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December 5th, 2013

LIMA METRO LINE 1- PERU

Figure 01: The reforested areas and art murals near L1ML station in Micaela Bastidas, Lima / Source: L1ML

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1. PROJECT INTRODUCTION

This case study outlines the evaluation of the *Línea 1 del Metro de Lima* (L1ML) project, which consists of the operation and maintenance of the first urban electric metro train line in Lima, Peru. It runs on a double-rail track along a mainly elevated viaduct connecting 11 districts from the south to the northeast of the city.

The infrastructure is owned by the Peruvian government, and the planning, coordination, supervision, control and execution of the electric mass transportation system is overseen by the Ministry of Transportation and Communications through the Electric Train Autonomous Authority (AATE). In April 2011, the operation and maintenance of the L1ML was negotiated through a 30-year concessionary contract with GyM Ferrovías S.A. - a private company - as part of Peru's *Proinversión* initiative to incentivize and promote private investment in Peru's competitiveness and sustainable development.[1]

GyM Ferrovías S.A. is a joint venture composed of the Peruvian holding company Graña y Montero S.A.A. with 75% participation and Ferrovías S.A.C. from Argentina with 25% participation.[2] GyM Ferrovías S.A. offered the lowest guaranteed price per kilometer and was granted a concession of approximately US $270 million. The contract includes not just operation and maintenance, but also the service, financing, and design of a major maintenance workshop for the railway rolling stock and the acquisition of 19 new trains.

Construction of the Lima Metro started in 1986, when 9.2 km were completed and 5.5 km were left partially built, put on hold due to lack of funds in an environment of political crises, unrest in the country, and suspicion of bribery.[3] The L1ML, once complete, will extend along a total of 33.9 km of surface track and viaduct, with 26 stations and 24 trains.[4] It is envisioned in two sections: the first is a 21.9 km long stretch with 16 stations connecting Villa El Salvador station in the south to Grau Avenue station in downtown Lima. This has been operational since 2012, transporting about 100,000 persons daily with five trains.[5] The second section, which is currently under construction, will be 12 km long with 10 stations that will connect Grau Avenue station to Bayóvar station in San Juan de Lurigancho district in the northeast. The project utilizes approximately 7 MW of power supplied by two electric energy distributors in Lima: Luz del Sur and Edelnor.[6]

Once section 2 is complete and new trains are acquired, L1ML is projected to transport more than 125,000 persons daily in approximately 50-minute complete route trips with only a 6-minute interval

[1] Proinversión. Mission and Vision. http://www.proinversion.gob.pe/1/0/modulos/JER/PlantillaStandardsinHijos.aspx?ARE=1&PFL=0&JER=798

[2] Autoridad Autónoma del Sistema Eléctrico de Transporte Masivo de Lima y Callao. GyM y Ferrovías Operarán la Línea 1 del Metro de Lima. http://www.aate.gob.pe/2011/03/24/gym-y-ferrovias-operaran-la-linea-1-del-metro-de-lima/

[3] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Declaración de Impacto Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao Línea 1:Villa El Salvador – Avenida Grau, cap. 2, Descripción del Proyecto; Reseña Histórica Línea 1 del Metro de Lima, Hitos-Línea 1 del Metro de Lima

[4] Línea 1 Metro de Lima, Plan de Conservación para el Año 2013

[5] Línea 1 Metro de Lima, Plan de Conservación para el Año 2013

[6] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Declaración de Impacto Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao Línea 1 Villa El Salvador – Avenida Grau, Resumen Ejecutivo, p.20; Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. IV, Línea Base Socio Ambiental, p. 49

between trains.[7] This represents a critical reduction of commuting time for many workers, which is expected to contribute to an increase in productivity and in demand for public transportation.[8]

2. PROJECT LOCATION & DESCRIPTION

Figure 02: Sections 1 and 2 of Metro Lima Line 1
Source: Ministerio de Transportes y Comunicaciones, La República

Lima is the fifth largest and densest city in the Americas with a population of almost 9 million and a density of 3,000 inhabitants per square kilometer.[9] It is located in the central Peruvian coastal plain in the valleys of the Chillón, Rímac and Lurín rivers. Its topography slopes drastically from elevations

[7] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. IX, Programa de Afectaciones Prediales, p. 19; Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Declaración de Impacto Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao Línea 1:Villa El Salvador – Avenida Grau, cap. 2, Descripción del Proyecto, p.16

[8] http://www.globalmasstransit.net/archive.php?id=2738

[9] Municipalidad Metropolitana de Lima and Instituto Metropolitano de Planificación, Plan Regional de Desarrollo Concertado de Lima (2012 – 2025): Lima Somos Todos, 2012, p. 38.

exceeding 500 meters above sea level in the Andes to the Peruvian coastal valley. Although most of the city lies within the valley areas, growth of informal settlements continues in the isolated hills of El Agustino, San Cosme, El Pino, La Milla, Muleria and Pro.

Lima's metro system was first envisioned in the 1970s, during the military dictatorship of the Revolutionary Government, through an international competition that conceived the Lima Metro project as a mostly underground metro system that linked Lima with Callao.

The north-south axis of the L1ML will bisect important avenues and cross the environmentally sensitive Rímac River watershed. Most of the earthwork required for the elevated rail tracks will consist of berms within the medians of avenues. As the L1ML runs on electricity purchased locally, it will not contribute to air contamination and will help reduce CO_2 emissions indirectly by 66%.[10]

In 2014, the L1ML will finally connect the most populated areas in Lima, from southern Villa El Salvador to northeastern San Juan de Lurigancho - an area with around 1 million inhabitants[11] that is the most populous district in all of Peru and in South America – both areas have been prioritized due to their impact on the largest number of passengers.[12] The L1ML is expected to help realize the current unmet demand for public transportation, specifically between the southern and northeastern parts of the city. Moreover, L1ML is part of a larger mobility project for the city of Lima that contemplates establishing five more metro lines with connections to rapid bus transit routes.[13]

Figure 03: Proposed metro lines infrastructure network in Lima
Source: L1ML, Reseña Histórica Línea 1 del Metro de Lima, p. 3.

[10] Línea 1 Metro de Lima, Análisis Comparativo Reducción CO2, p.1
[11] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. IV, Línea Base Socio Ambiental, p. 87.
[12] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. X, Conclusiones y recomendaciones, p. 2
[13] Línea 1 Metro de Lima, Reseña Histórica Línea 1 del Metro de Lima, p.3

Lima Metro Line 1, Peru

4. EVALUATION CATEGORIES

4.1. QUALITY OF LIFE

The first category of *Envision* rating system is Quality of Life. The assessment here mainly refers to the impact of the project on the surrounding communities and their well-being. As stated in the Envision manual, *"Quality of Life particularly focuses on assessing whether infrastructure projects are in line with community goals, incorporated into existing community networks, and will benefit the community long term."* It also determines if the project is aligned with the community needs.

This category is divided into 3 subcategories and 12 credits: Purpose (QL 1.1, QL 1.2, QL 1.3, and QL 1.4), Community (QL 2.1, QL 2.2, QL 2.3, QL 2.4, QL 2.5, and QL 2.6) and Well-Being (QL 3.1, QL 3.2, QL 3.3).

CREDIT SCORING

				IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE
1	QUALITY OF LIFE	PURPOSE	QL1.1 Improve community quality of life	2	5	10	20	25
2			QL1.2 Stimulate sustainable growth and development	1	2	5	13	16
3			QL1.3 Develop local skills and capabilities	1	2	5	12	15
4		COMMUNITY	QL2.1 Enhance public health and safety	2			16	
5			QL2.2 Minimize noise and vibration	1			8	11
6			QL2.3 Minimize light pollution	1	2	4	8	11
7			QL2.4 Improve community mobility and access	1	4	7	14	
8			QL2.5 Encourage alternative modes of transportation	1	3	6	12	15
9			QL2.6 Improve site accessibility, safety and wayfinding		3	6	12	15
10		WELLBEING	QL3.1 Preserve historic and cultural resources	1		7	13	16
11			QL3.2 Preserve views and local character	1	3	6	11	14
12			QL3.3 Enhance public space	1	3	6	11	13
						Maximum points possible:		181

Figure 04: Quality of life category, credits distribution.

4.1.1. Purpose

In the **Purpose subcategory**, the L1ML achieved the highest maximum scores possible, with all three credits evaluated as Restorative (QL1.1 Improve Community Quality of Life, QL1.2 Stimulate Sustainable Growth and Development, and QL1.3 Develop Local Skills and Capabilities).

The L1ML contributes greatly to improving the quality of life of its neighboring communities in social, physical and economic terms, predominantly through the rehabilitation of important community assets and the addition of infrastructure capacity. The adequacy of this 34 km long mass transportation project lies in its direct large-scale impacts on the mobility of more than 3 million people living in its direct area of influence.[14]

The L1ML project has upgraded and extended access, increased safety, and improved mobility and environmental quality. Community awareness and pride are achieved by creating a direct communication channel to work together with neighbors in order to identify and transform areas

[14] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Declaración de Impacto Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao Línea 1:Villa El Salvador – Avenida Grau, Resumen Ejecutivo, p. 22; Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. IV, Línea Base Socio Ambiental, p. 87.

littered with construction debris and rubbish, with poor infrastructure, and a high presence of gang paint and graffiti. These collaborations are realized through the Metro Culture program (Cultura Metro, MC) with strategies to transform stations and trains into spaces of citizenship education and to recover adjacent areas for the community. For these efforts a multidisciplinary team called the Metro Culture Team (MTC) created a comprehensive community participative process.

The L1ML's MC further supports community development by creating several social programs such as a mural art painting program to reincorporate unsafe areas back into the community while fostering their individual identities, encouraging and integrating urban art. Public safety is also promoted inside and outside the L1ML through various infrastructure upgrade initiatives.

Sustainable, long-term economic growth and development for the community are stimulated by providing mass transportation that helps cut down commuting times, which in turn boosts productivity locally and at an urban scale. Lima's capacity for business and industry is expected to expand considering that the L1ML connects people and places in the most populated areas in a shorter amount of time, saving, for instance, 12.5 million hours for every 25 million people transported.[15]

Additionally, local skills and capabilities are developed through training and hiring locally. The L1ML's recruitment policy established a hiring ratio of at least 70% of employees living in the area of influence. This policy extends to companies linked to the L1ML, such as GyM Ferrovías, Concar, and their main suppliers for safety and cleanliness.[16]

Figure 05: Reforestation with the community in Micaela Bastidas
Source: L1ML, Sistema de Gestión Cultura Metro, p. 35.

[15] Línea 1 Metro de Lima, Análisis de los Beneficios de la Candidatura, p. 10.
[16] Línea 1 Metro de Lima, Informe de Política de Contratación, p.1.

4.1.2. Community:

In the **Community subcategory**, two out of six credits were considered outstanding with "Restorative" scores (QL 2.5 Encourage Alternative Modes of Transportation, QL2.6 Improve Site Accessibility, Safety and Wayfinding), three were evaluated highly with Conserving scores (QL2.1 Enhance Public Health and Safety, QL2.2 Minimize Noise and Vibration, and QL2.4 Improve Community Mobility and Access), and one was evaluated as Superior (QL2.3 Minimize Light Pollution).

The project offers outstanding improvements in community mobility and access, guided toward creating more livable communities by offering mass transportation in Lima's most populated areas, eliminating access barriers, resurrecting 20-year-old unused train and station infrastructure, and siting the train line's location in generally unused areas like the median strips of main avenues. Substantial restoration of safety and access to adjacent neighborhoods has also been done in 16 identified "areas to recover" which has included cleaning illegal dumping sites near pedestrian bridges, reforestation, and repainting walls with murals designed by the community.[17]

Alternative modes of transportation are encouraged, in an impressive approach to support riding the L1ML. Bike parking, bike rentals, uniform fares and collection, and Metropolitano Bus Rapid Transit (MBRT) transfers to reach stations are facilitated through many proposed agreements with municipalities, ministries, state institutions, commercial centers and companies. Additionally, different monthly destinations are promoted aboard the L1ML.

Figure 06: Presbítero Maestro Cemetery monthly destination promotion
Source: L1ML, Destino del Mes, p. 9.

Beyond regulations, public health and safety are excellently addressed in the implementation of the L1ML considering the risks that constitute operating and riding an electric train. The L1ML MC's strategy is to transform stations and trains into a space for citizen education, by offering information sessions to the community, utilizing graphic and verbal announcements in trains and stations, and providing the operations staff with training and contingency plans as stated in the Social and Environmental Management Plan (ESMP). Not only does the project utilize nonpolluting electrical energy for its

[17] Línea 1 Metro de Lima, Plan de Recuperación de Espacios, p. 10 – 115.

operation, but it also decreases traffic[18] and rail accidents since trains pass over an unobstructed elevated viaduct across the city.

Figure 07: Information session in Micaela Bastidas communal center
Source: L1ML, Recuperación de Espacios Micaela Bastidas, p. 9.

Figure 08: Signage for safety in trains and stations
Source: L1ML, Sistema de Gestión Cultura Metro, p. 17.

In general, local noise and vibration regulations have not been exceeded during both the construction and operation phases, although there is room for improvement in the mitigation efforts. Levels are periodically monitored and addressed through the maintenance plan with actions such as securing the ballast,[19] and long-term actions such as the reforestation mitigation effort to create a biological corridor along the viaduct to act as a natural barrier. Moreover, noise levels, one of the main public concerns, are expected to decrease overall with the operation of the L1ML reducing the volume of traffic by mobilizing more than 125,000 people per day on a south-northeast axis through Lima.

During the operation phase, procedures and actions set to reduce energy consumption help to minimize light pollution through a cohesive lighting-zoning plan that reduces lighting in stations based on activity and safety limits, for instance, cleaning operations are exclusively done at daytime and stairs and ramps are lit only during times of operation.

[18] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. X, Conclusiones y Recomendaciones, p. 4.

[19] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. VII, Identificación y Evaluación de Impactos Ambientales, p. 93.

Figure 09 & 10: Bicycle parking areas in Miguel Grau station and Jorge Chavez station
Source: L1ML, Estacionamiento de Bicicletas en Estaciones, p. 3,5.

4.1.3. Wellbeing:

In the **Wellbeing subcategory**, all three credits received the highest scores, Restorative (QL3.1 Preserve Historic Character and Cultural Resources, QL3.2 Preserve Views and Local Character, and QL3.3 Enhance Public Space).

Lima's historical and cultural areas are greatly improved by bringing people and attention to the deteriorated areas without disrupting historical monuments, such as the Presbítero Maestro Cemetery (figure 5), the first cemetery in Lima, and the historic wall of Lima, Bastión Santa Lucía. The L1ML's layout in the historic center is in strict compliance with Municipal Ordinance No. 975, which concerns the preservation of historical and cultural monuments in the area.[20] The L1ML respects and improves its surroundings superbly through context-sensitive approaches, such as the proposed Alameda Cultural that will connect monuments through a pedestrian corridor accessible from two L1ML stations.

Excellent relationships between neighborhood associations and the L1ML's Metro Culture (MC) are achieved by recovering public spaces impacted by garbage accumulations, crime and other threats.[21] Initiatives such as the mural and façade painting programs promote the artistic and cultural participation of L1ML's neighbors, in order to foster local identity in spaces previously occupied by undesired activities. For instance, MC's AlegrArte's façade-painting upgrading project aims to transform the physical and psychosocial nature of Pumacahua hill, near Pumacahua station, which has been a highly unsafe area. [22]

[20] Línea 1 Metro de Lima, Informe Alameda Cultural, p.1.
[21] Línea 1 Metro de Lima, Informe Jornada Muralista, p.3.
[22] Línea 1 Metro de Lima, Proyecto AlegrARTE, p. 9; Línea 1 Metro de Lima, AlegrARTE 2013, video.

Figure 11: AlegrArte program façade painting upgrading pilot program
Source: L1ML, Programa AlegrArte, p. 5.

Figure 12: Pumacahua Hill view close from L1ML
Source: L1ML, Programa AlegrArte, p. 15.

Figure 13: Pumacahua Hill first façade painting pilot program
Source: L1ML

Figure 14: View to L1ML from Pumacahua Hill façade painting pilot area
Source: L1ML

Local character is greatly encouraged by assisting neighboring communities in cleaning, reforesting and painting murals in the L1ML walls and within the communities. The ubiquitous visual impact of the 34 km of mostly elevated viaduct is perceived as a positive agent of change that offers a way to observe the city from a new perspective, encouraging improvement of the local environment and promoting the preservation of views. Additionally, reforestation programs and creation of green areas along the L1ML viaduct will contribute in improving the local character.

Public space is also enhanced and substantially restored through several successful MC community participation programs that encourage participation from program conception to implementation.[23] The communal mural art workshops include the painting of the project's walls by the community and the creation of urban art galleries by inviting highly recognized graffiti artists to paint.

[23] Línea 1 Metro de Lima, Proyecto Concurso de Buenas Prácticas en Gestión Vecinal, p. 1.

Figure 15: Communal art mural painting workshop
Source: L1ML, Sistema de Gestión Cultura Metro, p. 52.

Figure 16: Popular Art Gallery Mateo Pumacahua
Source: L1ML, Sistema de Gestión Cultura Metro, p. 54.

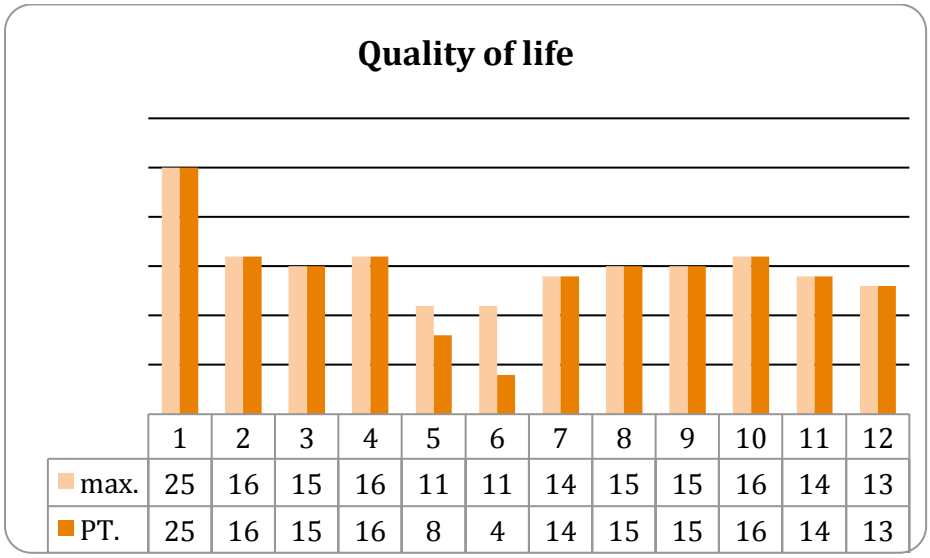
4.1.4. Summary of results for the Quality of Life Category.

The table below shows the distribution of credits as well as the level of achievement reached in each credit (figure 17).

			LIMA METRO LINE 1, PERU	PT.	Performance	% Total	max.
1	QUALITY OF LIFE	PURPOSE	QL1.1 Improve Community Quality of Life	25	Restorative	100.0%	25
2			QL1.2 Stimulate Sustainable Growth & Development	16	Restorative	100.0%	16
3			QL1.3 Develop Local Skills And Capabilities	15	Restorative	100.0%	15
4		COMMUNITY	QL2.1 Enhance Public Health And Safety	16	Conserving	100.0%	16
5			QL2.2 Minimize Noise And Vibration	8	Conserving	72.7%	11
6			QL2.3 Minimize Light Pollution	4	Superior	36.4%	11
7			QL2.4 Improve Community Mobility And Access	14	Conserving	100.0%	14
8			QL2.5 Encourage Alternative Modes of Transportation	15	Restorative	100.0%	15
9			QL2.6 Improve Site Accessibility, Safety & Wayfinding	15	Restorative	100.0%	15
10		WELLBEING	QL3.1 Preserve Historic And Cultural Resources	16	Restorative	100.0%	16
11			QL3.2 Preserve Views And Local Character	14	Restorative	100.0%	14
12			QL3.3 Enhance Public Space	13	Restorative	100.0%	13
			QL0.0 Innovate Or Exceed Credit Requirements	0	N/A		
			QL	171		94.5%	181

Figure 17: Summary of results in Quality of life category.

Quality of Life (QL) is the highest-achieving category throughout the L1ML project. Although most credits achieved the highest score possible, there are some with opportunities for improvement in the subcategory of Community that involve conceiving better mitigation efforts in noise and vibrations levels, and light pollution reduction. Considering all credits and the maximum possible values for each indicator, the percentage of achievement adds to 94.5%, or 171 points out of 181.



	1	2	3	4	5	6	7	8	9	10	11	12
max.	25	16	15	16	11	11	14	15	15	16	14	13
PT.	25	16	15	16	8	4	14	15	15	16	14	13

Figure 18: Summary of results in Quality of life category.

4.2. LEADERSHIP

Envision's Leadership category evaluates the collaboration, management and planning of the project's team, as well as its stakeholders. *Envision* states that *"communicate and collaborate early on, involve a wide variety of people in creating ideas for the project, and understand the long-term, holistic view of the project and its life cycle."*

The 12 credits in this category are: collaboration (LD 1.1, LD 1.2, LD 1.3, LD 1.4), management (LD 2.1, LD 2.2) and planning (LD 3.1, LD 3.2, LD 3.3).

CREDIT SCORING

			IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE
13	LEADERSHIP	COLLABORATION	LD1.1 Provide effective leadership and commitment	2	4	9	17	
14			LD1.2 Establish a sustainability management system	1	4	7	14	
15			LD1.3 Foster collaboration and teamwork	1	4	8	15	
16			LD1.4 Provide for stakeholder involvement	1	5	9	14	
17		MANAGEMENT	LD2.1 Pursue by-product synergy opportunities	1	3	6	12	15
18			LD2.2 Improve infrastructure integration	1	3	7	13	16
19		PLANNING	LD3.1 Plan for long-term monitoring and maintenance	1	3		10	
20			LD3.2 Address conflicting regulations and policies	1	2	4	8	
21			LD3.3 Extend useful life	1	3	6	12	
						Maximum points possible:	121	

Figure 19: Leadership category, credits distribution.

