the community and the general public in the development of the system.
- Programs and activities will be developed in both the resettlement plan and in the social management plan based on the needs and characteristics of the population.
- The work will generate an impact on the people settled in the corridor during the pre-construction and construction stages, which will mean the implementation of work management plans related to the information on the modifications of the topics of mobility and safety, among others.
- The project will seek to promote changes in mobility habits in terms of promoting the use of alternative transportation modes and the use of public transportation.