4.2.1. Collaboration

In the **Collaboration subcategory**, the results of the L1ML assessment present a high scoring credit as Conserving (LD1.4 Provide for Stakeholder Involvement), two credits as Superior (LD1.1 Provide Effective Leadership and Commitment, and LD1.2 Establish a Sustainability Management System), and one low scoring credit as Improved (LD1.3 Foster Collaboration and Teamwork).

Numerous efforts have been made to foster leadership and social development by including nontraditional stakeholders in addressing the economic, environmental, and social aspects of the project, especially within its reforestation and cultural programs. The L1ML created the Metro Culture program (MC) to establish meaningful programs for stakeholder identification, engagement, and involvement in project decision-making. Collaborating with stakeholders to achieve sustainability goals demonstrates the L1ML's significant commitment, which is backed up by numerous and wide-ranging examples of activities undertaken beyond the scope of the project.

The mission statement of the L1ML operators indicates their commitment to providing public transportation to better the quality of life of their clients and contribute to the development of the city.[24] The project team has provided a Social and Environmental Management Plan (ESMP) as part of their strategy for environmental conservation, in harmony with the socioeconomic development of local neighborhoods. The staff responsible for the execution of the ESMP are to receive proper training and education in order to successfully fulfill their tasks.[25]

The ESMP includes a goal of establish a social affairs program to effectuate the involvement of stakeholders and create permanent channels of communication.[26] Through the MC, it created the multidisciplinary Metro Culture Team (MCT), composed of a psychologist, an industrial engineer, sociologists, and anthropologists, to take account of community needs, goals, plans, and issues through a four-phase community participation process as a working method for social diagnosis.[27]

The scope of the mechanisms established by the L1ML's ESMP seems sufficient to address the economic, environmental, and social aspects prioritized in the project during both the construction and operation phases. The ESMP seeks to establish prevention and risk control measures or contingency plans for labor and accidents, establish an environmental monitoring program, establish a social affairs program to encourage stakeholder participation, and to determine the costs of executing technical measures proposed for the mitigation of environmental liabilities.[28]

The L1ML has incorporated principles of collaboration and teamwork in the construction and operation phase by hosting informational meetings in order to include the communities at various levels. Although the L1ML project team recognizes the importance of working together as a team, no particular process or methodology has been incorporated to integrate the design, delivery methodologies and collaborative processes.

[24] Línea 1 Metro de Lima, Misión de la Empresa, p. 2.
[25] Línea 1 Metro de Lima, Plan de Manejo Socio Ambiental, p. 38.
[26] Línea 1 Metro de Lima, Plan de Manejo Socio Ambiental, p. 5.
[27] Línea 1 Metro de Lima, Diagnóstico Social Zona de Influencia, p. 1-2.
[28] Línea 1 Metro de Lima, Plan de Manejo Socio Ambiental, p. 5.

4.2.2. Management:

The **Management subcategory** received the maximum score, Restorative, in credit (LD2.2 Improve Infrastructure Integration), and a low Improved score in credit (LD2.1 Pursue By-product Synergy Opportunities).

There is high performance and overall improvement in infrastructure integration through restorative actions in the neighboring communities of the L1ML project. The Peruvian government, owner of the infrastructure, along with the L1ML project team has been working with the community to identify existing community assets in the natural or built environment which, when restored, would improve the community's economic growth and development capacity.

The L1ML project considers the integration of other elements into the community mobility infrastructure in order to improve overall infrastructure efficiency and effectiveness by seamless connection with other mass transportation systems, such as the Metropolitano Bus Rapid Transit (MBRT) stations and private feeder bus routes to L1ML stations.[29] Moreover, in the L1ML's Conservation Plan, goals to improve and integrate recreational infrastructure into its surroundings are specified by preserving and maintaining public areas located along the viaduct and within the project's direct area of influence.

Opportunities for by-products synergies between systems and larger infrastructure systems are limited, with a lack of in-depth identification, and have not been documented extensively. Most of the by-product reuse is linked to the management of solid waste within the project, framed within the general policy of the company and in compliance with the local Solid Waste Act regulations. The main goals of the Solid Waste Management Plan (SWMP) are to reduce waste, improve project performance, and reduce project costs by identifying and pursuing opportunities to use unwanted by-products or discarded materials and resources from nearby operations.[30] A better and in-depth effort at identification and use of unwanted by-products could help achieve a higher score.

4.2.3. Planning:

In the evaluation results of **Planning subcategory**, two credits received, Conserving, the highest score for (LD3.1 Plan for Long-term Monitoring and Maintenance, and LD3.2 Address Conflicting Regulations and Policies) and one high score, Superior (LD3.3 Extend Useful Life).

Comprehensive maintenance and conservation plans are incorporated in the operation phase of the L1ML for the long term, which should increase its sustainability potential by identifying future growth trends and establishing costs. The plans have been established to help ensure that mitigation, ecological protection, and enhancement measures are incorporated from early stages of the project. The Environmental and Social Management Plan (ESMP) is the main key program in managing the development and operation of the L1ML, to ensure that project activities are safe, reliable, responsible, preserving of the environment, and complying with health and environmental standards. Additionally, there is a specific maintenance target program, the Conservation Plan (CP), with a primary purpose of

[29] Línea 1 Metro de Lima, Copia de Convenios, p. 2.
[30] Línea 1 Metro de Lima, Plan de Manejo de Residuos Sólidos, p. 4.

ensuring infrastructure for secure transit of trains through inspections done twice daily verifying the rolling stock, design parameters and maintenance of the superstructure.[31]

Conflicting regulations and policies are addressed by working extensively with officials and neighboring communities to identify and address laws, standards, regulations or policies that may unintentionally create barriers to the implementation of the public mass transportation system. The L1ML addresses these issues through various proposed agreements between different entities, and through community upgrading strategies to eliminate barriers to increased mobility of the surrounding community, which is most affected by: lack of fare regulation in minor public transportation (especially in privately operated mototaxis[32]), informality in public transportation (lack of formal mototaxi stops[33]), inefficient management from the Transport and Road Safety Subdivision and mototaxi drivers associations, and social insecurity, especially in the Villa El Salvador district where a lack of action by the authorities is compounded by the neglect and resignation of their residents, making the district a dangerous place.[34]

Extension of the project's useful life is part of the L1ML project goals, as part of a larger transportation infrastructure network and as a durable public infrastructure that would serve Lima's residents for at least 50 years, as stipulated by Peruvian law concerning civil works structures, but the project's operation concession and its Conservation Plan (PC) have been designed for 30 years. The L1ML is the first of six projected metro lines, also contemplated to connect with the Metropolitano Rapid Bus Transit (MBRT) system.[35]

4.2.4. Summary of results for the Leadership category.

The table below (figure 20) shows the distribution of the credits, as well as the level of performance achieved in each.

			LIMA METRO LINE 1, PERU	PT.	Performance	% Total	max.
13	LEADERSHIP	COLLABORATION	LD1.1 Provide Effective Leadership And Commitment	9	Superior	52.9%	17
14			LD1.2 Establish A Sustainability Management System	7	Superior	50.0%	14
15			LD1.3 Foster Collaboration And Teamwork	1	Improved	6.7%	15
16			LD1.4 Provide For Stakeholder Involvement	14	Conserving	100.0%	14
17		MNGMT.	LD2.1 Pursue By-Product Synergy Opportunities	1	Improved	6.7%	15
18			LD2.2 Improve Infrastructure Integration	16	Restorative	100.0%	16
19		PLANNING	LD3.1 Plan For Long-Term Monitoring & Maintenance	10	Conserving	100.0%	10
20			LD3.2 Address Conflicting Regulations & Policies	8	Conserving	100.0%	8
21			LD3.3 Extend Useful Life	8	Superior	66.7%	12
			LD0.0 Innovate Or Exceed Credit Requirements	0	N/A		
			LD	74		61.2%	121

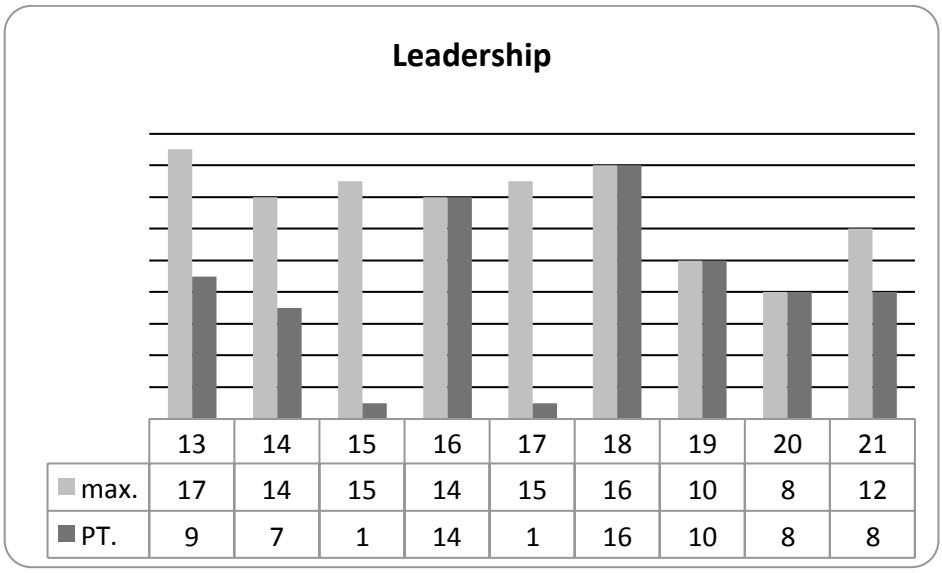
Figure 20: Summary of results in Leadership category.

Overall the Leadership (LD) category obtained a good performance, but there are some opportunities

[31] Línea 1 Metro de Lima, Plan de Conservación para el año 2013, p.6.
[32] Línea 1 Metro de Lima, Diagnóstico Social del Distrito de Villa EL Salvador, p.28.
[33] Línea 1 Metro de Lima, Diagnóstico Social del Distrito de Villa EL Salvador, p.49.
[34] Línea 1 Metro de Lima, Diagnóstico Social del Distrito de Villa EL Salvador, p.39.
[35] Línea 1 Metro de Lima, Reseña Histórica de la Línea 1 del Metro de Lima, p.3.

for improvement, especially in the Collaboration and Management subcategories. For instance, a better management of by-products synergies can still be achieved with more aggressive opportunity searches and negotiation with unwanted by-product supplies during the construction of L1ML's second section.

Considering all credits and the maximum possible values for each indicator, the percentage of achievement adds to 61.2%, or 74 points out of 121.



	13	14	15	16	17	18	19	20	21
max.	17	14	15	14	15	16	10	8	12
PT.	9	7	1	14	1	16	10	8	8

Figure 21: Summary of results in Leadership category.

4.3 RESOURCE ALLOCATION

The Resource Allocation (RA) category deals with the quality and source of the materials used in the project during its construction and operation phases. Use and allocation of materials and other resources has a great impact on the overall sustainability of the project. The RA category is divided into 13 credits: materials (RA 1.1, RA 1.2, RA 1.3, RA 1.4, RA 1.5, RA 1.6, RA 1.7), energy (RA 2.1, RA 2.2, RA 2.3) and water (RA 3.1, RA 3.2, RA 3.3).

CREDIT SCORING

				IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE	
22	RESOURCE ALLOCATION	MATERIALS	RA1.1 Reduce net embodied energy	2	6	12	18		
23			RA1.2 Support sustainable procurement practices	2	3	6	9		
24			RA1.3 Use recycled materials	2	5	11	14		
25			RA1.4 Use regional materials	3	6	9	10		
26			RA1.5 Divert waste from landfills	3	6	8	11		
27			RA1.6 Reduce excavated materials taken off site	2	4	5	6		
28			RA1.7 Provide for deconstruction and recycling	1	4	8	12		
29		ENERGY	RA2.1 Reduce energy consumption	3	7	12	18		
30			RA2.2 Use renewable energy	4	6	13	16	20	
31			RA2.3 Commission and monitor energy systems		3		11		
32		WATER	RA3.1 Protect fresh water availability	2	4	9	17	21	
33			RA3.2 Reduce potable water consumption	4	9	13	17	21	
34			RA3.3 Monitor water systems	1	3	6	11		
							Maximum points possible:		182

Figure 22: Resource Allocation category, credits distribution.

4.3.1. Materials:

In the **Materials subcategory**, out of seven credits, two were assessed with high scores, as Conserving (RA1.4 Use Regional Materials and RA1.6 Reduce Excavated Materials Taken Off Site), two were evaluated as Enhanced (RA1.3 Use Recycled Materials and RA1.7 Provide for Deconstruction and Recycling), one was considered as "Improved" (RA1.2 Support Sustainable Procurement Practices) and, two were evaluated with the lowest scores No score (RA1.1 Reduce Net Embodied Energy, and RA1.5 Divert Waste from Landfills).

Regional sourcing for construction materials and a reduction in moving excavated soils off-site were best achieved in the Materials subcategory. About 95% of all materials, including plants and soils are sourced within recommended distances. Construction materials were supplied locally by authorized dealers, with the Ministry of Energy and Mines permission for quarrying in Lima.[36] Most landscape materials for the reforestation program, such as trees and soils, come from the transplanting of existing trees and reuse of organic soil within the L1ML site. Movement of soils and other excavated materials off site was kept to a minimum since all excavated material has been used as filler in the project during the construction phase.

A better performance was achieved by minimizing the total amount of materials through the use of recycled material and infrastructure reuse. About 27% of the volume of the materials used came from

[36] Línea 1 Metro de Lima, Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Villa EL Salvador - Avenida Grau, Descripción del Proyecto, Cap.2, p. 19, 64.

reclaimed or recycled sources from the site and elevated structures from the initial Lima Metro project that had remained unfinished and in disuse for approximately 20 years. The L1ML replaced the rails, concrete ties, fastenings and ballast between Villa El Salvador station and Pumacahua station, and remediated contaminated ballast along the rail line in order to return it suitable for service.[37] Additionally, the rolling stock is composed of both new Allston trains and reused Ansaldo trains, acquired in 1980s, with adequate repairs and parts replacement support established locally.[38] At least 50% of L1ML's project-specified materials and components could be easily recycled or reused after the useful life of the project has ended. Construction of section 2 uses recycled and reused materials, and demolishes existing infrastructure only when it is not possible to remove or relocate it.[39] All of the prefabricated elements of the L1ML superstructure, accounting for at least the 50% of the project's components, are easy to deconstruct, reuse, and recycle.[40]

Opportunities for improvement are mostly found in material sourcing and minimization of embodied energy. No estimations were submitted of net embodied energy of project materials or a set sustainability target for materials procurement,[41] making it possible to attest energy conservation by net embodied energy reductions over the project's life. Sustainable procurement practices on materials sourcing and supply are considered basic, but enough to avoid external dependency and ensure metro train services availability and timeliness. Minimizing waste and diverting waste from landfills need a more comprehensive waste management plan that can perform better and account for at least 25% of total waste, since the actual percentage of waste diverted from disposal or the industry norms are unknown.

4.3.2. Energy:

The **Energy subcategory** obtained mostly low scores, out of three credits, only one credit performed well and was assessed as Enhanced (RA2.3 Commission and Monitor Energy Systems), one was evaluated as Improved (RA2.1 Reduce Energy Consumption) and one considered as No Score (RA2.2 Use Renewable Energy).

The Conservation Plan (PC) initially commissioned the project's energy system, which was implemented by the state Electric Train Autonomous Authority (AATE) in 2010. Efficient functioning and the extending of useful life have been ensured by the monitoring of the performance of energy systems of the L1ML established through the PC. The performance, operation, and maintenance of the energy systems are developed under specific criteria under technical specialists in internal combustion engines and generation systems. After the initial monitoring, it has not been stated whether third party commissioning of electrical/mechanical systems has been considered or established.

[37] Línea 1 Metro de Lima, Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Villa EL Salvador - Avenida Grau, Descripción del Proyecto, Cap.2, p. 8.
[38] Línea 1 Metro de Lima, Informe de Desarrollo de proveedores, p. 1.

[39] Línea 1 Metro de Lima, Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Villa EL Salvador - Avenida Grau, Descripción del Proyecto, Cap.2, p. 42.
[40] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Declaración de Impacto Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao Línea 1:Villa El Salvador – Avenida Grau, Resumen Ejecutivo, p. 10.
[41] Línea 1 Metro de Lima, Plan de Manejo Socio Ambiental, p. 6.

At least 10% of energy reductions are achieved by reducing overall consumption in operation and maintenance throughout the project's life cycle. The L1ML project conserves energy in its operation by the following: reducing energy consumption in the Alstom trains, installing a natural gas-fueled cogeneration power plant, direct purchasing from power distributors, and replacing fluorescent light bulbs with LEDs.[42]

The biggest consumers of energy are the electric train cars, which use approximately 80% of the total energy consumed.[43] Reduced energy consumption in Alstom trains has been achieved by excluding the rear brake lever from the design. This exclusion has demonstrated that it does not violate safety in gear trains in full operation. This reduction in net embodied energy represents an 11% in savings.[44]

Currently the amount of renewable energy that the L1ML buys from local electric companies such as Edelnor and Luz del Sur has not been stated.[45] The documentation does not state whether the L1ML project team has carried out studies to evaluate the feasibility of supplying energy needs for its operation from renewable sources. Also, the energy needed to move reforestation cistern trucks has not been accounted for.

4.3.3. Water:

The **Water subcategory** obtained the minimum scores with all three credits evaluated as Improved (RA3.1 Protect Fresh Water Availability, RA3.2 Reduce Potable Water Consumption and RA3.3 Monitor Water Systems).

A negative net impact on freshwater availability, quantity and quality was reduced by several measures taken during both construction and operation phases, but a water availability assessment at the scale of the whole L1ML project has not been realized. Water used during construction came mostly from cistern trucks with pretreated non-potable water.

The L1ML reforestation program could contribute to groundwater recharge, since water used for irrigation of parks and gardens in the districts where the Rímac River runs contributes to some extent to Lima aquifer recharge.[46] The Rímac River is the main water source for the L1ML area of influence (which is located in the Rímac River basin and to a lesser extent in the Lurín River basin). With respect to groundwater, the Lima aquifer recharges with the waters of the rivers Chillón and Rímac, with some contribution from the Surco River. The Rímac's main recharge sources are through existing crop fields in the valleys of Chillón and Rímac, and upstream filtration areas.[47]

There is ongoing research to implement a small pilot wastewater treatment plant in the L1ML railway yard in Villa El Salvador to filter the yard's effluent for reuse in the reforestation areas.[48] The wastewater

[42] Línea 1 Metro de Lima, Iniciativas de Uso Eficiente de Energía, p.1.
[43] Línea 1 Metro de Lima, Proporción de Consumo de Energía, p. 1.
[44] Línea 1 Metro de Lima, Iniciativas de Uso Eficiente de Energía, p. 1.
[45] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Declaración de Impacto Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao Línea 1:Villa El Salvador – Avenida Grau, Resumen Ejecutivo, p. 27.
[46] Línea 1 Metro de Lima, Línea de Base Ambiental, p.68.
[47] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Declaración de Impacto Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao Línea 1:Villa El Salvador – Avenida Grau, Resumen Ejecutivo, p. 19-20.
[48] Línea 1 Metro de Lima, Proyectos de Investigación, p. 7; Línea 1 Metro de Lima, Planta de Tratamiento de Agua, p. 5.

effluent resulting from project activities cannot be disposed by dumping it untreated into water bodies or soil.[49]

The reforestation program is currently using local networks of cistern trucks with pretreated water that reduce potable water consumption.[50] In order to establish the use of gray water, the L1ML project team must review and analyze the national legal framework, which carries provisions relating to the granting of discharges and reuses of treated wastewater.[51]

An initial water system monitoring program by a third party was implemented before the construction phase of the L1ML to check water systems' performance during operations and their impacts on receiving waters of the Rímac River. The results of the initial water quality analysis established that the waters exceed the contamination values established by national standards.[52] The Environmental Impact Study (EIA) establishes preventive, corrective and/or mitigation measures when there are high probabilities that the water sources will be compromised, as happens in the areas where the L1ML crosses the basin.

According to the EIA, construction of the L1ML can further alter the quality of Rímac River waters and the project must meet the regulations stated in the monitoring surface water quality program.[53] Higher achievement levels would require further third party monitoring not specified in the documentation.

Figure 23: Reforestation program cistern truck irrigation
Source: L1ML, Gestión Ambiental, p. 3.

Figure 24: Reforestation program cistern truck irrigation
Source: L1ML, Gestión Ambiental, p. 3.

[49] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Declaración de Impacto Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao Línea 1:Villa El Salvador – Avenida Grau, Resumen Ejecutivo, p. 30.
[50] Línea 1 Metro de Lima, Informe Socio Ambiental(Julio – Septiembre 2013), p. 10.
[51] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Declaración de Impacto Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao Línea 1:Villa El Salvador – Avenida Grau, Resumen Ejecutivo, p. 4.
[52] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. VII, Identificación y Evaluación de Impactos Ambientales, p. 87.
[53] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. VII, Identificación y Evaluación de Impactos Ambientales, p. 21.

4.3.4. Summary of results for the Resource Allocation category.

The table below (figure 25) shows the distribution of credits, as well as the level of performance achieved in each credit. The biggest opportunities for improvement are concentrated in the Materials and Energy subcategories. Improvement in the Energy subcategory could benefit the L1ML tremendously, especially through incorporating renewable energy sources, since it is basically an electric train that utilizes 80% of the total energy consumed. Considering all credits and the maximum possible values for each indicator, the percentage of achievement adds to 22%, or 40 points out of 182.

			LIMA METRO LINE 1, PERU	PT.	Performance	% Total	max.
22	RESOURCE ALLOCATION	MATERIALS	RA1.1 Reduce Net Embodied Energy	0	No Score	0.0%	18
23			RA1.2 Support Sustainable Procurement Practices	2	Improved	22.2%	9
24			RA1.3 Used Recycled Materials	5	Enhanced	35.7%	14
25			RA1.4 Use Regional Materials	10	Conserving	100.0%	10
26			RA1.5 Divert Waste From Landfills	0	No Score	0.0%	11
27			RA1.6 Reduce Excavated Materials Taken Off Site	6	Conserving	100.0%	6
28			RA1.7 Provide for Deconstruction & Recycling	4	Enhanced	33.3%	12
29		ENERGY	RA2.1 Reduce Energy Consumption	3	Improved	16.7%	18
30			RA2.2 Reduce Pesticide and Fertilizer Impacts	0	No Score	0.0%	20
31			RA2.3 Commission & Monitor Energy Systems	3	Enhanced	27.3%	11
32		WATER	RA3.1 Protect Fresh Water Availability	2	Improved	9.5%	21
33			RA3.2 Reduce Potable Water Consumption	4	Improved	19.0%	21
34			RA3.3 Monitor Water Systems	1	Improved	9.1%	11
			RA0.0 Innovate Or Exceed Credit Requirements	0	N/A		
			RA	**40**		**22.0%**	**182**

Figure 25: Summary of results in Resource Allocation category.

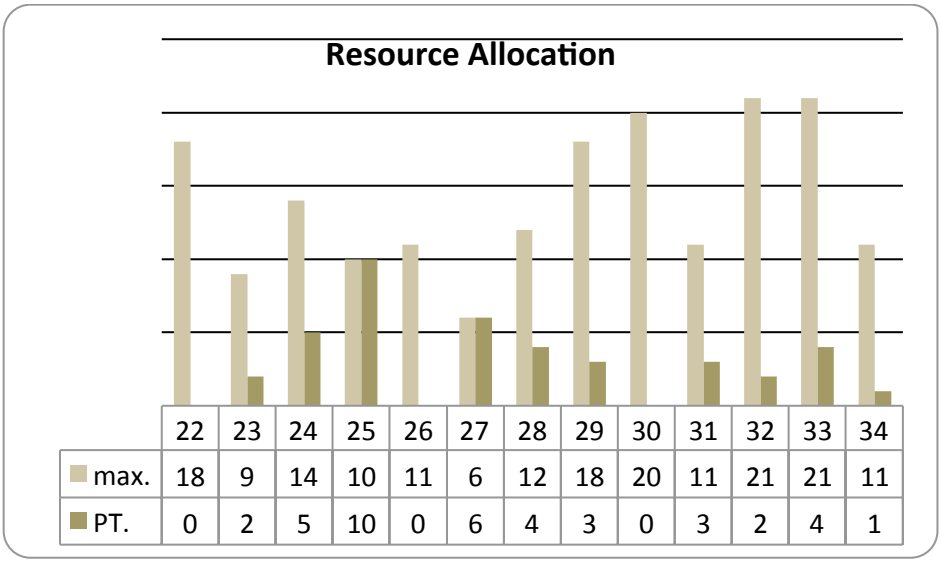


Figure 26: Summary of results in Resource Allocation category

4.4. NATURAL WORLD

The Natural World category addresses "*how to understand and minimize negative impacts while considering ways in which the infrastructure can interact with natural systems in a synergistic, positive way.*" The NW category is divided into 14 credits related to project sitting (NW 1.1, NW 1.2, NW 1.3, NW 1.4, NW 1.5, NW 1.6, and NW 1.7), impacts on land and water (NW 2.1, NW 2.2, NW 2.3) and biodiversity (NW 3.1, NW 3.2, NW 3.3, NW 3.4).

CREDIT SCORING

				IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE
35	NATURAL WORLD	SITING	NW1.1 Preserve prime habitat			9	14	18
36			NW1.2 Protect wetlands and surface water	1	4	9	14	18
37			NW1.3 Preserve prime farmland			6	12	15
38			NW1.4 Avoid adverse geology	1	2	3	5	
39			NW1.5 Preserve floodplain functions	2	5	8	14	
40			NW1.6 Avoid unsuitable development on steep slopes	1		4	6	
41			NW1.7 Preserve greenfields	3	6	10	15	23
42		LAND & WATER	NW2.1 Manage stormwater		4	9	17	21
43			NW2.2 Reduce pesticide and fertilizer impacts	1	2	5	9	
44			NW2.3 Prevent surface and groundwater contamination	1	4	9	14	18
45		BIODIVERSITY	NW3.1 Preserve species biodiversity	2			13	16
46			NW3.2 Control invasive species			5	9	11
47			NW3.3 Restore disturbed soils				8	10
48			NW3.4 Maintain wetland and surface water functions	3	6	9	15	19
							Maximum points possible:	203

Figure 27: Natural World credit distribution

4.4.1. Siting

In the **Siting sub-category**, three credits received high score with Conserving (NW1.3 Preserve Prime Farmland, NW 1.4 Avoid Adverse Geology, and NW1.7 Preserve Greenfields), two credits were evaluated as Superior (NW1.1 Preserve Prime Habitat, and NW1.6 Avoid Unsuitable Developments on Steep Slopes), and two credits were assessed low as No Score (NW 1.2 Protect Wetlands and Surface Waters and NW 1.5 Preserve Floodplain Functions).

The L1ML is located in a previously developed urban site outside of areas deemed as prime farmland as the appropriate environmental impact studies state. Nor is the location of the L1ML is considered a greenfield, since it is in a 100% previously developed area, a grayfield, principally located in the median berms of the avenues that make up the viaduct's south-to-north axis. Its structure only occupies the areas needed for the pillars of the elevated viaducts and stations.

The L1ML also avoids development in adverse geologic formations and safeguards aquifers to reduce the risk of natural hazards and preserve high-quality groundwater resources. According to the Environmental Impact Study, no major earthquake fault along the L1ML site has been identified. But there is a high level of seismic activity, according to seismic zoning maps, because the city of Lima is on the alluvial fan of the rivers Rímac and Chillón.[54] The L1ML project would be most vulnerable only during

[54] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. VII, Identificación y Evaluación de Impactos Ambientales, p. 9.

its construction phase to contaminant spillage into groundwater because of its earthworks, and to the occurrence of earthquakes while the structure is being built, but not thereafter since it must comply with the earthquake-resistant design requirements of the category A standard of Peruvian Standards for Earthquakes.[55]

The siting of the project avoids the use of lands characterized as prime habitat, by utilizing derelict and underutilized spaces of the city such as is the middle of an existing road. The L1ML avoids areas of high ecological value since it is located in areas of urban use.

The L1ML project avoids adverse steep slopes by developing in predominantly flat areas, with platforms running on a level above the ground.[56] There is no documentation supporting a site selection process that deliberately identified and avoided high-risk hillsides or steep slopes.

Wetlands and surface waters are not protected from the project by a buffer zone. Section 2 connecting Grau station to San Juan de Lurigancho, currently under construction, compromises areas belonging to the Rímac River watershed, with greenery on its riverbanks removed for the construction of the elevated rail viaduct. The mitigation strategies meet the local codes to return the area to its previous condition, but no documentation has been submitted that supports a proposed or existing vegetation and soil protection zone to protect, buffer, enhance and restore the Rímac bank areas.

Impacts to floodplain functions are minimized or avoided by limiting the development of the site to the use of an elevated structure. Actions impacting floodplain functions are avoided, but do not go beyond local laws and requirements. There is no documentation comparing pre-and post-development floodplain storage changes or how sitting helps reduce floodplain impacts.

4.4.2. Land and water:

In the **Land and Water** subcategory, out of three credits, only one received an "Improved" evaluation (NW2.3 Prevent Surface and Groundwater Contamination), and two were assessed as No score (NW2.1 Manage Stormwater, and NW2.2 Reduce Pesticide and Fertilizers Impact).

Before construction of the L1ML section 1, during the Environmental Impact Study, the Rimac River waters exceeded the maximum contamination set by the Environmental Quality Standard (ECA) due to the presence of organic waste, dumping of domestic sewage, and discharge of chemicals, among other things. A section of the river in the districts of El Augustino and San Juan de Lurigancho is being affected by the dumping of solid waste by the local people and informal recyclers. During construction mitigation measures are being taken in order to avoid the risk of spillage of fuels and lubricants such as performing regular maintenance of vehicles and machinery used, moistening the work areas, and placing a perimeter fence to minimize the generation of dust. The L1ML project team has also contemplated the

[55] Línea 1 Metro de Lima, Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Villa EL Salvador - Avenida Grau, Descripción del Proyecto, Cap.2, p. 20.

[56] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. VII, Identificación y Evaluación de Impactos Ambientales, p. 10.

incorporation of several measures to prevent pollutants from contaminating surface and groundwater and monitor impacts of operations.

Although the L1ML is an elevated viaduct with most of its structure above ground, development can change the natural flow of runoff on a site. An increase in the area of impervious surfaces contributes to increasing the volume of stormwater runoff by having less area for water to infiltrate into the ground. The L1ML's infrastructure impact on stormwater runoff quantity and quality has not been minimized or assessed, as no documentation on the infiltration and evapotranspiration capacity of the site before development has been submitted. Although precipitation is almost absent in Lima, with a scarce rainfall that can vary from 0 to 40 mm, sudden rain events can happen. Lima is mostly unprepared when sudden heavy rains events do occur and the city confronts havoc in the form of flooding, landslides, huaycos, or avalanches in higher elevations.[57]

Maintenance of green areas in the project, estimated to be around 115,000 m^2, include the use of unspecified amounts of fertilizers and pesticides. The L1ML project aims to recover and improve the landscape quality of the green areas around it. Two types of fertilizers will be utilized: chemical and organic, and pesticides will also be used to control pests and diseases and protect the soil from degradation.[58]

4.4.3. Biodiversity:

In the **biodiversity subcategory**, L1ML presents a good performance. Considering all four credits, two were evaluated high with Conserving (NW3.3 Restore Disturbed Soils and NW3.4 Maintain Wetland and Surface Water Functions), one was assessed as Improved (NW3.1 Preserve Species Biodiversity), while one credit was evaluated low with a No Score (NW3.2 Control Invasive Species).

The soils disturbed during construction and operation of the L1ML are planned to be restored in order to bring back ecological and hydrological functions. Soil restoration goes beyond the extent required by regulations and construction permits. A comprehensive soils disturbance study, made as part of a student thesis implementation program, contributed to the qualification of green space for reforestation. The current characteristics of the soil were classified into three main types: 5 ha of bare soil, 10 ha of vegetated soil, and 2.5 ha of bare soil with high urban impact.[59]

Soil disturbance prevention during construction is also practiced. For instance, the topsoil layer is saved and placed at distance not less than 1.50 meters from the boundary of the excavation, for security purposes and to facilitate the return of excavated material.[60] The reforestation of green areas is the main means to restore disturbed soils; trees along the projected viaduct are evaluated, in coordination with the municipalities for removal or pruning as appropriate, vegetation (grass) is removed, organic

[57] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. IV, Línea Base Socio Ambiental, p. 88.
[58] Línea 1 Metro de Lima, Plan de Manejo Socio Ambiental, p. 79.
[59] Línea 1 Metro de Lima, Avances Tesis Ambiental Caracterización de Suelos, p.1-28.
[60] Línea 1 Metro de Lima, Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Villa EL Salvador - Avenida Grau, Descripción del Proyecto, Cap.2, p. 71.

soil is retired and conserved, and finally the area is reforested (trees and grass) or the affected coverage (trees and grass) is returned to the corresponding district municipalities.[61]

Wetland and surface water functions are maintained as the L1ML traverses waterways and riparian areas of the Rímac River without disrupting its connectivity. The project implementation impact is minimal during the operation phase and maintains the hydrologic connection in the Rímac River. Local regulation also supports the prevention of negative environmental impacts by protecting streams, wetlands, water bodies and their riparian areas. It is expected that the water quality will be compromised during the construction phase and some mitigation strategies have been taken, but no meaningful action has been taken to maintain or restore ecosystem functions of waterways on the project.

Biodiversity is protected by preserving and restoring green areas. During the Environmental Impact Study (EIA), the project team and local agencies helped identify existing habitats, to ensure and compensate them for losses. Peru is one of the most biodiverse countries in the world with about 1,800 species of birds reported or 18.5% of all bird species on the planet, in Lima and near its coast it is possible to find over 300 species.[62] In the L1ML area of influence 44 species of trees, 14 species of birds, 24 species of phytoplankton, 12 species of zooplankton, and 7 species of benthic macroinvertebrates were identified.[63]

The area of the Rímac River is where most biodiversity is observed. The construction of the elevated viaduct will increase the levels of noise contamination, and contamination in the air and water. The temporary displacement of local birds that congregate daily in the areas around the river is expected. Among the most affected bird species is the *Parabuteo unicinctus* "gavilan" (hawk) International Union for Conservation of Nature (IUCN) protected species in category LC (Least Concern).[64] It is estimated that these birds will return after construction work is finished.

Among the trees in the area, two trees are from the species *Cedrela odorata*, protected by national legislation. However, it is important to note that these two trees are in common green areas not affected by the implementation and development project.[65]

In the L1ML reforestation program, locally appropriate plants are identified and used while noxious plants are identified and removed. Invasive species control is included in the maintenance of the areas surrounding the stations, which will generally be kept clean by eradicating invasive weeds using

[61] Línea 1 Metro de Lima, Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Villa EL Salvador - Avenida Grau, Descripción del Proyecto, Cap.2, p. 61-62.

[62] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. IV, Línea Base Socio Ambiental, p. 105.

[63] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. X, Conclusiones y Recomendaciones, p. 1-2.

[64] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. IV, Línea Base Socio Ambiental, p. 124.

[65] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. IV, Línea Base Socio Ambiental, p. 104.

pesticides and physical removal.[66] Although invasive species will be eradicated, a comprehensive multiyear management plan to control them is not mentioned in the documentation submitted.

Additionally, there is an intent to use locally appropriate vegetation, as the arborization thesis work (PTA) recommends, for the development of a biological corridor along the L1ML with an appropriate mix of native forest species that thrive in urban ecosystems.[67]

4.4.4. Summary of results, Natural Word category:

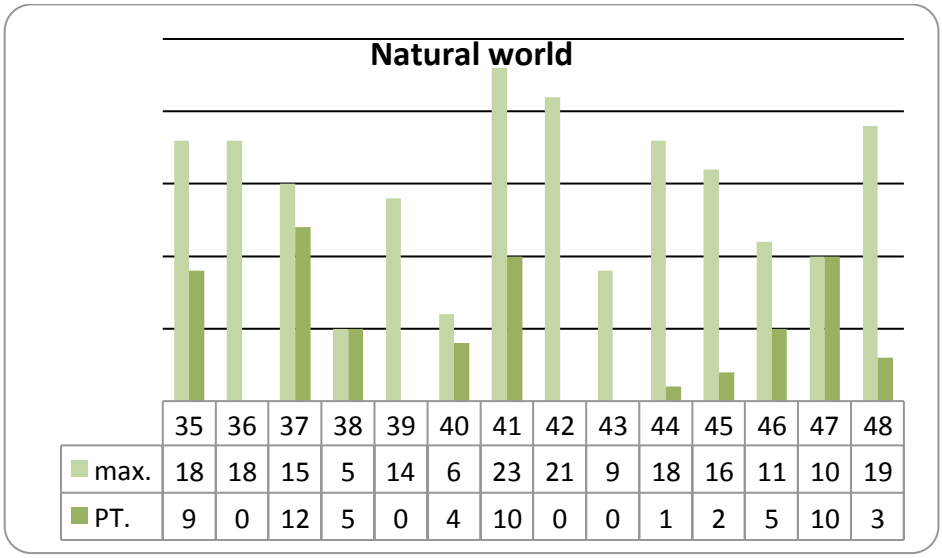
The table below shows the distribution of credits, as well as the level of performance achieved in each credit. The performance in Natural World is one of the lowest in the evaluation among Envision's five analytical categories. Opportunities for improvement can be found in all three subcategories (Siting, Land and Water, Biodiversity) but especially in the Land and Water subcategory, where stormwater is not considered, pesticide and fertilizer management is not comprehensive, and some actions have been taken toward preventing surface and groundwater contamination. Considering all credits and the maximum possible values for each indicator, the percentage of achievement adds to 30%, or 61 points out of 203.

			LIMA METRO LINE 1, PERU	PT.	Performance	% Total	max.
35	NATURAL WORLD	SITING	NW1.1 Preserve Prime Habitat	9	Superior	50.0%	18
36			NW1.2 Preserve Wetlands and Surface Water	0	No Score	0.0%	18
37			NW1.3 Preserve Prime Farmland	12	Conserving	80.0%	15
38			NW1.4 Avoid Adverse Geology	5	Conserving	100.0%	5
39			NW1.5 Preserve Floodplain Functions	0	No Score	0.0%	14
40			NW1.6 Avoid Unsuitable Development on Steep Slopes	4	Superior	66.7%	6
41			NW1.7 Preserve Greenfields	10	Conserving	43.5%	23
42		L & W	NW2.1 Manage Stormwater	0	No Score	0.0%	21
43			NW2.2 Reduce Pesticides and Fertilizer Impacts	0	No Score	0.0%	9
44			NW2.3 Prevent Surface and Groundwater Contamination	1	Improved	5.6%	18
45		BIODIVERSITY	NW3.1 Preserve Species Biodiversity	2	Improved	12.5%	16
46			NW3.2 Control Invasive Species	5	Superior	45.5%	11
47			NW3.3 Restore Disturbed Soils	10	Restorative	100.0%	10
48			NW3.4 Maintain Wetland and Surface Water Functions	3	Improved	15.8%	19
			NW0.0 Innovate or Exceed Credit Requirements	0	N/A		
			NW	61		30.0%	203

Figure 28: Summary of results in Natural World category

[66] Línea 1 Metro de Lima, Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Villa EL Salvador - Avenida Grau, Descripción del Proyecto, Cap.2, p. 71; Línea 1 Metro de Lima, Plan de Manejo Socio Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao, p.79.

[67] Línea 1 Metro de Lima, Proyecto de Tesis Arborización, p.54.



	35	36	37	38	39	40	41	42	43	44	45	46	47	48
max.	18	18	15	5	14	6	23	21	9	18	16	11	10	19
PT.	9	0	12	5	0	4	10	0	0	1	2	5	10	3

Figure 29: Summary of results in Natural World category

4.5. CLIMATE AND RISK

Envision's Climate and Risk category is divided in two main sub-categories, emissions and resilience. The main goals of the category are to "minimize emissions that may contribute to increased short and long-term risks" and "to ensure infrastructure projects are resilient to short-term hazards or long-term altered future conditions." The credits are distributed as: Emissions (CR.1.1, CR. 1.2) Resilience (CR.2.1, CR. 2.2, CR.2.3, CR. 2.4, CR. 2.5).

CREDIT SCORING

				IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE
49	CLIMATE & RISK	EMISSIONS	CR1.1 Reduce greenhouse gas emissions	4	7	13	18	25
50			CR1.2 Reduce air pollutant emissions	2	6		12	15
51		RESILIENCE	CR2.1 Assess climate threat				15	
52			CR2.2 Avoid traps and vulnerabilities	2	6	12	16	20
53			CR2.3 Prepare for long-term adaptability				16	20
54			CR2.4 Prepare for short-term hazards	3		10	17	21
55			CR2.5 Manage heat islands effects	1	2	4	6	
						Maximum points possible:		116

Figure 30: Climate and Risk credit distribution.

4.5.1 Emissions

In the **emissions sub-category** both two credits were assessed as Conserving (CR1.1 Reduce Greenhouse Gas Emissions, and CR1.2 Reduce Air Pollutant Emissions).

The L1ML project team life cycle assessment states that the project produces 41-80% reductions in carbon emissions as compared to regulatory requirements. The trains of the L1ML are electrically operated thus constituting minimal greenhouse gas emissions. At the same time they improve the mobility of citizens and the air quality in Lima, the fifth largest city in Latin America. The L1ML is the city's first metro line and forms part of a larger mass transportation project to include five more metro lines in combination with the Metropolitano Bus Rapid Transit (MBRT), which will potentially reduce the number of cars and taxis on the streets and also help reorganize routes for mototaxis, public vans, or combis that circulate in Lima, thus reducing the air pollutant emissions indirectly.

Air pollution constitutes one of the greatest health hazards and one of the problems that most affect the citizens of Lima.[68] In Lima the automotive fleet, responsible for generating 90% of air pollution, grows 7% on average per year with almost no control in emission of greenhouse gases due to the lack of maintenance of vehicles and poor technical regulation. The main automotive pollutants are carbon monoxide, nitrogen oxides, volatile organic compounds (VOCs), and lead, among others.

In 10 months of operation, the L1ML has mobilized more than 26 million customers in section 1, with an average distance of 22 kilometers. According to the Electric Train Autonomous Authority (AATE), the L1ML's section 1 has reduced 32,000 tons of CO_2 emissions in the city per year.[69] In Lima, 40% of people that work or study outside home travel by public vans or combis, which is one of the most polluting and unregulated mode of collective transportation, producing about 2 kg of CO_2 for every 12 km traveled.[70]

[68] Observatorio Ciudadano, Encuesta Lima Cómo Vamos 2012, p.11.
[69] Línea 1 Metro de Lima, Gestión Ambiental, p.1.
[70] Línea 1 Metro de Lima, Gestión Ambiental, p.4; Observatorio Ciudadano, Encuesta Lima Cómo Vamos 2012, p.12.

The L1Ml not only achieves negligible air pollution impacts and net zero production of criteria pollutants, but implements measures to improve existing air quality by reducing air pollution through reforestation strategies. In the 10 months of operation, approximately 329,200 m^2 of green areas have been maintained with the aim of trapping and holding particulate contaminants (dust, ash, pollen and smoke).[71]

The air quality monitoring through the concessionaire's Air Quality Monitoring Subprogram, more comprehensive than the Peruvian Environmental Quality Standards (ECA), will verify compliance with the regulations and trends of air quality change with a methodology based on EPA Method 40 CFR.[72]

4.5.2 Resilience

The **resilience subcategory** offers many opportunities for improvement. One out of five credits was assessed as Improved (CR2.4 Prepare for Short Term Hazards), and four were assessed as No score (CR2.1 Assess Climate Threat, CR2.2 Avoid Traps and Vulnerabilities, CR2.3 Prepare for Long Term Adaptability and CR2.5 Manage Heat Islands Effects).

In terms of short-term hazards, the L1ML team has considered natural and man-made hazards that are possible in the region and researched the frequency and severity of these disasters. There is an awareness of likely natural hazards in the area and several contingency plans for such emergencies. The Social and Environmental Management Program is the umbrella plan, with various programs and subprograms that deal with natural and man-made hazards.[73]

Climate threats have not been assessed; there is no mention of a comprehensive climate impact assessment and adaptation plan developed that includes vulnerability assessment, risk assessment and adaptation assessment in collaboration with the local emergency management department and meetings with the local community.

Assessments and recommendations vis-à-vis traps and vulnerabilities that could create high, long-term costs and risks were not found. There is a lack of documentation supporting that the team identified potential approaches and practices to address possible resource constraints and vulnerabilities that the community could face in the future due to climate change.

Considering Lima's vulnerability to sudden rain events, expected to occur more often with climate change, no comprehensive preparations for climate change consequences seemed to have been made in the L1ML, nor has the team considered aspects such as sea level rise in cities or extended droughts, among others. There are no long-term adaptability preparation plans in the L1ML infrastructure systems that can prepare the system to be resilient to the consequences of long-term climate change, perform adequately under altered climate conditions, or adapt to other long-term change scenarios.

There is also no consideration for managing heat islands effects in the L1ML project that are created by hard surfaces, such as the elevated viaduct, rooftops and pavements. Heat islands effects occur when

[71] Línea 1 Metro de Lima, Gestión Ambiental, p.2.
[72] Línea 1 Metro de Lima, Plan de Manejo Socio Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao, p.161, 162.
[73] Línea 1 Metro de Lima, Plan de Manejo Socio Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao, p.2-3.

hard surfaces absorb a large percentage of the incident solar radiation, heating surfaces and the surrounding air and altering the microclimate around them, which can lead to increased energy consumption for additional cooling, and its cumulative impact can contribute to larger climate-related effects.

4.5.3 Summary of results Climate and Risk category.

The table below (figure 31) shows the distribution of credits as well as the level of performance achieved in each credit:

LIMA METRO LINE 1, PERU				PT.	Performance	% Total	max.
49	CLIMATE	EMISSION	CR1.1 Reduce Greenhouse Gas Emissions	13	Superior	52.0%	25
50			CR1.2 Reduce Air Pollutant Emissions	12	Conserving	80.0%	15
51		RESILENCE	CR2.1 Assess Climate Threat	0	No Score	0.0%	15
52			CR2.2 Avoid Traps And Vulnerabilities	0	No Score	0.0%	20
53			CR2.3 Prepare For Long-Term Adaptability	0	No Score	0.0%	20
54			CR2.4 Prepare For Short-Term Hazards	3	Improved	14.3%	21
55			CR2.5 Manage Heat Island Effects	0	No Score	0.0%	6
			CR0.0 Innovate Or Exceed Credit Requirements	0	N/A		
			CR	28		23.0%	122

Figure 31: Summary of results in Climate and Risk category

Climate and Risk (CR) presents one of the lowest performances in this assessment. Many opportunities for improvement can be found in the Resilience subcategory in terms of vulnerabilities in regard to climate threats, avoiding traps and vulnerabilities, creating long-term adaptability, and minimizing heat islands effects. Considering all credits and the maximum points available for each credit, the percentage of achievement adds to 27%, or 33 points out of 122.

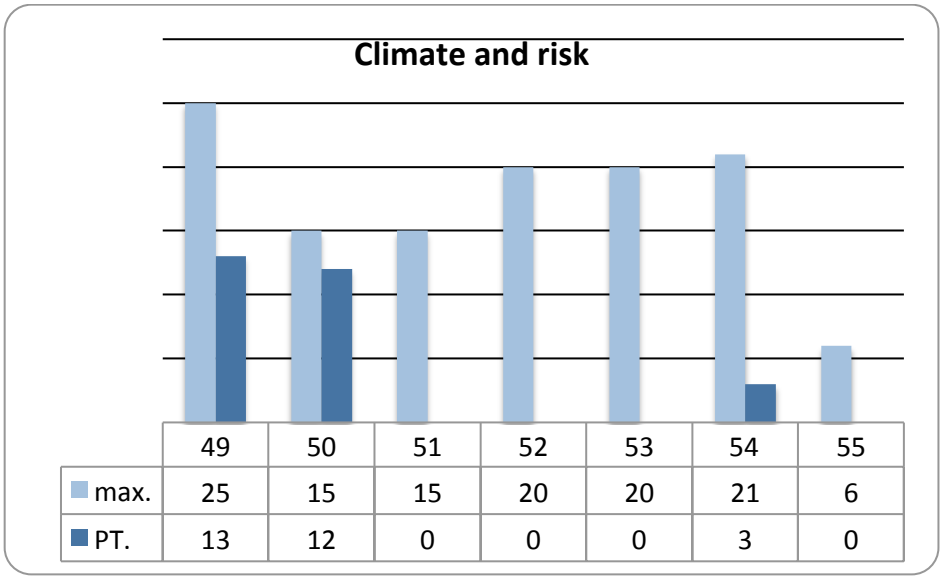


Figure 32: Summary of results in Climate and Risk category

Lima Metro Line 1, Peru

5. RESULTS AND CONCLUSION

The L1ML is the first metro line in Lima. It has resurrected 20-year-old unused train and station infrastructure, while the siting is located in generally unused areas in main avenues median berms. When finalized, its almost 34 km length will run 19 trains, connecting the most populated areas of Lima and Peru. Moving around 132,000 commuters per day, this mass transportation project has direct large-scale impacts in the mobility of more than 3 million people that live in the area of influence across 11 districts of Lima, which contributes to expected reductions in traffic volume, and indirect impacts to the citywide productivity level by greatly reducing communing times.[74]

The L1ML not only provides mobility but addresses many of the more visible problems found in most districts, such as social insecurity, youth unemployment, traffic chaos, and pollution, often caused by inadequate system of waste collection.[75] L1ML's commitment is to ameliorate the quality of life for Lima's citizens by increasing mobility, rehabilitating important community assets, upgrading and extending access, increasing safety, improving environmental quality, adding infrastructure capacity, and ultimately contributing in setting a benchmark for the other projected metro line projects.

Quality of Life (QL) became the highest-achieving Envision category in the whole assessment of L1ML project with 94.5% achievement (171 points out of 181), revealing its many strengths in community quality-of-life improvements by increasing mobility and access; developing local skills and capabilities by hiring locally; stimulating sustainable growth by reducing commuting times; encouraging alternative modes of transportation to and from stations; enhancing health and safety through direct communication channels with clients and the community; and improving site accessibility, safety, and wayfinding through upgrading of community assets. Additional extraordinary recognition goes to the efforts to preserve the historic character of certain site areas by giving access and bringing people to visit historic monuments, preserving views and local character through infrastructure upgrading, promoting destinations aboard the train, and enhancing public space by collaborating with the community on reforestation, mural art, urban art graffiti programs and social activities. Although this category is the highest-achieving, there is room for improvement in further minimizing light pollution, and reducing noise and vibration levels to a target lower than pre-development levels.

The project performed well **in the Leadership** (LD) category, achieving a 61.2% (74 points out of 121). This represents a great effort in improving infrastructure integration in Lima, as well as involving stakeholders from different backgrounds to collaborate with the L1ML. The project team has provided a Social and Environmental Management Plan (ESMP) as part of their strategy for environmental conservation, congruent with the socioeconomic development of local neighborhoods, with

[74] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Declaración de Impacto Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao Línea 1:Villa El Salvador – Avenida Grau, Resumen Ejecutivo, p. 22; Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. IV, Línea Base Socio Ambiental, p. 87.

[75] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. VI, Participación Ciudadana, p. 4.

mechanisms established that seem sufficient to address the economic, environmental, and social aspects prioritized in the project during both the construction and operation phases.

Efforts in long-term planning, in addressing conflicting regulations, and in monitoring and maintenance, also performed well. Part of the L1ML project goals are to create durable public infrastructure with useful life extension, as it belongs to a larger transportation infrastructure network that contemplates adding five more metro lines, and by law it needs to serve Lima's residents for at least 50 years.

Conflicting regulations and policies, such as lack of fares regulation and informality in minor public transportation, are addressed by working extensively with officials and neighboring communities to identify and address laws, standards, regulations, or policies that may unintentionally create barriers to the implementation of the public mass transportation system.

The Metro Culture program (MC), within the L1ML, is the main mechanism involved in establishing meaningful programs that go beyond local regulations and the project's jurisdiction for stakeholder identification, engagement, and involvement in decision-making. The MC's objectives are to educate the users to use the L1ML well; empower users and neighbors in the care of the system; and bring commuters and neighbors new services that contribute to better citizenship development.

Although the L1ML project team recognizes the importance of working together as a team, no particular process or methodology has been incorporated to integrate the design, project delivery methodologies, and collaborative processes. Opportunities for by-products synergies between systems and among larger infrastructure systems are limited due to a lack of in-depth identification and limited documentation. Opportunities for improvement lie in better managing by-products synergies and further extending the useful life of the project.

The **Resource Allocation** (RA) category is the project's lowest-achieving category with only 22% (40 points out of 182). The project performed well in the use of regional materials and the reuse of excavated materials on site. In terms of waste and recycling, although improvements are needed in diverting more waste from landfills, there is a comprehensive solid waste plan, and at least 50% of L1ML's project-specified materials and components could be easily recycled or reused after the useful life of the project has ended, especially since the viaduct's superstructure is prefabricated, facilitating its deconstruction and recycling in the future.

The total amount of materials was minimized through the use of recycled material and infrastructure reuse. About 27% of the volume of the materials used came from reclaimed or recycled sources from the site and pillar structures from the earlier version of Lima metro that remained unfinished and in disuse for approximately 20 years. Furthermore, the rolling stock is composed of both new Allston trains and reused Ansaldo trains, acquired in the 1980s, while adequate repairs and parts replacement support have been established locally.[76]

The biggest opportunities for improvement are concentrated in the Materials and Energy subcategories. Improvement in the Energy subcategory can benefit the L1ML tremendously, especially in incorporating renewable energy sources, since electric trains utilize 80% of the total energy consumed. Overall energy

[76] Línea 1 Metro de Lima, Informe de Desarrollo de proveedores, p. 1.

consumption reduction, and commissioning and monitoring of the energy systems could improve enormously.

Although the negative net impact on freshwater availability, quantity and quality was reduced by taking several measures, such as using non-potable water during both construction and operation phases, a water availability assessment at the scale of the whole L1ML project has not been realized. Considering that the Rímac River pre-development contamination levels were high, there are opportunities for improvement in its restoration and monitoring. Furthermore, there are already considerations to implement a wastewater treatment plant to treat the rail yard effluents and reuse water in reforestation.

The performance in the **Natural World** (NW) category is also on the lower end of the evaluation with a percentage of achievement that adds to 30%, or 61 points out of 203. Some actions have been taken toward preventing surface and groundwater contamination, but stormwater, pesticide and fertilizer management are either nonexistent or not comprehensive.

The siting received high scores mostly because the location of the L1ML is in a grayfield or previously developed urban site, outside of areas deemed as prime farmland or greenfields. The location is in a 100% previously developed area, also avoiding adverse steep slopes by developing in predominantly flat areas in the median berms of the three main avenues that make up the viaduct's south-to-northeast axis.

Actions impacting floodplain functions are avoided (but only to the extent mandated by local laws and requirements), by developing the site minimally through the use of an elevated structure mostly above ground, which occupies only areas for the pillars of the elevated viaducts and stations.

During construction several mitigation measures are being taken to avoid the risk of spilling fuels and lubricants, and to reduce dust generation by moistening the work areas and placing a perimeter fence. The L1ML project team has also contemplated incorporating of several measures to prevent pollutants from contaminating surface and groundwater and to monitor impacts during the system's operations.

As the L1ML traverses waterways and riparian areas of the Rímac River, wetland and surface water functions maintain their connectivity, but are not protected by a buffer zone or existing vegetation and soil protection zone (VSPZ) to protect, buffer, enhance and restore the Rímac River bank areas. There are mitigation strategies that meet local codes to return the area to previous condition, but there is room for improvement in restoring the already contaminated waters.

Because there is a near-absence of precipitation in Lima, there is a lack of assessment and preparation of infrastructure for stormwater impact in runoff quantity and quality. Improvements in this area can help minimize vulnerabilities and casualties when sudden rains do occur.

The maintenance of green areas currently includes the use of unspecified amounts of fertilizers and pesticides, which can improve with better management in controlling quality, quantity, and frequency of application. There is basic invasive species control, using pesticides and physical removal, in the maintenance of the areas surrounding the stations.

The project provides for soil disturbance prevention during construction and a comprehensive soil restoration program that goes beyond the extent required by regulations and construction permits, to

bring back ecological and hydrological functions to soils disturbed during construction and operation of the L1ML.

Preserving and restoring green areas helps protect biodiversity. Construction will increase the levels of noise pollution and air and water contamination temporarily displacing local birds that congregate daily in the areas around the river. Improvements are possible if further habitat restoration and monitoring go beyond local code stipulations.

Climate and Risk (CR) presents one of the lowest performances in the assessment with a percentage of achievement of 23%, or 28 points out of 122. Improvement opportunities can be found if the project undertakes consideration and assessment of climate threats and long-term adaptability, and avoids traps and vulnerabilities and heat island effects.

The trains of the L1ML are electrically operated, constituting a greenhouse gas emissions reduction and negligible air pollution. The L1ML project team life cycle assessment states that the project produces 41-80% reductions in carbon emissions. According to the Electric Train Autonomous Authority (AATE), with only L1ML's section 1 operating, CO_2 emissions have been reduced by 32,000 tons in the city per year through reduction in the use of public vans or combis, one of the most polluting and popular modes of collective transportation.[77]

Air pollution constitutes one of the greatest health hazards and one of the problems that most affect the citizens of Lima.[78] The L1Ml not only achieves negligible air pollution impacts and net zero production of criteria pollutants, but implements measures to improve existing air quality to a level higher than pre-development through the reforestation strategies.

The L1ML team through the Social and Environmental Management Program has considered the frequency and severity of short-term natural and man-made hazards that are possible in the region and has created several contingency plans for such emergencies.

Considering Lima's vulnerability to sudden rain events, expected to occur more often with climate change, and other climate threats that can occur such as sea level rise, and extended droughts, more comprehensive preparations to deal with climate change consequences are necessary. There is no mention of a comprehensive climate impact assessment and adaptation plan that includes vulnerability, risk, and adaptation assessment in collaboration with the local emergency management department and the local community.

The L1ML is expected to have positive impacts in the most populated areas of Lima, contributing to reductions in traffic volume, in CO_2, in air pollutants, and in commuting times. Based on the documentation, these impacts will prove beneficial for the city, the region, and the country. The community has been supportive of the project; the operation of section 1 so far has surpassed the ridership expectations, from approximately 126,000[79] daily passengers to 132, 000.[80] Further integration

[77] Línea 1 Metro de Lima, Gestión Ambiental, p.1, 4
[78] Observatorio Ciudadano, Encuesta Lima Cómo Vamos 2012, p.11.
[79] Ministerio de Transportes y Comunicaciones and ECSA Ingenieros, Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. II, Descripción del Proyecto, p. 16.
[80] Línea 1 Metro de Lima, Reseña Histórica del Metro de Lima, p. 2.

of the L1ML to the five new projected lines, the Metropolitano Bus Rapid Transit (MBRT), feeder routes, minor public transportation, and cycling will help achieve greater connectivity and mobility for Lima's citizens. The integration of community empowerment and involvement in the project has proven to be a successful combination that has helped with the maintenance of infrastructure, and created public safety which will help ensure the quality of the service in the long term.

The graphs below demonstrate the project's performance under the three Infrastructure 360^{o} Awards. The **People and Leadership Award** (figure 33) represents the QL and LD categories from the Envision™ Rating System. The project received a score of 245 points out of a total of 302 combined points within these categories, which equates to a 81.1% level of achievement. The **Climate and Environment Award** (figure 34) represents the RA, NW and CR categories within the Envision™ Rating System. The project received a score of 129 points out of a total of 507 combined points within these categories, which equates to a 25.4% level of achievement. Thus, the overall achievement of the Lima metro Line 1 project under the **Infrastructure 360 Award** (figure 35) is 374 out of 809 points, or 46.2% of the total score.

This report evaluates the sustainability performance of the Lima metro Line 1 project according to the Envision™ Rating System. The report identifies areas in which the project scored highly, as well as low-scoring areas that represent opportunities for which the project team can learn and improve on in future projects, as they strive to achieve sustainable project design and construction methodologies.

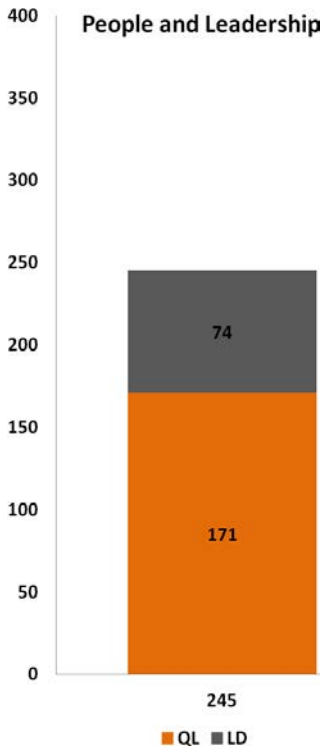


Figure 33:People and Leadership. Score distribution

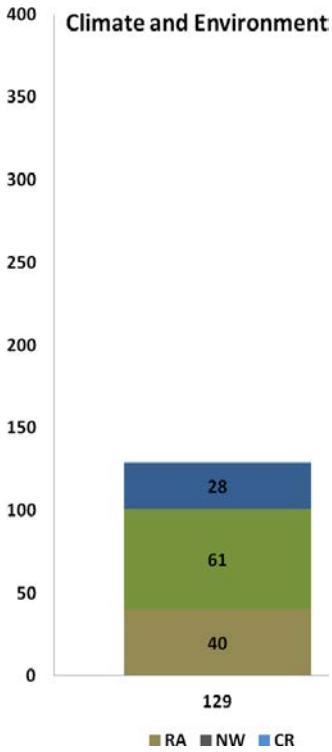


Figure 34:Climate and Environmental. Score distribution

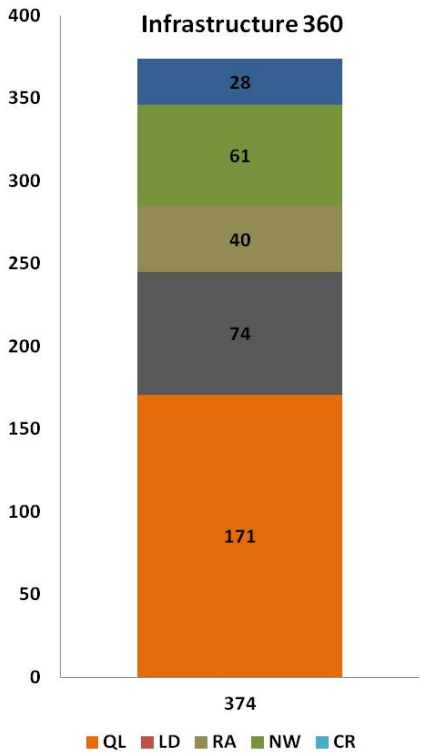


Figure 35:Infrastructure 360. Score distribution

APPENDIX A: PROJECT PICTURES AND DRAWINGS

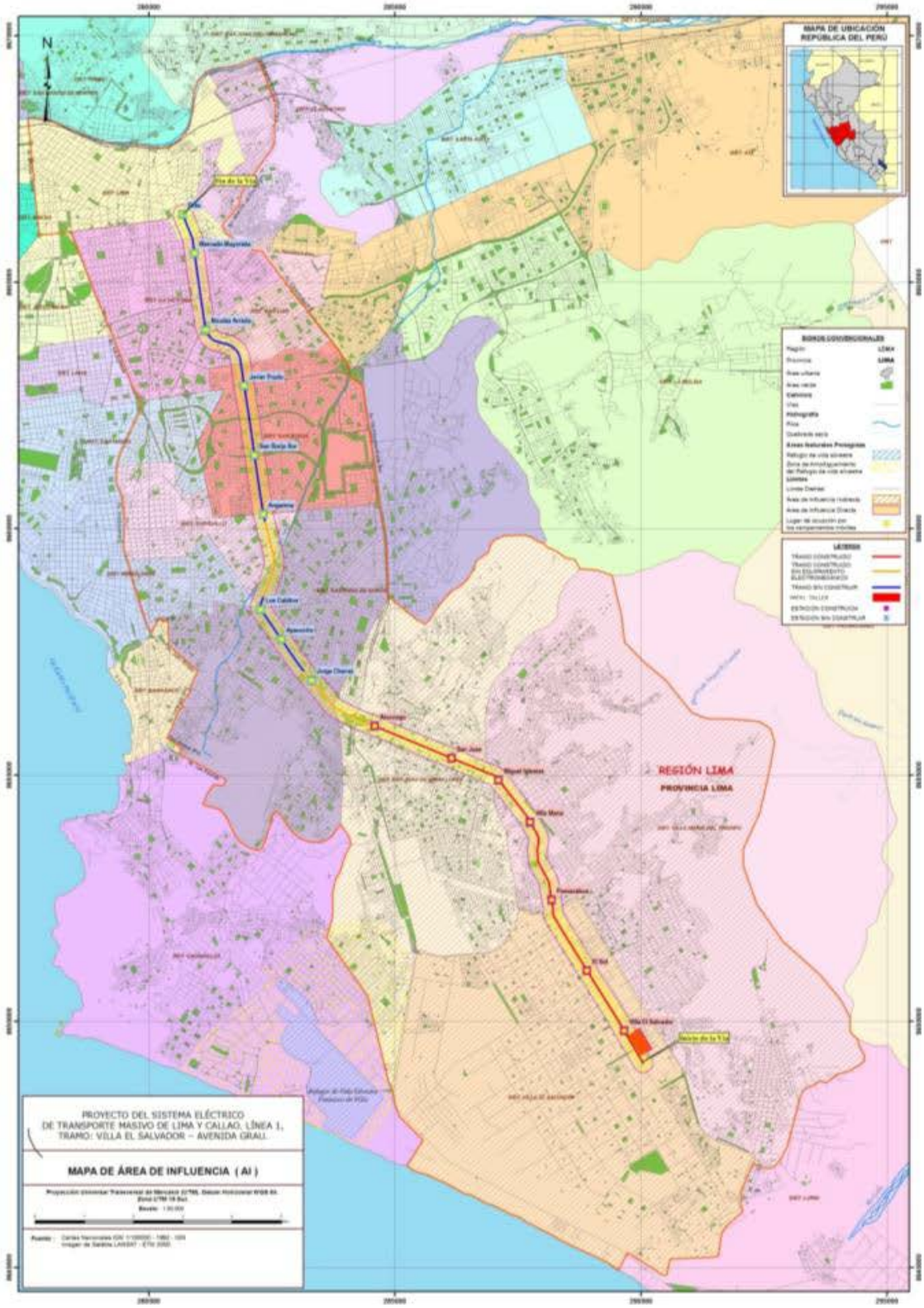


Figure 36: Metro Lima Line 1 direct influence area / Source: IPSOS, Estudio de Reputación Cuantitativo, p. 3

Figure 37: New Alstom trains in station/ Source: L1ML

Figure 38: New Alstom trains in station / Source: IPSOS, Estudio de Reputación Cuantitativo, p. 1

Figure 39: L1ML Section 1 reforested areas and art murals in Micaela Bastidas / Source: L1ML

Figure 40: Próceres de la Independencia Avenue viaduct / Source: http://www.skyscrapercity.com/archive/index.php/t-837458-p-80.html

Lima Metro Line 1, Peru

Figure 41: L1ML's Section 1 station and rail viaduct in Villa Maria del Triunfo district / Source: L1ML

Figure 42: L1ML's Section 1 rail viaduct in Villa Maria del Triunfo district / Source: L1ML

Figure 43: L1ML's Section 1 rail viaduct in Micaela Bastidas neighborhood association, Villa Maria del Triunfo district / Source: L1ML

Figure 44: L1ML's Section 1 rail viaduct in Micaela Bastidas neighborhood association, Villa Maria del Triunfo district / Source: L1ML

Figure 45 & 46: Training and hiring of local university students /Source: L1ML, Plan Social de Formación y Empleo de Estudiantes Universitarios, p. 16

Figure 47: Arte Vecinal cultural activity in station
Source: L1ML, Sistema de Gestión Cultura Metro, p. 44.

Figure 48: Arte Vecinal cultural activities in stations program
Source: L1ML, Sistema de Gestión Cultura Metro, p. 41.

Figure 49: Arte Vecinal cultural activity in station
Source: L1ML, Sistema de Gestión Cultura Metro, p. 44.

Figure 50: Graffiti urban art program in L1ML walls
Source: L1ML, Sistema de Gestión Cultura Metro, p. 50.

Lima Metro Line 1, Peru

Figure 51: Reforestation program in Micaela Bastidas
Source: L1ML, Informe de Reforestación Micaela Bastidas, p. 2.

Figure 52: Volunteers in reforestation program, Micaela Bastidas
Source: L1ML, Informe de Reforestación Micaela Bastidas, p. 6.

Figure 53 and 54: Before and after from the reforestation program in Micaela Bastidas
Source:L1ML, Informe de Reforestación Micaela Bastidas, p. 9.

Figure 55 and 56: Before and after from the reforestation program in Micaela Bastidas
Source:L1ML, Informe de Reforestación Micaela Bastidas, p. 10.

COMITE CENTRAL DE MICAELA BASTIDAS
"PUYUCAHUA"
ASENTAMIENTO HUMANO INCA PACHACUTEC - 3er. SECTOR
Fundado el 6 de Agosto de 1968
Villa Maria del Triunfo (Postal 35) Lima - Perù

MICAELA BASTIDAS 10-07-2013

CARTA DE AGRADECIMIENTO:

SRES: LINEA UNO DEL METRO DE LIMA

ES GRATO DIRIGIRNOS A USTEDES POR EL APOYO BRINDADO A NUESTRA COMUNIDAD EN LA RECUPERACION DE ESPACIOS PUBLICOS COMO ES UN AREA VERDE DONDE ANTYES OSLO HABIAN BASURA Y ERA UN FOCO INFECIOSO PERO HOY TIENE UNA NUEVA IMAGEN SIENDO ESTA LA ENTRADA DE MICAELA BASTIDAS PODEMOS DECIR ¡GRACIAS POR SU APOYO! Y ESPERAMOS PODER SEGUIR COODINANDO EN FUTURO LAS DIVERSAS ACTIVIDADES QUE PODEMOS REALIZAR. SIN OTRO PARTICULAR ME DESPIDO Y DESEANDOLE LA PROTECCION DE DIOS Y DE LA VIRGEN PARA CON TODOS SUS TRABAJADORES Y SUS FAMILIAS.

FRATERNALMENTE.

SECRETARIO GENERAL — SUB SECRETARIO — SECRETARIA DE ACTAS

SARA RAMIREZ TAYPE — ELIO RODAS

SECRETARIA DE SEGURIDAD CIUDADANA — SECRETARIO NIÑO Y ADOLESCENTE

LOCAL COMUNAL DE MICAELA BASTIDAS JR. JOSÉ OLAYA 1RA CUADRA

Figure 57: Thank you letter for reforestation in Micaela Bastidas neighborhood association / Source: L1ML, Cartas de Agradecimiento, p. 5.

Figure 58, 59 and 60: L1ML and World Vision Peru anti bullying art mural program with neighboring communities' kids in Mariano Melgar Source:L1ML, Informe Muralización Basta de Bullying, p. 14, 22.

Figure 61 and 62: Mural art painting workshop with community (area in blue) and local graffiti artists (area in yellow) in Micaela Bastidas Source: L1ML, Informe del Taller y Jornada Muralista, p. 2, 8.

Lima Metro Line 1, Peru

Figure 63 and 64: Famous urban artists in Tacora Urban Art Gallery, Cercado de Lima Source: L1ML, Informe Mejora Urbana Muralización Tacora: Galería Urbana Tacora, p. 2, 13.

Figure 65 and 66: Before and after of Tacora Urban Art Gallery featuring famous urban artists, Cercado de Lima
Source: L1ML, Informe Mejora Urbana Muralización Tacora: Galería Urbana Tacora, p. 6.

Figure 67 and 68: Alternatives modes of transportation with new feeder routes connecting to Villa El Salvador station / Source: L1ML, Proyecto Cultura Ciudadana a Rutas Alimentadoras, p. 6.

Figure 69: L1ML intervention and stations in Lima's historic center
Source: L1ML, Informe Alameda Cultural, p. 2.

Figure 70: Alameda Cultural pedestrian corridor integrating L1ML in Lima's historic center
Source: L1ML, Informe Alameda Cultural, p. 8.

Figure 71 and 72: Lima's historic monuments, Bastión Santa Lucía (left) and Presbitero Maestro Cemetery (right) / Source: L1ML, Informe Alameda Cultural, p. 4, 6.

Figure 73: Bicibox rental bicycles docking station proposal and rendered image
Source: L1ML, Proyecto Bicibox Estaciones Ecologicas: Estaciones Ecológicas Seguras, p. 6, 4.

Lima Metro Line 1, Peru

Figure 74: L1ML prefabricated superstructure
Source:http://lh3.ggpht.com/_FuSNxVwHjvI/TDTui_invSI/AAAAAAAABqI/Jgon3Dk0OPw/s720/DSCF1746.JPG

Figure 75: L1ML viaduct in central avenues berm
Source:http://lh6.ggpht.com/_FuSNxVwHjvI/TDTuGt1D81I/AAAAAAAABpo/RicshhKX86c/s720/DSCF1562.JPG

Figure 76: Rímac River provisional protection dikes during L1ML's construction / Source: MTC and Consorcio Tren Eléctrico, Memoria Descriptiva de las Obras Provisionales en el Lecho del Rio Rimac, p. 8.

Figure 77: Proposed Huáscar Bridge crossing Vía de Evitamiento Avenue will help cut down commute time
Source: L1ML, Cruzando la Vía de Evitamiento: Plataforma de Seguridad, p. 1.

Figure 78: Ground characterization for soil restoration and reforestation, optimal reforestation with Aptenia cordifolia (right)
Source: L1ML, Avances Tesis Ambiental Caracterización de Suelos, p. 15, 29, 11.

APPENDIX B: *ENVISION* POINTS TABLE

CREDIT SCORING

				IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE
1	QUALITY OF LIFE	PURPOSE	QL1.1 Improve community quality of life	2	5	10	**20**	**25**
2			QL1.2 Stimulate sustainable growth and development	1	2	5	13	**16**
3			QL1.3 Develop local skills and capabilities	1	2	5	12	**15**
4		COMMUNITY	QL2.1 Enhance public health and safety	2			**16**	
5			QL2.2 Minimize noise and vibration	1			8	**11**
6			QL2.3 Minimize light pollution	1	2	4	8	**11**
7			QL2.4 Improve community mobility and access	1	4	7	**14**	
8			QL2.5 Encourage alternative modes of transportation	1	3	6	12	**15**
9			QL2.6 Improve site accessibility, safety and wayfinding		3	6	12	**15**
10		WELLBEING	QL3.1 Preserve historic and cultural resources	1		7	**13**	**16**
11			QL3.2 Preserve views and local character	1	3	6	11	**14**
12			QL3.3 Enhance public space	1	3	6	11	**13**
						Maximum points possible:	**181**	
13	LEADERSHIP	COLLABORATION	LD1.1 Provide effective leadership and commitment	2	4	9	**17**	
14			LD1.2 Establish a sustainability management system	1	4	7	**14**	
15			LD1.3 Foster collaboration and teamwork	1	4	8	**15**	
16			LD1.4 Provide for stakeholder involvement	1	5	9	**14**	
17		MANAGEMENT	LD2.1 Pursue by-product synergy opportunities	1	3	6	12	**15**
18			LD2.2 Improve infrastructure integration	1	3	7	13	**16**
19		PLANNING	LD3.1 Plan for long-term monitoring and maintenance	1	3		**10**	
20			LD3.2 Address conflicting regulations and policies	1	2	4	**8**	
21			LD3.3 Extend useful life	1	3	6	**12**	
						Maximum points possible:	**121**	
22	RESOURCE ALLOCATION	MATERIALS	RA1.1 Reduce net embodied energy	2	6	12	**18**	
23			RA1.2 Support sustainable procurement practices	2	3	6	**9**	
24			RA1.3 Use recycled materials	2	5	11	**14**	
25			RA1.4 Use regional materials	3	6	9	**10**	
26			RA1.5 Divert waste from landfills	3	6	8	**11**	
27			RA1.6 Reduce excavated materials taken off site	2	4	5	**6**	
28			RA1.7 Provide for deconstruction and recycling	1	4	8	**12**	
29		ENERGY	RA2.1 Reduce energy consumption	3	7	12	**18**	
30			RA2.2 Use renewable energy	4	6	13	16	**20**
31			RA2.3 Commission and monitor energy systems		3		**11**	
32		WATER	RA3.1 Protect fresh water availability	2	4	9	17	**21**
33			RA3.2 Reduce potable water consumption	4	9	13	17	**21**
34			RA3.3 Monitor water systems	1	3	6	**11**	
						Maximum points possible:	**182**	
35	NATURAL WORLD	SITING	NW1.1 Preserve prime habitat			9	14	**18**
36			NW1.2 Protect wetlands and surface water	1	4	9	14	**18**
37			NW1.3 Preserve prime farmland			6	12	**15**
38			NW1.4 Avoid adverse geology	1	2	3	**5**	
39			NW1.5 Preserve floodplain functions	2	5	8	**14**	
40			NW1.6 Avoid unsuitable development on steep slopes	1		4	**6**	
41			NW1.7 Preserve greenfields	3	6	10	15	**23**
42		LAND & WATER	NW2.1 Manage stormwater		4	9	17	**21**
43			NW2.2 Reduce pesticide and fertilizer impacts	1	2	5	**9**	
44			NW2.3 Prevent surface and groundwater contamination	1	4	9	14	**18**
45		BIODIVERSITY	NW3.1 Preserve species biodiversity	2			13	**16**
46			NW3.2 Control invasive species			5	9	**11**
47			NW3.3 Restore disturbed soils				8	**10**
48			NW3.4 Maintain wetland and surface water functions	3	6	9	15	**19**
						Maximum points possible:	**203**	
49	CLIMATE & RISK	EMISSIONS	CR1.1 Reduce greenhouse gas emissions	4	7	13	18	**25**
50			CR1.2 Reduce air pollutant emissions	2	6		12	**15**
51		RESILIENCE	CR2.1 Assess climate threat				**15**	
52			CR2.2 Avoid traps and vulnerabilities	2	6	12	16	**20**
53			CR2.3 Prepare for long-term adaptability				16	**20**
54			CR2.4 Prepare for short-term hazards	3		10	17	**21**
55			CR2.5 Manage heat islands effects	1	2	4	**6**	
						Maximum points possible:	**116**	
							803	

**The five innovation credits are bonus points and not included in total point tallies*

APPENDIX C: CREDIT DETAILS

CATEGORY I, PEOPLE AND LEADERSHIP (PL)			
SUB CATEGORY: QUALITY OF LIFE			
	LIMA METRO LINE 1, PERU		**RECOMMENDATIONS**
PL1.1 Improve Community Quality of Life	**25**	**Restorative** The L1ML reinvigorates the host and nearby communities through rehabilitation of important community assets, upgraded and extended access, increased safety, improved environmental quality and additional infrastructure capacity. The L1ML established the following objectives through the Cultura Metro program (Metro Culture, MC): educating the client the proper use of the system, for friendly and peaceful coexistence; engage and empower customers and neighbors to care for this public service; to offer customers and neighbors new services to help them become better citizens. (SGCM, p.13) The L1ML through the MC, created the Metro Culture Team (MCT) to take into account community needs, goals, plans and issues through a four-phase community participative process. The MCT is a multidisciplinary team composed of a psychologist, an industrial engineer, sociologists and anthropologists that implemented the four-phase process as their working method for social diagnosis. The L1ML project elevates the community awareness and pride by being able to work with them in order to identify and transform areas with high presence of construction debris, rubbish, poor infrastructure, high uncertainty, and high presence of paint and graffiti. Juntas vecinales or neighborhood organizations are legitimized organizations elected by the people to represent neighbors to authorities and institutions, and also to promote diverse activities related to the development of the community of people who live on a clearly defined territory (DJV, p.1). As the documentation supports, L1ML's MCT identified 58 different neighborhood organizations in order to work with them towards achieving goals together (DSZI, p.1). There are numerous existing neighborhoods organizations in Lima in the areas impacted by the L1ML. In order to prevent favoritisms and work effectively with the existing neighborhood organizations, the MCT characterized them according to their proximity to the L1ML zone of influence and categorized them into 19 adjacent neighborhood organizations and 39 not adjacent neighborhood organizations. The four-phase community participative process breaks down into the following phases: first phase, mapping neighborhood organizations and classifying them by proximity to the L1ML zone of influence; second phase, propose the "areas to recover" with the help of the affected neighborhood organizations for which 16 "areas to recover" were declared; third phase, the information obtained was evaluated through risk, sustainability, commitment and problematic of the affected neighborhood organizations; and the fourth phase is the recommendation and work prioritization phase where MCT meetings are held to validate each proposed zone through the use of a qualitative traffic signal work tool evaluating physical space into good, regular, or bad conditions and neighborhood associations willingness to cooperate into high risk, neutral and no risk conditions(DSZI, p.1-4). The MCT concluded their process to improve community quality of life by	Further documentation with how the MCT complies with local regulations and policies for stakeholder involvement will help understand better how inclusive is the four-phase process. Also, additional documentation on how each affected neighborhood associations represents the affected population by the L1ML, on how "areas to recover" were transformed will be helpful to assess if the community is satisfied and endorsing the L1ML.

		declaring 16 “areas to recover” with 3 levels of priority where most areas presented physical space and infrastructure in bad conditions and also presented no risk in most affected neighborhood associations willingness to cooperate. There is evidence of community support in the form of letters of thanks and notes of thanks in communal newspapers. For instance, a thank letter was sent from the Central Board of directors from Micaela Bastidas in the district of Villa Maria del Triunfo thanked the L1ML for the afforestation of 2400m2 (RCP, p. 5). Source: Diagnóstico Social Zona de Influencia (DSZI) Definición Junta Vecinal (DJV) Sistema de Gestión Cultura Metro (SGCM) Diagnóstico Social de distritos de Influencia.pdf Línea Base de Intervención social, educativo y cultural.pdf Plan de Recuperación de Espacios.pdf Informe Reforestación Micaela Bastidas.pdf Proyecto Recuperación Puente 4 y Alrededores Respaldo de la Comunidad al Proyecto	
PL1.2 Stimulate Sustainable Growth & Development	**16**	**Restorative** The L1ML fosters sustainable, long-term economic growth and development for the community by providing a transportation system across Lima that helps cut down commuting time and boosts productivity at an urban scale. Community productivity is enhanced by reductions in commuting time and traffic congestion and increases in public transport efficiency gained through connections between the L1ML and the existing rapid bus network. The L1ML expands the capacity for business, industry and the public by connecting people and places in Lima in a shorter amount of time. The physical infrastructure of the viaduct and stations create an urban corridor where more than 100,000 commuters will be moving and consuming. For instance, representatives of small businesses near Gamarra station estimated an increase of 500,000 customers from the typical 300,000 (IVC, p.1). The L1ML stimulates sustainable growth by hiring locally. During the construction and operation phases, the L1ML has created jobs that employed the local population. Not only were jobs created, but formative programs for students were created. Community attractiveness for compatible business and industry is improved by the presence of the L1ML through visibility, transformation of “areas to recover”, and community engagement. These favorable conditions in turn boost the economic and social capital within the community. One example of how influential the L1ML has been is found in the district of Villa Salvador where the operation of the line has positively impacted an area that was home to the original unused, decrepit metro train infrastructure for more than 20 years. The L1ML project retook these areas and refurbished the stations of Villa Salvador and Parque Industrial to render the area safe. Villa El Salvador started as an informal squatter area where neighborhood organizations gained formal recognition as a district through a highly organized and self-managed system that obtained the provision of all utilities (water, sewage and electricity) (DSDI). Reforestation efforts of the L1ML also play a big role in the impact on the community by improving the recreation spaces, restoring communal spaces, and repurposing community infrastructure.	It will be helpful to include more evidence such as reports supporting how new employment opportunities have been created directly and indirectly by the L1ML impact. It will also be beneficial to present evidence showing how the overall business environment improved by improving the access to facilities and infrastructure, increased alternative resources, facilities and infrastructure.

		Source: Impacto en Valor Comercial (IVC) Diagnóstico Social Zona de Influencia (DSZI) Diagnóstico Social de distritos de Influencia (DSDI) Línea Base de Intervención social, educativo y cultural.pdf Plan de Recuperación de Espacios.pdf Informe Reforestación Micaela Bastidas.pdf Proyecto Recuperación Puente 4 y Alrededores Impacto en Valor Comercial Impacto en Zonas Comerciales	
PL1.3 Develop Local Skills and Capabilities	**15**	**Restorative** The operation of the L1ML is a 30-year long concession that is committed to work with the local community to assess local employment and educational needs and to address future community competitiveness. The Metro Culture Team (MCT) works with the community leaders in understanding their needs, shortfalls and goals. Even before the operation phase started, there were initiatives to employ people residing in the influence area of the L1ML. The L1ML recruitment policy favors hiring locally and have established a metric and desired hiring ratio that at least 70% of our employees must live in our area of influence (IPC, p.1). This policy extends to companies linked to the L1ML, such as GyM Ferrovías, Concar, and their main suppliers for safety and cleanliness (IPC, p.1). The operational efficiency of the L1ML relies on the maintenance of train parts to avoid affecting the service and high cost repairs. The L1ML supports sustainable development of local suppliers and also contracts locally for services such as cleaning, security and maintenance of the stations and rolling stock. The L1ML has also created formative student programs to train them to become conductors, station administrators and to impart specialized rail knowledge that will not only be useful in the L1ML but also in the growing Peruvian rail industry. The program ran for a year beginning in July 2012, and included students from the universities located in Villa El Salvador district. This district was most affected by two decades of stagnation and misuse of space that set the stage for criminal activities and waste disposal along the infrastructure corridor. Currently, 25 former students have become train conductors. In the 16 identified “areas to recover” by the Metro Culture Team (MTC) several local cultural and educational groups were identified to create social programs such as the mural art painting efforts to re-incorporate unsafe areas back into the community while fostering their individual identities and encouraging artists. There are Charlas de Aprendizaje or Learning talks on different topics that develop local skills and capabilities in the L1ML areas of influence. Learning Talks are training activities that take place in the neighborhood councils and are part of the Social and Environmental Management Plan (PMSA). The talks promote good use of the service, safety standards and environmental conservation, strengthen the rules of behavior while using the system, establish a clear communication between the company and the neighbors, monitor the perceptions of the neighborhood councils in addition to collecting information and suggestions to help improve the service, strengthen the L1ML image amongst population and inform the public about the various entities involved in the L1ML (ATTE, Metro Line 1 and Consortium of Lima) (ICA, p.2).	Further documentation on the effect of the already established social programs can help understand the impact of the initiatives with existing community groups and how will be best to proceed after the 16 “areas to recover” are transformed.

		Source: Diagnóstico Social Zona de Influencia (DSZI) Diagnóstico Social de distritos de Influencia (DSDI) Informe de Charlas de Aprendizaje.docx (ICA) Informe Política de Contratación.docx (IPC) Plan de Manejo Socio Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1, Tramo 1: Villa El Salvador – Grau (PMSA) Línea Base de Intervención social, educativo y cultural.pdf Plan de Recuperación de Espacios.pdf Informe Reforestación Micaela Bastidas.pdf Proyecto Recuperación Puente 4 y Alrededores Informe Muralización Basta de Bullying.pdf Misión de la empresa.pdf Visión de la Empresa.pdf	
PL2.1 Enhance Public Health And Safety	**16**	**Conserving** Overall, the L1ML project enhances public health and safety by utilizing non-polluting electrical energy for its operation and by decreasing traffic and rail accidents since trains pass through an unobstructed elevated viaduct through the city (CREIA, p. 5). The L1ML implementation will reduce considerably the congestion of vehicular traffic ameliorating public health and safety in Lima (CREIA, p. 4). Additionally, the health and safety plans and programs for the project exceed all applicable requirements. They seek to inform the population about issues that can compromise their security and health while they wait for or travel by train. Explicit and comprehensive consideration has been given to the application of new technologies and equipment; information is provided to the public via graphics and verbal announcements. Health and safety issues that arise from the use of moving trains, access stairs, etc. have also been discussed in information sessions conducted with the communities in and adjacent to the zone of influence. Appropriate health and safety methodologies and protocols for the operation of the L1ML are established in the Environmental and Social Management Plan (PMSA). The PMSA establishes measures for prevention and control of occupational hazards, accidents or contingencies, establishes an environmental monitoring program, establishes social affairs program that allows effective participation and involvement of stakeholders, and determines the costs required for the implementation of environmental technical measures proposed for mitigating environmental liabilities (PMSA, p. 5). During the construction phase, the Programa de Afectaciones Prediales or the Land Parcel Damages Program, is established to reduce the environmental impact to the population affected by rail construction. It consists primarily of the fair compensation for the impact on its premises, established by the state, according to the rules national law, bearing in mind the concepts of ownership and possession, as well as policy guidelines of the Inter-American Development Bank (IDB) and the World Bank (WB) (PAP, p.1). Another efforts to enhance public health are campaigns carried out in stations to inform the public about prevention and health issues affecting the Peruvian population. The L1ML along with the Peruvian Ministry of Health carried out public health campaigns and clinics against diseases such tuberculosis and hypertension (DCPE, p. 2-3).	Further information indicating the number of public sessions held to inform about safety and hazards will be helpful to understand the L1ML commitment to enhance public health and safety beyond the typical graphics and speaker announcements. It would be beneficial to count with documentation regarding safety and public health measures taken during the construction phase.

		Source: Cap X Conclusiones y recomendaciones EIA (CREIA) Plan De Manejo Socio Ambiental Del Sistema Electrico De Transporte Masivo De Lima Y Callao, Linea 1, Tramo 1: Villa El Salvador – Grau (PMSA) Informe Impacto Ambiental, CAP IX Programa de Afectaciones Prediales (22DIC10).pdf (PAP) Diagnóstico Social Zona de Influencia (DSZI) Diagnóstico Social de distritos de Influencia (DSDI) Difusor de Campañas publicas en estaciones.pdf (DCPE) Línea Base de Intervención social, educativo y cultural.pdf Difusión en Estaciones de Actividades Públicas	
PL2.2 Minimize Noise And Vibration	**8**	**Conserving** There are mitigation proposals that will be implemented to help minimize train-borne noise and vibrations in the affected communities. Appropriate studies have been conducted to predict the noise and vibration generation during both the construction and operation phases of the L1ML will not exceed local regulations. The L1ML trains run in an elevated viaduct in the middle of heavily-transited avenues, and will contribute in creating higher noise levels and vibrations to directly abutting communities. In the 2012 city-wide survey Lima How Are We Doing (ELCV), for third year in row the public felt that authorities should give higher priority to traffic congestion reduction and 2 out of 10 Lima citizens are concerned about increasing noise levels (ELCV, p.11, 24). Noise levels in Lima have been increasing mainly due to traffic congestion, but they are expected to decrease overall with the operation of the L1ML reducing the volume of traffic. As the L1ML is a mass transportation project that mobilizes more than 125,000 people per day on a south-northeast axis through Lima, traffic congestion is expected to reduce significantly. The Environmental and Social Management Plan's main objective is to implement environmental measures that will prevent, correct or mitigate negative impacts while maximizing positive impacts of the L1ML for environmental conservation in the project's area of influence (PMSA, p.5). Periodical noise measurements will be taken throughout the system to quantify the noise emitted during commercial operation and maintenance, and to obtain field data that can be compared to the maximum values allowable under Peruvian law (PMSA, p.76). In the construction phase of the Project, the vibrations generated by the refurbishment and implementation will be minimal, and be associated with conditioning and pouring of concrete pillars. Proposals for noise and vibration reduction in the operation phase are comprehensive and are directed at combating the sources of the noise and providing mitigation strategies (PMSA, p.76) to keep noise below targeted levels. During the construction phase, as stated in the Environmental Impact Report, the noise levels were below the allowable limits. During its operational phase, the results of daytime environmental noise monitoring showed levels below the allowable noise levels for industrial zoning (80 dB) and commercial zoning (70 dB) (ISA, p.51). Vibration reduction will occur as part of the daily maintenance and continuous improvement of the L1ML railways. Rail wear from train tilting and cornering around curved paths will result in increased friction between the wheels and track which will produce noise and vibrations. The environmental impact studies (IEIA) state that in order to minimize such noise and vibrations it is necessary to insure the ballast in the rails provides a solid surface with certain elasticity that absorbs vibrations (IEIA,	A higher achievement level could have been contemplated if documentation supported that the L1ML was designed in such way as to reduce ambient noise in the area. Further documentation will be beneficial to indicate how the implementation of the PTA ideas will help with noise and vibration mitigation go below local code levels. Also, more information on how noise levels were mitigated during construction and before planted trees reach maturity will be pertinent.

		p. 93). According to the IEIA, the noise and vibrations are under the allowable levels and are considered insignificant in nature and light in magnitude (IEIA, p. 93). There is a shift from meeting standards and regulatory requirements to further reductions in ambient noise and vibrations with the reforestation program, through the PMSA. As indicated in the Arborization Thesis Project (PTA), mitigation efforts contemplate reforesting the adjacent areas to create a biological corridor along the viaduct to act as natural barriers. To this end, an extensive inventory of existing trees and their healthiness (APAU) has been prepared.	
		Source: Plan De Manejo Socio Ambiental Del Sistema Electrico De Transporte Masivo De Lima Y Callao, Linea 1, Tramo 1: Villa El Salvador – Grau (PMSA) Proyecto de Tesis de Arborizacion (PTA) Avances Plan Arborización Urbana.pdf (APAU) Informe Trimestral de Afluencia de Clientes Compilado (ITACC) Encuesta Lima Cómo Vamos 2012 (ELCV) CAP VII Identificación y Evaluación de Impactos Ambientales.pdf (IEIA) Informe Socio Ambiental (ISA) Plan de Arborizacion, Alcances y Requerimientos.pdf Programa de Investigación en Ingeniería.docx	

PL2.3 Minimize Light Pollution	**4**	**Superior** The L1ML operation phase has incorporated cohesive zoning procedures, actions and projects aimed at reducing energy consumption such as reduced use of lighting in stations, limiting cleaning operations to daytime and replacing incandescent light bulbs with LEDs. An overall assessment of the lighting needs for the operation of the L1ML has been performed. The project's lighting requirements are balanced against the needs and limitations posed by nearby safety-sensitive environments. The lighting of the 16 stations has been divided into four zones according to use and all are automatically controlled by PLC DURUS and time switches (IPE, p.1). The Four lighting zones that have been established are: platform areas, box office areas, stairs, and bridges. Lighting is programmed according to time and zones. For instance, 75% of the fluorescent light bulbs in the platform and box office areas are lit at night from 6 pm to 10 pm, and 25% are lit from 10 pm to 6 am (IPE, p.1). As stairs and bridges need more lighting for safety issues, 100% of light bulbs are lit from 6pm to 10pm and 25% from 10pm to 6am (IPE, p.1). Unnecessary lighting has been removed in accordance with these established lighting zones. There is also an effort to change all the light bulbs in the L1ML stations into LED lights in order to save energy. The lack of street lighting in certain areas is a concern of many neighborhood associations, especially in Villa El Salvador. Artificial lighting of the stations and viaduct will have a positive benefit for the community in helping to create safer environments. Source: Iniciativas de uso eficiente de la energía.doc Iluminación Parcial en Estaciones.doc (IPE) Proyecto de Mejora de Consumo de Energía.doc	Documentation on how light pollution is minimized will help achieve a higher level in this category. Also, a lighting assessment plan to find out where to light effectively to render safety in delicate areas and minimize light pollution will support a higher achievement level. Further information on how the lighting assessment plan during the construction phase will also help.

QL2.4 Improve Community Mobility And Access	**14**	**Conserving** The L1ML is a mass transportation project comprised of a 34-kilometer long trunk line that connects 11 districts of the city of Lima along a south to northeast axis. This electric train improves mobility and access for hundreds of thousands of commuters in Lima, and helps ease Lima's traffic congestion by providing a fast, safe, convenient and economical alternative to a private car. Once the entire L1ML project is complete, which is anticipated in 2014, approximately 180,000 commuters are projected to benefit from the mass transportation system (DP, p.16). The first three months will be free for users in order to promote ridership and familiarize people with the system (ITACC, p.4). The route of section 2 to San Juan Lurigancho improves community mobility and access by providing mass transportation to economically disadvantaged areas in Lima. The L1ML section 2,starts within the urban area of Cercado de Lima currently in urban decline, then across areas with precarious settlements in the district of El Agustino, and finally connecting to the more consolidated area of San Juan de Lurigancho district in the northeast of Lima (PAP, p.11). The L1ML improves and repurposes the existing transportation infrastructure. It maintains its urban location in-between berms of main avenues, and takes advantage of a generally unused area that is hard to maintain and shield from vandalism. The L1ML offsets negative impacts to affected communities by providing mobility and transforming old infrastructure and stations, especially in section 1. Part of L1ML section 1 will resurrect 20-year-old unused train infrastructure located in socially sensitive areas of Lima. This project had its start back in the 1980s, but lack of resources and an inability to finish resulted in low ridership and rendered it ineffective in solving Lima's transportation problems. The L1ML is involved not only with decision-makers but also with local community officials and neighbors through the Metro Culture Team (MTC) in order to identify concerns and improve community access to the L1ML (DSZI, p.1). During the construction phase the the project team developed plans and specifications to reduce disruptions during construction and provide with corrective actions as established in the Programa de Afectaciones Prediales or the Land Parcel Damages Program (PAP, p.1). Source: Informe Impacto Ambiental, CAP IX Programa de Afectaciones Prediales (22DIC10).pdf (PAP) Plan de Manejo Socio Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1, Tramo 1: Villa El Salvador – Grau Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho, Cap. II Descripcion del Proyecto (DP) Informe Trimestral de Afluencia de Clientes Compilado (ITACC) Diagnóstico Social Zona de Influencia (DSZI)	Further documentation on the environmental and social impacts of the L1ML will help confirm that community mobility and access has improved with section 1 and will improve with section 2. It will be beneficial to have background and historical information that attests Lima's transportation challenges and problems development. Additional documentation that can show how the L1ML role and integration in Lima's transportation masterplan will benefit the understanding of mobility and access improvement in the community.

QL2.5 Encourage Alternative Modes of Transportation	**15**	**Restorative** The L1ML has been designed, constructed and operated to support and encourage public transportation in Lima. It will become a trunk line in the transportation network mainly because its south-northeast axis crosses the city and joins 11 districts. Also, the L1ML will connect to the Metropolitano Bus Rapid Transit (MBRT) system at various stations (CC,p.2). According to the Ipsos Public Affairs study on the L1ML corporate reputation, the reputation of the MBRT is better amongst Lima inhabitants, and a connection between them could improve the L1ML's reputation, as it also encourages alternative modes of transportation (ERQI, p.11). The L1ML presence in social media networks, with around 280,000 followers on Facebook, encourages ridership by informing citizens about security, changes, special events, and fares (ER, p.5). Various agreements have been made with different entities, such as municipalities, ministries, state institutions, commercial centers and companies that facilitate transportation, to promote the use of L1ML. For instance, the L1ML agreed to provide free publicity for the Peruvian Sports Institute (IPD) if it is the exclusive means of transport for foreign guests to IPD's international events such as the Bolivarian Games 2013 (CC, p.2). Another agreement with Protransporte specifies that after specific assessments are conducted, the Peruvian Ministry of Transport and Communications will entertain a proposal to integrate fare payment methods and transfer options between the L1ML and the MBRT's high-capacity segregated trunk route or Corredor Segregado de Alta Capacidad (COSAC I) (CC,p.2). The Electric Train Autonomous Authority (AATE) is responsible for increasing Rutas Alimentadoras or feeder routes to the different L1ML stations. Feeder routes are bus routes designed to bring users to the L1ML and are currently used for the MBRT system. The AATE is running a pilot project with 2 carriers in south Lima that cover the Pachacamac and Punta Negra routes in order to extend their routes to reach Villa El Salvador station (CRA, p.2). Commuter and recreational cycling are also encouraged by the L1ML through the provision of bike parking in stations (EBE, p.1-5), the introduction of the BIcibox bike rental project in station exits (PBEE, p.6), and the promotion of different monthly destinations accessed by the L1ML (DM). The L1ML enhances public transportation facilities, and implements programs to encourage the use of public and non-motorized transportation. It is contemplated that the existing MBRT network in Lima will be connected to the L1ML at multiple stations and that one fare may be utilized in transfers. The L1ML is also an electric train that causes significantly less pollution than motorized transportation methods reliant on fossil fuels. Currently, the AATE is making accessibility improvements such as ramps, traffic lights, and sidewalks to ensure general safety, and particularly for those people with disabilities. Additionally, in coordination with the Municipality of Lima, the first connection between the transport system and Metropolitan Subway Line 1 at Station Gamarra Lima district of La Victoria has been implemented since July 2012.	Documentation stating how the L1ML connects to the Corredor Segregado de Alta Capacidad (COSAC) of the Metropolitano Bus Rapid Transit (BRT) and if there would be implemented a fare integration as is suggested in Copia de Convenios (CC, p.2) will support the Restorative achievement level. Further documentation on how the L1ML supports bikeways in Lima and that stations have secure bicycle lockers will be beneficial to support achieving the highest level, the restorative level.

		Source: Copia de Convenios (CC) Cultura para Rutas Alimentadoras (CRA) Estudio de Reputación Quantitativo IPSOS (ERQI) Estrategia en Redes (ER) Estacionamiento de Bicicletas en Estaciones (EBE) Destino del Mes (DM) Proyecto Bicibox Estaciones Ecológicas (PBEE) Redes de Accesibilidad Peatonal.pdf Accesibilidad peatonal.pdf Semaforización y accesibilidad.pdf Proyecto educación a choferes y clientes de nuevas rutas de transporte Noticia Metropolitano y Gamarra.png Detalle Interconexión Metropolitano y Línea 1.pdf	
QL2.6 Improve Site Accessibility, Safety & Wayfinding	**15**	**Restorative** Initiatives are underway to increase the ability of L1ML users to understand and to safely enter and exit train cars and stations. During the construction phase, neighborhood associations were invited to learn about the project and to express their concerns about its main features and the Environmental Impact Statement (PC, p.3). Moreover, the L1ML's Facebook page has information on how to use the transportation system safely (ER, p.5). Signage is provided to guide users on how to orient themselves and navigate from place to place. For example, there are posters indicating vertical access through elevators and escalators in stations (ITACC, p.184). Additionally, all stations will have access for disabled and senior citizens in all public spaces and facilities, eliminating barriers that prevent their use (DP, p. 24). Installed signs also point out waiting areas for the disabled or reduced-mobility users during all seasons, and match the signals used for wheelchair-accessible doors (ITACC, p.117). In case of emergency, safety and accessibility are improved due to the availability of trained personnel, an activated Response Group, and the ability of first aid brigades established at each station to respond to all types of emergencies (earthquakes, fires and civil commotions). Furthermore, safety is reassured through the Peruvian government's initiative to perform nationwide earthquake and tsunami drills, which involved staff and clients in all stations of L1ML (ITACC, p.108). Concerns have been voiced by residents of abutting neighborhoods in community meetings regarding the many unsafe areas in the L1ML area of influence. The L1ML project team promotes a net positive impact on public safety and security across all the stations and throughout the area of influence. In the 16 "areas to recover" identified by the Metro Culture Team, every household was surveyed about their perception of the L1ML and the problems that they encounter in their neighborhood. Several programs have started to transform the spaces and change the perception of the neighbors. Substantial restoration of safety and access to adjacent neighborhoods has been done in the "areas to recover" which has included cleaning illegal dumping sites near pedestrian bridges, reforestation, and repainting walls with murals designed by the community (PRE). Source: Estrategia en Redes (ER) Informe Trimestral de Afluencia de Clientes Compilado (ITACC) Estudio de Impacto Ambeintal, Cap. IX Participacion Ciudadana.pdf (PC) Plan de Recuperación de Espacios (PRE) Cap. II Descripcion del Proyecto (DP)	Documentation showing the different types of signage that is utilized for wayfinding are not only in the system but in the adjacent neighborhoods in both the construction phase and operation phase to show L1ML's interest to improve user accessibility, safety of the site and surrounding areas. Further documentation showing that the signage utilized to indicate stations names, emergency exits is legible for all types of users and that it promotes safety in neighborhoods will be helpful to achieve a higher level of achievement. Additionally, design documentation showing access and egress routes witl help state the impact of the L1ML in public safety and security. Since the L1ML is an elevated rail structure that will obstruct the views, it is important to show with design documents the degree of integration of constructed works with the local community and surroundings

QL3.1 Preserve Historic And Cultural Resources	**16**	**Restorative** In L1ML's section 2 route, a 750 m stretch of the viaduct crosses the historic center of Lima, between Locumba Avenue and Ferrocarril Central way, near historic and cultural resources that have been declared National Cultural Heritage by the Peruvian Cultural Institute (IAC, p.1 and LBSA, p. 145-146). For this reason, the layout of the L1ML viaduct route was studied by the Municipality of Lima under the Municipal Ordinance No. 975 which considers the preservation of historical and cultural monuments in the area (IAC, p.1). The layout of the route was ensured to be accurate to specific coordinates and in strict compliance with the Municipal Ordinance (IAC, p.1). The insertion of a portion of L1ML in the historic center of Lima will help enhance historical and cultural areas by bringing people and attention to the area. The Alameda Cultural proposes to connect the historic and cultural resources in the area through a pedestrian corridor that includes access to two L1ML stations: El Ángel and Martinete. Both the Alameda Cultural and L1ML routes have various important but deteriorated historic monuments, such as the Presbítero Maestro cemetery, the first cemetery in Lima, and the historic wall of Lima, Bastión Santa Lucía. The L1ML's viaduct structure crosses through existing deteriorated housing but does not disrupt the monuments (IAC, P. 2). The construction of these passenger stations will strengthen the Alameda Cultural proposal for urban integration and will generate renewed focus to improving conditions of important historic monuments found in the area. The L1ML also helps preserve and restore significant cultural sites by promoting access to a monthly destination such as the Museum Cemetery Presbítero Maestro via the metro line (DM, p.9). In addition, the L1ML project enhances cultural resources by rehabilitating green spaces, and upgrading and expanding recreational facilities. The project team has worked with cultural stakeholders and the community to identify cultural resources documented within the L1ML influence area (DSZI). Furthermore, the mural painting programs, such as the one in Micaela Bastidas, are intended to promote artistic and cultural participation of L1ML neighbors in order to foster local identity in spaces previously occupied by undesired activities. The L1ML project team desires to establish a cordial relationship with neighborhood councils surrounding the viaduct by allowing recovery of public spaces that were previously impacted by an accumulation of garbage, crime and other threats (IJM, p.3). Inclusion of the neighboring communities in cultural programs such as mural painting also allows the neighbors to take ownership of and to protect their surroundings. Source: Diagnóstico Social Zona de Influencia (DSZI) Diagnóstico Social de distritos de Influencia (DSDI) Informe de Alameda Cultural (IAC) Destino del Mes (DM) Linea de Base Socio Ambiental cap. 4 (LBSA) Línea Base de Intervención social, educativo y cultural.pdf Plan de Recuperación de Espacios.pdf Informe Reforestación Micaela Bastidas.pdf Proyecto Recuperación Puente 4 y Alrededores Diagrama Cultura Metro.png Informe mejora urbana Muralización Tacora Informe Jornada Muralista (IJM) Informe de Desarrollo de proveedores Proyecto Concurso de Buenas Prácticas de Gestión Vecinal Informe arte vecinal compiladas	Drawings or documents indicating that the site avoids impacting any historical or cultural resource are needed to understand the L1ML impact on preserving cultural resources. Additional documentation supporting how the cultural initiatives helped lower delinquency in adjacent areas will also help to maintain this achievement level.

QL3.2 Preserve Views And Local Character	**14**	**Restorative** An inventory of landscape, cultural, and historical resources was prepared with the aid of respective authorities in Lima. In the L1ML's direct area of influence several cultural, landscape and religious resources were identified through interviews with municipal representatives from the districts of El Agustino, San Juan de Lurigancho and Cercado de Lima. In addition, there is a List of Colonial and Republican Monuments declared National Cultural Heritage by the Peruvian National Culture Institute. The project promotes the local character of the neighboring communities by assisting them in cleaning, reforesting and painting murals within their boundaries. The visual impact of the elevated viaduct is pervasive as it runs for 34 km through many communities in Lima. From aboard the L1ML it is possible to observe the city from a new perspective; this can encourage the improvement of the local environment and promote the preservation of views. The L1ML team intends to have a positive impact by working with the communities to learn more about their needs and desires. Documentation submitted shows that the character of the adjacent areas has changed in a positive manner and is perceived optimistically. For example, in the 16 designated areas to be recovered, surveys were distributed to understand the neighbors' perceptions of the L1ML. Most respondents, including those of bridge number four in Villa Salvador, answered positively when asked if the L1ML betters their community (LBISEC, p. 8). Reforestation and creation of green areas along the L1ML viaduct would contribute to improving the local character. The population of the district of San Juan de Lurigancho is mainly impacted by the removal of the existing tree canopy for construction within the central berm of Heroes of Independence Avenue (CREIA, p.3). Such disturbances will be ameliorated by the implementation of the Arborization Thesis reforestation and mitigation program which will establish a biological corridor along the L1ML (PTA, p.34, 52). The L1ML has worked with local officials, neighboring communities and decision makers to institute different community projects that help create positive impacts on the local character and views of the area. Community art programs such as the Jornada de Muralización, Festival Latido Americano, Jornada Graffiteros de la Zona, and Galería Urbana Tacora (IG, p.3) have been successful in improving neighborhoods. The Alameda Cultural proposal is another project to improve the local character through creation of a pedestrian corridor that can be accessed by the L1ML and connects various important but deteriorated historic monuments: Presbítero Maestro cemetery - the first cemetery in Lima, and the historic wall of Lima Bastión Santa Lucía (IAC, p. 2). The L1ML team makes efforts to aid local communities in developing more comprehensive policies and regulations regarding views that fit with the local character. Some views from the L1ML show depressed living conditions in the hills of Lima. The project AlegrARTE started in 2012 in the hills of Pamplona with the purpose of enlivening the population through art. The program encourages people living in precarious conditions to become part of the local physical and social transformation (PA, p.3). The L1ML and AlegrARTE aim to transform the physical and psychosocial nature of Pumacahua hill, a highly unsafe area, near Villa El Salvador station, by helping the 522 households paint murals on the facades of their homes about their history (PA, p. 9).	Drawings or documents indicating local codes on height limitations and material choices will aid in understanding L1ML's visual impact on the local character. Additional documentation showing inventories of landscape features to be protected, and support for structural adaptability to different conditions, should be provided as evidence that views and character are being preserved.

		Source: Línea Base de Intervención Social, Educativo y Cultural (LBISEC) Informe de Alameda Cultural (IAC) Impacto Grafitti (IG) Proyecto Alegrarte (PA) Conclusiones y Recomendaciones EIA (CREIA) Línea Base de Intervención social, educativo y cultural.pdf Plan de Recuperación de Espacios.pdf Informe Reforestación Micaela Bastidas.pdf Proyecto Recuperación Puente 4 y Alrededores Informe Muralización Basta de Bullying.pdf Diagrama Cultura Metro.png Informe mejora urbana Muralización Tacora Informe Jornada Muralista (IJM) Proyecto mi Huerta Informe de Desarrollo de proveedores Proyecto Concurso de Buenas Prácticas de Gestión Vecinal Informe arte vecinal compiladas	
QL3.3 Enhance Public Space	**13**	**Restorative** The L1ML restores, transforms and adds public space within its area of influence. Various projects have been instituted in many stations along the railway viaduct. For example, the Alameda Cultural pedestrian corridor proposal intends to connect monuments, and create new sports venues and public plazas. The L1ML team identified and implemented meaningful enhancements and beneficial restorations of existing public spaces in the adjacent communities. The Metro Culture Team (MCT) assessed the community needs, goals, plans and issues through a four-phase community participative process (DSZI, p.1). In the MTC, 16 "areas to recover" were declared with 3 levels of priority. Most areas were characterized by poor physical space and infrastructure conditions but presented no risk in neighborhood association willingness to cooperate (DSZI). One way to enhance public space is through mural painting. The mural painting community art programs help regain and transform public spaces affected by gang graffiti into public spaces painted by the community. Currently, threats such as vandalism, gang painting, and football team fan painting affect public spaces along the L1ML system (IJM, p.5). The mural painting community program recognizes graffiti as one of the popular art forms of young people, and instead of promoting blank walls, welcomes community mural painting done without informality, illegality and secrecy. The local public agencies and stakeholders are satisfied with the L1ML plans involving public space. Several successful community participation programs have been offered such as Plan Graffiti, Neighborhood Art, Urban Improvements, Guided Tours and Learning Talk lectures (PCBP, p.1). The L1ML also sponsors a public space ideas competition amongst the neighborhood associations in various categories: a) Public Ways - consisting of cleaning and/or planting trees in the sidewalks, facade repairs, roof cleaning, street signage replacements or projects related to neighborhood streets; b) Green Areas - improvement of squares, gardens, parks, sports areas, or initiatives such as repairs, planting trees, cleaning or other; c) Infrastructure - consists of infrastructure improvements in common areas such as buildings, sidewalks, trails, library, square, or other local venue; and d) Creativity - consisting of management of novel activities to improve public space (PCBP, p. 2). Through this competition it is possible to integrate neighboring community desires and support proposals that are meaningful and beneficial for the L1ML area of influence.	Further information such as plans showing the new and/or enhanced public space will be helpful to understand and visualize the scope of L1ML initiatives.

		Source: Diagnóstico Social Zona de Influencia (DSZI) Informe de Alameda Cultural (IAC) Informe Jornada Muralista (IJM) Impacto Grafitti (IG) Cap. II Descripcion del Proyecto (DP) Proyecto Concurso de Buenas Prácticas en Gestión Vecinal (PCBP) Diagnóstico Social de distritos de Influencia.pdf Línea Base de Intervención social, educativo y cultural.pdf Plan de Recuperación de Espacios.pdf Informe Reforestación Micaela Bastidas.pdf Proyecto Recuperación Puente 4 y Alrededores	
QL0.0 Innovate Or Exceed Credit Requirements	**0**	*N/A*	
	171		

SUB CATEGORY:LEADERSHIP			
	LIMA METRO LINE 1, PERU		**RECOMMENDATIONS**
LD1.1 Provide Effective Leadership And Commitment	**9**	**Superior** There is a significant commitment and leadership to achieve sustainability goals. The mission statement of the L1ML operators indicates their commitment to providing public transportation to better the quality of life of their clients and contribute to the development of the city (ME, p.2). The project team has provided a Social and Environmental Management Plan (ESMP) as part of their strategy for environmental conservation that is harmonious with the socioeconomic development of local neighborhoods. The staff responsible for the execution of the ESMP is intended to receive proper training and education in order to successfully fulfill their tasks (PMSA, p. 38). There are various key leadership positions in the implementation of the Environmental and Social Management Plan (ESMP): the Environmental and Social Management Coordinator, who is responsible for compliance with environmental regulations involving the L1ML transportation system; the Coordinator of Occupational Safety and Health, who is responsible for ensuring effective implementation of health and safety provisions, including various subprograms of the ESMP; and Chief of Risk Prevention and Social and Environmental Management, who is responsible for implementing, documenting, recording and verifying the ESMP, as well as assessing the results obtained in coordination with the health and safety specialists. The L1ML provides effective leadership and commitment by integrating their transportation and development agenda with the existing juntas vecinales or neighborhood associations' (NAs) concerns. The L1ML will share the reforestation and public space transformation responsibilities with the existing NAs. The NAs are organizations of people who live within a clearly defined boundary and are represented by an elected board. The NAs act as liaisons between the neighborhoods and authorities or institutions, and work to promote diverse activities related to community development (DJV, p.1). The L1ML's Metro Culture Team (MCT) identified 58 different NAs in the direct and indirect area of influence with which to work towards achieving mutual goals (DSZI, p.1).	The L1ML sustainability policies and practices must be clear and evidenced by showing documentation in the form of public statements of commitment backed up by evidence o performance and breadth of coverage in both the construction and operation phase of the project. Further information stating that the L1ML sustainability goals, published sustainability reports, organizational principles and policies regarding sustainability will help achieve a higher level.

		Commitment is backed up by numerous and wide-ranging examples of activities undertaken beyond the scope of the direct influence area of the project. Numerous efforts have been taken to foster leadership and social development to address the economic, environmental and social aspects of the project, especially within its reforestation and cultural programs. Neighbors from many of the areas adjacent to the L1ML complain about the lack of public safety which is in part due to the presence of littered debris, informal garbage dumping and lack of public lighting. The L1ML has helped the adjacent communities with reforestation and betterment of areas surrounding pedestrian bridges and stations. Meetings with the NAs have been held in support of these initiatives to hear the neighbors concerns, questions and invite them to join the reforestation efforts in Micaela Bastidas (IRA, p.1). *Source*: Misión de la Empresa (ME) Informe de Reuniones de Articulación (IRA) Línea Base de Intervención Social, Educativa y Cultural (LBISEC) Definición de Junta Vecinal (DJV) Diagnóstico Social Zona de Influencia (DSZI) Plan de Manejo Socio-Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1(PMSA)	
LD1.2 Establish A Sustainability Management System	**7**	**Superior** A significant commitment has been made throughout the L1ML organization towards improving sustainability performance. The Sustainability Management System of L1ML is mostly related to train service performance through maintenance of its rolling stock, infrastructure, green areas and promotion of user safety. It consists of an umbrella program, the Environmental and Social Management Plan (ESMP), with various programs and subprograms such as the Conservation Plan and the Solid Waste Management Plan. Certain environmental, economic and societal aspects of the L1ML have been prioritized within the project's goals and commitments. For instance, the ESMP ensures that project activities are conducted in a safe, reliable, responsible way that preserves the environment and complies with environmental standards. The L1ML has a goal to preserve and maintain public areas located along the viaduct in order to have continuous and uniform green areas that meet the levels of service required by the concession agreement and to offer aesthetically pleasing facilities. The Conservation Plan is focused on the conservation of green areas that could be affected by the operation of the L1ML (PMSA, p.78) The scope of the mechanisms established by the L1ML organization seems sufficient to address the economic, environmental and social aspects prioritized in the project during both the construction and operation phases. The ESMP also seeks to establish prevention and risk control measures or contingency plans for labor and accidents, establish an environmental monitoring program, establish a social affairs program to encourage stakeholder participation, and to determine the costs of execution of technical measures proposed for the mitigation of environmental liabilities (PMSA, p. 5). An example of ongoing actions to improve sustainable performance is the Conservation Plan (CP). The CP's main purpose is to make sure that infrastructure remains secure for transit by verifying the design parameters and maintenance. Most of the required inspections will be done twice daily (PC, p.6). Inspections are done on trains, self-propelled vehicles, railways, railroad switches, vertical signals, beacons, etc., to detect defects and categorize them according to their criticality and impact on the safe operation of trains. The defects are categorized as follows: defects that require immediate attention, defects to be corrected to preserve geometric characteristics of the railroad, and elements that must be monitored to avoid unsafe situations in the system. Other types of inspections include observations from vehicles under the viaduct	Although there is a well structured Environmental and Social Management Plan, the project roles, responsibilities, and authorities for addressing the issues of sustainability are not clearly defined in the documentation. Further documentation is needed to understand the sustainability management system from construction to operation, which would permit a higher level of achievement. Documentation is needed to explain its appropriateness for the affected communities, if it is sufficient and contains adequate set of mechanisms and business processes, and if the project sustainability management system is sufficient to manage extraordinary change in environmental conditions or key design variables.

		to detect potential risks, threats and environmental liabilities that require immediate remediation action (PC, p.6-9). Policies involving safety standards are included within the maintenance plan for the following systems: air conditioning system (ASHRAE Handbook, manufacturers criteria, installation drawings), industrial water system (HIDROSTAL hydro pneumatic equipment manual, SALMSON centrifugal pump manual, ALTIRAR VSD manual 31c, certificates of guarantee and indemnification), fire systems (Applied standards for fire systems, National Code Electricity and the National Association of Fire Protection), power generation system (performance, operation and maintenance of equipment are developed by internal combustion engines and generation systems staff specialists), rolling doors system (performance, operation and maintenance developed by our technical staff under the scope provided by CASSADO SA), and vertical circulation systems (maintenance plan prepared by ThyssenKrupp Elevators for all stations' lifts, electric ramps and escalators) (PC, p.27). The Solid Waste Management Plan is framed within the general policy of the company and in compliance with Solid Waste Act regulations. The plan describes the activities and identifies the sources of solid waste generation in order to provide technical and economic solutions. The management of solid waste is assessed in order to provide techniques for minimization, segregatation, and reuse (PMRS, p.4). The different activities occurring in the L1ML were monitored to classify waste material produced into dangerous and non-dangerous waste as stipulated in the Solid Waste Act (PMRS, p. 10). These classifications will help to apply reuse techniques that reduce the amount of solid waste generated and improve the efficiency of waste management. *Source*: Plan de Conservación 2013 (PC) Plan de Manejo de Residuos Sólidos (PMRS) Plan de Manejo Socio-Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1(PMSA)	
LD1.3 Foster Collaboration And Teamwork	**1**	**Improved** The L1ML project team recognizes the importance of working together as a team but no particular process or methodology has been incorporated to integrate the design, delivery methodologies and collaborative processes. It has incorporated principles of collaboration and teamwork in the construction and operation phase of the project by hosting meetings and workshops with stakeholders in order to include the communities at various levels. The project team started identifying the existing neighborhood associations (NAs) through the use of an interdisciplinary team on site, the Metro Culture Team (MCT). The MCT identified 58 different NAs in the direct and indirect area of influence to work together towards achieving goals together (DSZI, p.1) There are meetings hosted by L1ML project team and the NAs to know their concerns, propose solutions and introduce the new mass transportation system. For instance, one of the Environmental and Social Management Plan (ESMP) goals is to establish a social affairs program to effectuate the participation and involvement of stakeholders (PMSA, p. 5). Collaboration and teamwork are also fostered by different activities to identify opportunities for improving sustainable performance and reducing design conflicts. The L1ML also sponsors a public space ideas competition amongst the neighbors associations to find out the desires upon betterment of the public areas in the area of influence. There is also interest in engaging the at-risk youth within these neighborhoods by sponsoring and promoting the arts, cultural activities and social development through associations such as the Angeles D1 Cultural Association and L1ML Project of Social Responsibility (ICCAD1, p.4). This commitment aims to generate a change in attitude and to foster youth leadership through arts education.	Additional documentation is needed to demonstrate that the L1ML team incorporated whole systems design and delivery methodologies throughout all phases of the project.

		Source: Diagnóstico Social Zona de Influencia (DSZI) Plan de Manejo Socio-Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1(PMSA) Impact Comunidad Convenio Angeles D1 (ICCAD1)	
LD1.4 Provide For Stakeholder Involvement	**14**	**Conserving** The Environmental and Social Management Plan (ESMP) includes a goal to establish a social affairs program to effectuate the participation and involvement of stakeholders (PMSA, p. 5). As such, the L1ML has established meaningful programs for stakeholder identification, engagement, and involvement in project decision-making. The Metro Culture program created the Metro Culture Team (MCT) to account for community needs, goals, plans and issues through a four-phase community participative process. The MCT is a multidisciplinary team composed of a psychologist, an industrial engineer, sociologists and anthropologists who will implement the four-phase process as a working method for social diagnosis. There are numerous existing neighborhood organizations in Lima in the areas impacted by the L1ML. As the documentation supports, L1ML's MCT identified 58 different juntas vecinales or neighborhood organizations with which to work towards achieving mutual goals (DSZI). In order to prevent favoritism and to work effectively with the existing neighborhood organizations, the MCT characterized them according to their proximity to the L1ML zone of influence and categorized them into 19 adjacent neighborhood organizations and 39 non-adjacent neighborhood organizations. The four-phase community participation process breaks down as follows: (1) mapping neighborhood organizations and classifying them by proximity to the L1ML zone of influence; (2) proposing the "areas to recover" with the help of the affected neighborhood organizations for which 16 "areas to recover" were declared; (3) evaluating the information obtained on the metrics of risk, sustainability, commitment and problematic of the affected neighborhood organizations; and (4) recommending and prioritizing work through MCT meetings that validate each proposed zone based on the following: the use of a qualitative traffic signal tool that evaluates conditions of physical space as good, regular, or bad; and neighborhood associations' willingness to cooperate under high risk, neutral and no risk conditions. Thus, the L1ML project elevates community awareness and pride by working with neighborhoods to identify and transform areas with high levels of construction debris, rubbish, poor infrastructure, uncertainty, and a predominance of paint and graffiti. *Source*: Plan de Manejo Socio-Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1(PMSA) Diagnóstico Social Zona de Influencia (DSZI)	Additional documentation is needed to demonstrate that the L1ML team established meaningful programs for stakeholder identification, engagement, and involvement in project decision-making not only in the operation phase, but also in the construction phase of the project.
LD2.1 Pursue By-Product Synergy Opportunities	**1**	**Improved** By-products synergy opportunities between systems and among larger infrastructure systems have not been identified nor documented extensively although there is an inclination and intent to address them, especially in the operation phase of the L1ML. In both L1ML section 1 and 2 solid waste management plans, waste reduction is one of the main goals of the plans, as the Solid Waste Management Plan (SWMP) indicates, to improve project performance and reduce project costs by identifying and pursue opportunities to use unwanted by-products or discarded materials and resources from nearby operations (PMRS). The SWMP for section 1 has the general guidelines to follow for handling solid waste generated by the operation of the L1ML, using techniques of minimization, reuse and separation, plus defines the considerations to be taken in order to gather, transfer, storage, transport and dispose waste.	Documentation shows intent to reduce, reuse and recycle waste, but it does not show a broad and comprehensive effort to identify discarded materials nearby that can be used in the project. Documentation with research into a regional by-product synergy projects or aggressive searching

		Moreover, the Subprogram of Solid Waste Management and Wastewater, valid and consistent with current Peruvian environmental regulations, establishes a proper handling and management of solid waste generated during construction and operation of Mass Transport Electric System of Lima and Callao, Line 1, Section 2: Grau-San Juan de Lurigancho (CREIA, p.4). The management plan of solid waste is framed within the general policy of the company and in compliance with the Solid Waste Act regulations. The plan describes the activities and identifies the sources of solid waste generation in order to provide technical and economic solutions. The current management of solid waste is assessed in order to provide minimization techniques, segregate, and reuse (PMRS, p.4). The different activities occurring in the L1ML were monitored to classify the waste material produced into dangerous and non-dangerous waste as stipulated in the Solid Waste Act (PMRS, p. 10). These classifications will help to apply reuse techniques that reduce the amount of solid waste generated and improving the efficiency of waste management. The solid waste management strategy follows a hierarchical ranking order: to reduce, reuse and recycle. The strategy gives top priority to reduce waste in order to avoid the generation of hazardous waste (PMSA, p. 42). *Source*: Plan de Conservación 2013 (PC) Plan de Manejo de Residuos Sólidos, tramo 2 (PMRS T2) Plan de Manejo de Residuos Sólidos, tramo 1 (PMRS) Conclusiones y Recomendaciones EIA (CREIA) Plan de Manejo Socio-Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1(PMSA)	and screening of opportunities would be helpful to achieve higher levels. Additional documentation explaining L1ML's intent to reduce waste will be beneficial, not only in the operation phase, but in the construction phase of the project. Also documentation supporting the reuse, recycling of materials during the construction phase will help achieve a higher level. A better and in-depth assessment in identification and use of unwanted by-products can also help achieve a higher score.
LD2.2 Improve Infrastructure Integration	**16**	**Restorative** There is high performance in overall improvement in infrastructure integration through restorative actions in the neighboring communities of the L1ML project. The Peruvian government, owner of the infrastructure, with the L1ML project team work with the community to identify existing community assets in the natural or built environment which, when restored, would improve the economic growth and development capacity of the community. The L1ML project is designed and planned to incorporate community assets by restoring and sustaining them. For instance, the Metro Culture Team (MCT) was created to take into account community needs, goals, plans and issues through a four-phase community participative process (DSZI). Other elements of community mobility infrastructure have been considered in the L1ML design in order to improve overall infrastructure efficiency and effectiveness. The connection of the L1ML to the Metropolitano Bus Rapid Transit (MBRT) system at various stations, such as L1ML Grau Station / MBRT Grau Station, will help integrate the system with other transportation networks (CC, p. 2). In addition, the Electric Train Autonomous Authority (AATE) is responsible for increasing Rutas Alimentadoras or feeder routes to the different L1ML stations. Feeder routes are bus routes designed to bring users to the L1ML and are currently used for the MBRT system. The AATE is running a pilot project with 2 carriers in south Lima, that cover the Pachacamac and Punta Negra routes, in order to extend their routes to reach Villa El Salvador Station (CRA, p.2). The L1ML's goal to improve infrastructure integration seeks to also preserve and maintain public areas located along the viaduct. Continuous and uniform green areas are required by the concession agreement in order to offer aesthetically pleasing facilities that also meet required levels of service. The Conservation Plan is also focused on the conservation of green areas that could be impacted by the operation of L1ML (PMSA, p.78).	Additional documentation supporting the improvement of the integration of infrastructure not only in the operation phase, but also in the construction phase of the project will be helpful. Evidence of improvements in the integration with other community infrastructure elements will help support this achievement level.

		Source: Copia de Convenios (CC) Cultura para Rutas Alimentadoras (CRA) Plan de Manejo Socio-Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1(PMSA) Diagnóstico Social Zona de Influencia (DSZI)	
LD3.1 Plan For Long-Term Monitoring & Maintenance	**10**	**Conserving** There are comprehensive maintenance and conservation plans to ensure that mitigation, ecological protection and enhancement measures are incorporated in the operation phase of the project in the long term. The Environmental and Social Management Plan (ESMP) is key in the management to be met during the development and operation of the L1ML to make sure that the project activities are conducted in a safe, reliable, responsible, preserving the environment and complying with the environmental standards. It operates under various laws protecting the health, environment and promoted sustainable development. For instance, the General Environmental Law No. 28611 and decree legislation amending the General Environmental Law D.L.N° 1055 establishes that any person has the inalienable right to live in a healthy, balanced and appropriate environment for the full development of life, and the duty to contribute to effective environmental management and protect the environment and its components, ensuring particularly the health of people individually and collectively, the conservation of biological diversity, the use sustainable natural resources and sustainable development of the country (PMSA, p.6). The ESMP goal is to establish prevention and risk control for labor and accident control measures or contingencies, establish a monitoring program and environmental monitoring, establish a social affairs program to effectuate the participation and involvement of stakeholder, and determine the costs that would demand the execution of the technical measures proposed for the mitigation of environmental liabilities acquired (PMSA, p. 5). In order to meet these goals, the ESMP designates tasks into five main organizational programs: the Preventive, Mitigating and Corrective Measures Program, the Health and Safety Program, the Environmental Education Training Program, the Environmental Monitoring Program, and the Social Responsibility Program. The Environmental Monitoring Program composed of four subprograms, the Air Quality Monitoring Program and the Environmental Noise Quality Monitoring, the Vibrations Monitoring and the Not-Ionizing Radiation Monitoring Program, controls most of the long term monitoring (PMSA, p. 2-3). Within these programs there are more specific subprograms as the ones under the Preventive, Mitigating and Corrective Measures Program such as the Solid and Liquid Waste Effluents Management, the Materials and Hazardous Substances Management, the Atmospheric Emissions and Noise Control Program, the Conservation and Protection of Green Areas Subprogram. The Health and Safety Program works with 2 subprograms: the Occupational Health and Safety Program. The Conservation Plan (CP) main purpose is to make sure that the infrastructure remains secure for the transit of trains by verifying the design parameters and maintenance of infrastructure. Most of the required inspections will be done twice daily at day and night (PC, p.6). The ESMP also determines the costs required for the implementation of these programs by incorporating their cost into the construction and operation budget. For instance during construction 34,853,117.6 Peruvian Nuevos Soles were allocated and during the first 2 years of operation 7,060,324.79 Peruvian Nuevos Soles were allocated (PMSAC8, p.238-244).	Additional documentation supporting the monitoring and maintenance of enhancement measures were taken not only in the operation phase, but also in the construction phase of the project will be helpful to maintain this level of achievement. The maintenance of this higher level of achievement is contingent upon further documentation stating that the measures will be maintained throughout the design life of the project, that sufficient funds and personnel are allocated to maintain designations of persons assigned to monitor, explanations on how funding is allocated, and assurance of these resources.

		Source: Plan de Conservación 2013 (PC) Plan de Manejo Socio-Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1(PMSA) Cap. VIII, Plan de Manejo Socio-Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1(PMSAC8)	
LD3.2 Address Conflicting Regulations & Policies	**8**	**Conserving** The L1ML works with officials and neighboring communities to identify and address laws, standards, regulations or policies that may unintentionally create barriers to the implementation of the public mass transportation system. The L1ML project team offers a view of how overall practices need to be changed to address new problems arising from sustainability issues. The team has been diligent in addressing conflicting regulations and policies by proposing agreements between different entities to increase the mobility of the surrounding community. One of the challenges is eliminating barriers to mobilize more citizens to board the L1ML through the creation of an integrated fare collection system that links with other public transportation systems in Lima. There is a lack of regulation or uniformity in the amount charged per trip in minor public transport methods such as privately operated mototaxis. This situation has become one of the main problems in accessing not only the main L1ML stations, but also any destination in the district (DSDI, p.28). The lack of regulation of minor public transport vehicles, lack of formal mototaxi stops, inefficient management from the Transport and Road Safety Subdivision and mototaxi drivers associations causes the following undesirable conditions in L1ML stations: 1) clutter and noise of mototaxi sound systems playing at excessive volumes, 2) constant dust caused by traffic, especially at peak times in L1ML stations, 3) distrust of mototaxis by users as many are utilized by informal drivers for robberies and assaults, and 4) bad treatment towards the user and lack of uniform rates (DSDI, p. 49). The lack of uniform regulations in fare collection and transfers increases the time and cost of connecting to other large public transportation systems such as the Metropolitano Rapid Bus Transit (MBRT). in order to ride seamlessly between these systems, the L1ML proposed and signed an agreement to connect with the MBRT system at various stations (CC, p.2). Social insecurity is a very pressing issue that limits the mobility of L1ML neighbors, especially in the Villa El Salvador district where a lack of action by the authorities is compounded by the neglect and resignation of their residents, making the district a dangerous place (DSDI, p. 39). The Metro Culture Team (MCT) also works with the neighborhood associations (NAs) to solve issues such as social insecurity, lack of participation in governmental agencies, corruption, lack of paved roads and walkways, lack of green areas, poor management of small transportation vehicles, and the need for mitigation of noise and vibration due to the L1ML (DSDI, p.39-47). It is common for the neighbors of many L1ML-adjacent areas to complain about the lack of public safety due to the presence of littered debris, informal garbage dumping and lack of public lighting. The MTC tries to help solve infrastructure and social issues that concern neighbors (DSZI). For instance, the L1ML devised a community Mural Art program to better urban spaces, and works to help neighborhood associations form agreements with municipalities to fix and provide street lighting and garbage control. *Source*: Plan de Manejo Socio-Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1(PMSA) Reseña Histórica Línea 1 del Metro de Lima (RH) Copia de Convenios (CC) Diagnóstico Social de los Distritos de Influencia-Diagnóstico Social del Distrito de Villa EL Salvador, (DSDI) Diagnóstico Social Zona de Influencia (DSZI)	Further documentation indicating how the L1ML team works with officials to identify and address laws, standards, regulations or policies regarding the NAs concerns will be helpful to support this achievement level. Documentation regarding the bidding process scheduled in December 2013 to find the concessionaire to integrate the fare collection systems will also support achievement of a higher level.

LD3.3 Extend Useful Life	**8**	**Superior** The nature of the L1ML project as part of a larger transportation infrastructure network requires efforts to extend its useful life through more durable, flexible and resilient construction. The L1ML is the first of six projected metro lines that will be connected to the Metropolitano Rapid Bus Transit (MBRT) system (RH, p.3). it was designed as a durable public infrastructure that would serve Lima's residents. Peruvian law states that civil works structures must be designed for a minimum 50-year lifespan. Moreover, the project must comply with the requirements of Peruvian Standard Category A for earthquakes and with the latest standards issued by: RNE (National Building Regulations), INDECOPI (National Institute for the Defense of Competition and Protection Intellectual Property), ASTM (American Society of Testing and Materials), ACI (American Concrete Institute), AWS (American Welding Society), AASHTO (American Association of State Highway and Transportation Officials), and the NATIONAL PROVIAS DGCF Bridge Design Manual (DP, p. 20-21). The Conservation Plan (PC) is designed for 30 years and aims for proper operation of all subsystems, infrastructure and rolling stock. It also aims to have an optimal level of maintenance to provide quality service as stipulated in the Conservation Levels Evaluation Program (ECON) standards. In the PC, there is documentation explaining how static structures and the rolling stock are to be maintained to achieve durability and resilience. Most of the structures are made of durable reinforced concrete formulated to withstand Lima's environmental conditions and are designed within Peruvian Standard Category A for earthquakes. The city of Lima is located on the alluvial fan of the Rímac River and Chillón on the Central Coast Region of Peru with a high seismic potential according to the Seismic Zoning Map of the Geophysical Institute of Peru (IEIA, p. 9). In order to expand the durability of trains, and to reuse and operate existing ANSALDO trains from the 1980s, feasibility studies were conducted. In addition, investments were targeted at the development of local suppliers in order to locally manufacture parts that are no longer available in the market (IDP, p. 2). *Source*: Reseña Histórica Línea 1 del Metro de Lima (RH) Plan de Conservación 2013 (PC) Cap. II Descripción del Proyecto (DP) Cap. VI Identificacion y Evaluacion de Impactos Ambientales.pdf (IEIA) Informe de Desarrollo de Proveedores (IDP)	There is no documentation stating that the Conservation Plan goes beyond the concession period of 30 years. Further information is needed to assess whether a longer lifespan has been planned for, at least in compliance with the 50-years civil works lifespan required by Peruvian law and practice.
LD0.0 Innovate Or Exceed Credit Requirements	**0**	*N/A*	
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CATEGORY II: CLIMATE AND ENVIRONMENT (CE)			
RESOURCE ALLOCATION			
	LIMA METRO LINE 1, PERU		**RECOMMENDATIONS**
RA1.1	**0**	**No Score**	Further documentation

Reduce Net Embodied Energy		An estimation of net embodied energy of project materials is required to fulfill this level. There is a lack in documentation attesting energy conservation by reducing the net embodied energy of project materials over the project life. Source: Iniciativas de Uso Eficiente de la Energía (IUEE) Proporcion de Consumo de Energia (PCE)	is needed to attest that the following measures have been taken with the exact amount of energy savings that the net embodied energy of project materials required for the operation of the metro line represent. Additional documentation indicating savings in net embodied energy in the construction materials will help achieve a higher level of saving.
1.2 Support Sustainable Procurement Practices	**2**	**Improved** There is a basic sustainable sourcing and a modest amount of materials, supplies and equipment purchased from manufacturers and suppliers that arguably follow sustainable practices. The Environmental and Social Management Plan (PMSA) that has been implemented during the development and operation of the L1ML works under various laws protecting the health, environment and promoting sustainable development but does not have a sustainability target set for materials procurement (PMSA, p.6). Sustainable practices such as the use of local suppliers has been implemented to avoid external dependency and ensure the availability and timeliness of the metro train services. The L1ML project team has encouraged the development of local suppliers and the creation of jobs to manufacture spare parts for the more than 30 years old ANSALDO trains, currently out of market (IDP, p. 1). Also, for section 1, fillers and aggregates (sand and stones), were purchased directly from local authorized dealers (DP, p. 19). An inventory of landscape materials have been tracked for sustainable procurement practices that include transplantation of existing trees, and reuse of organic soil in the reforestation program of the L1ML project. According to the inventory conducted for the development of the baseline, 2,011 healthy trees have been identified for transplantation in the L1ML's central berm. For instance, 7 trees of the species Ficus benjamina were identified between Grau Station and El Angel station, and 1127 individuals of different species between Caja de Agua station and Bayovar station (PMSA, p. 55). As part of PMSA objectives, solid waste minimization, reuse and recycling are prioritized. One of the sustainable reuse of materials practices consist of separating the solid waste components in the point of generation is one of the most effective ways to implement reuse techniques (PMSA, p. 20). Source: Informe de Desarrollo de proveedores (IDP) Cap. II Descripcion del Proyecto (DP) Cap VIII Plan de Manejo Socio Ambiental (PMSA)	Documentation supporting that basic sustainable sourcing was accomplished is necessary to maintain this achievement level. Further indication of stronger supplier evaluation practices will help achieve a higher level.

RA1.3 Used Recycled Materials	**5**	**Enhanced** Less than 50% of the volume of the materials used is from reclaimed or recycled sources. In the completion of L1ML's section 1 the site and existing structure dating from when construction started in 1986 was reutilized. Most of the site and pillar structures remained unfinished and in disuse for approximately 20 years since L1ML was only complete till Atocongo station. Considering that the section till Atocongo station is about 9.2 km of the projected 34 km, it can be assumed that 27% of the structure was reutilized for the completion of now operating section 1. During the construction of the section 2 many materials from section 1 have been reused efficiently. The L1ML replaced the rails, concrete ties, fastenings and ballast in both tracks between Villa El Salvador station and Pumacahua station (about 4.29 km), and remediated contaminated ballast along the rail line in order to reinstate it suitable for service (DP, p. 8). Additionally, the rolling stock is composed of both new Allston trains and reused Ansaldo trains that were acquired for the first 9.2km of section 1 in 1980s. Since these trains are not in the market, adequate support for repairs and parts replacement have been established locally (IDP, p.1). Source: Plan de Conservación 2013 Informe de Desarrollo de proveedores (IDP) Cap. II Descripción del Proyecto (DP) Plan de Manejo Socio Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1, Tramo 1: Villa El Salvador – Grau	Documentation with an inventory of the existing materials or structure that was reused, amount of recycled and reclaimed materials will help achieve a higher level.
RA1.4 Use Regional Materials	**10**	**Conserving** About 95% of all materials, including plant and soils are sourced within the recommended distances of 50 miles for soils and aggregates, 250 miles for plants and 500 miles for all other materials. The use of local suppliers has been implemented in the L1ML project to avoid external dependency and ensure the availability and timeliness of the metro train services. In cases where materials or parts were difficult to find, local suppliers were developed to manufacture them, for instance, spare parts for the more than 30 years old ANSALDO trains, currently out of market (IDP, p. 1). In L1ML section 1, fillers and aggregates (sand and stones), were purchased directly from local authorized dealers in Lima (DP, p. 19). The aggregate material suppliers should have the respective authorizations, as the approval of the respective environmental study, permission for quarrying awarded by the Ministry of Energy and Mines, for the area it is located (DP, p. 64). Most landscape materials for the reforestation program, such as trees and soils come from the transplantation of existing trees, and reuse of organic soil in the L1ML site. According to the inventory conducted for the development of the baseline, 2,011 healthy trees have been identified for transplantation in the L1ML's central berm. For instance, 7 trees of the species Ficus benjamina were identified between Grau Station and El Angel station, and 1127 individuals of different species between Caja de Agua station and Bayovar station (PMSA, p. 55). Source: Informe de Desarrollo de proveedores (IDP) Cap. II Descripción del Proyecto (DP) Cap VIII Plan de Manejo Socio Ambiental (PMSA)	Information with costs, inventory of construction materials and where the local suppliers are located will be helpful to attest this achievement level.
RA1.5	**0**	**No Score**	The L1ML counts with a

Divert Waste From Landfills		There is a comprehensive waste management plan to decrease project waste and divert waste from landfills that could account for at least 25%, although the percentage of total waste diverted from disposal nor the industry norms are known or established. The Solid Waste Management program consists in set of procedures to optimize the management of solid waste generated by the project, using appropriate minimization, reuse and segregation, as well as the proper management of the effluents. It also includes all the considerations needed to handle, storage, pick, transport and dispose waste (PMSA, p.10). The implementation of the PMSA in the L1ML facilities ensures the proper management of waste from the identification, segregation, reuse, storage, pick up, transportation and disposal. The amount of solid waste generated is reduced considerably with the reuse program thereby improving the efficiency of waste management. Every station have installed ecological points, which are different colored bins that indicate the type of waste that must be entered, these are: white (plastic), green (glass), blue (paper and cardboard) and brown (organic waste) (GA, p.1). The total estimated amount of solid waste generated by the operation of the L1ML is 220 MT/year, with 200 MT/year non-hazardous waste and 20 MT/year of hazardous waste (PMRS, p. 32). Non-hazardous waste will be transported to a landfill, or done through the municipal system or alternatively through an EPS-RS registered and licensed by the Environmental Health Directorate (DIGESA) (PMRS, p. 22). Hazardous waste is sent to a high security landfill through a Solid Waste Services Provider Company (EPS-RS) registered with the DIGESA and authorized by the local council (PMRS, p. 22). Source: Cap VIII Plan de Manejo Socio Ambiental (PMSA) Plan de Manejo de Residuos Solidos (PMRS) Gestion Ambiental L1ML (GA)	comprehensive waste management plan but further information is needed declaring the amount and percentage of waste diverted from landfills to achieve a higher level.
RA1.6 Reduce Excavated Materials Taken Off Site	**6**	**Conserving** The project team has designed the movement of soils and other excavated materials off site to a minimum to reduce transportation of materials and environmental impacts. The cut and fill balance is designed at more than 95% since all excavated material has been used as a filler in the project during the construction phase. The majority of the excavation consists in the removal of material for the construction of footings and columns along the L1ML viaduct axis. The excavated material in order to be reused must meets the requirements according to the results delivered by soil laboratories. The excavation for footings is 3m deep and material should be placed at distance not less than 1.50 meters from the boundary of the excavation, for security purposes and to facilitate the return of excavated material for filling (DP, p. 51). The surplus material from excavation and demolition will be sent to the Malecon Costanero Landfill, which is located in Lima (DP, p.43). Source: Cantera Sedapal.jpeg Cap. II Descripcion del Proyecto (DP)	Documentation attesting the cut and fill balance percentage is needed to maintain this achievement level. Additional documents will be helpful to show estimations of the excavated material to be taken off site, and design documents demonstrating how the project was designed to balance cut and fill.

RA1.7 Provide for Deconstruction & Recycling	**4**	**Enhanced** The L1ML project team has at least 50% of specified materials and components that can be easily recycled or reused after the useful life of the project has ended. For the construction of L1ML section 2 recycled and reused materials were implemented. The demolitions of infrastructure only occurred when it is not possible to remove or relocate infrastructure, such as houses affected, pedestrian bridges, poles, streetlight posts, and bus stops (DP, p. 42). The L1ML rail track structure is formed by the substructure and superstructure. The substructure of the rail track is constructed in situ and consists of three elements footings, columns and heads. The superstructure is prefabricated and easy to deconstruct and recycle. It consists of I-beams, slabs, typical edges and pre-slabs that are assembled on site by cranes. All of these prefabricated elements account for at least the 50% of L1ML components that can be easily be separated for reuse (RE, p. 10). Source: Cap. II Descripcion del Proyecto (DP) Resumen Ejecutivo (RE)	It is recommended to provide documentation that can show detail connections that will ease disassembly and encourage reuse or recycling, documentation that can show that materials will retain their recyclability through the end of project life and identify any opportunities for up-cycling.
RA2.1 Reduce Energy Consumption	**3**	**Improved** At least 10% of energy reductions are achieved by reducing overall operation and maintenance energy consumption throughout the project life cycle. The L1ML project conserves energy in its operation by implementing the following effective methods and initiatives for energy reduction: reducing energy consumption in the Alstom trains, installing a natural gas fueled cogeneration power plant, direct purchasing from power distributors, and replacing fluorescent light bulbs with LEDs (IUEE). The biggest consumers of energy are the electric train cars using approximately 80% of the total energy consumed (PCE, p.1). Reduced energy consumption in Alstom trains has been achieved by excluding the rear brake lever from the design. This exclusion has demonstrated that it does not violate safety in gear trains in full operation. This reduction in net embodied energy represents an 11% in savings (IUEE). Options for reducing energy consumption have been identified and reviewed. For instance, the natural gas fueled cogeneration power plant option is only viable if there is natural gas source in the installation area (IUEE). Further documentation and life cycle energy assessment are needed to know the amount of energy saved with this measure. Direct purchasing from power distributors is currently under negotiation but the savings it would represent are not established in the documentation. The replacement of fluorescent lights to LEDs in the stations also represent savings at the large scale, but further documentation and life cycle energy assessment are needed to know which stations have taken the measure and how much net energy savings does it represent. Studies showed that a 50% reduction in energy consumption in stations lighting could be achieved by replacing them with LEDs (PMCE, p.1). In order to comply with Law No. 27345 "Promotion of Efficient Energy Use Act" Issued by the Ministry of Environment (MINAN) the L1ML conducted a study in Ayacucho station to find how much energy consumption would be reduced if the lighting system is replaced with LED technology illumination (PMCE, p.1).	For higher achievement levels it will be helpful to provide documentation with design documents demonstrating the incorporation of energy saving strategies into the design, documentation of the calculation of the industry norm to use as a benchmark including the percentage reduction over the industry norm benchmark.

		Source: Iniciativas de Uso Eficiente de la Energía (IUEE) Proporcion de Consumo de Energia (PCE) Proyecto mejora de consumo de energía con LED (PMCE)	
RA2.2 Use Renewable Energy	**0**	**No Score** The L1ML project team has carried out studies to meet energy needs through renewable sources in order to incorporate the use of renewable energy in its operation. Currently the L1ML buys the electricity from local companies. During both L1ML construction and operation phases electric energy was purchased from EDELNOR (RE, p. 27). The project team has expressed their hopes to use a high percentage of renewable energy in the future. The biggest consumers of energy are the electric train cars using approximately 80% of the total energy consumed (PCE, p.1). Reduced energy consumption in Alstom trains has been achieved by excluding the rear brake lever from the design. This exclusion has demonstrated that it does not violate safety in gear trains in full operation. This reduction in net embodied energy represents an 11% in savings (IUEE). Source: Iniciativas de Uso Eficiente de la Energía (IUEE) Resumen Ejecutivo (RE)	Providing the feasibility studies on how and when the use of renewable energy can be incorporated can help understand L1ML goals. Documentation of anticipated annual output of all renewable sources, broken down by source type, and the overall percentage of renewable energy to total energy consumption can help achieve a higher level.
RA 2.3 Commissio n & Monitor Energy Systems	**3**	**Enhanced** There was an initial commissioning of the project's energy system established in the Conservation Plan (PC) and implemented by the state Autoridad del Tren Eléctrico (AATE) in 2010. Efficient functioning and the extending of useful life has been ensured by the monitoring of the performance of energy systems of the L1ML established through the PC. The performance, operation and maintenance of the energy systems are developed under specific criteria under technical specialists in internal combustion engines and generation systems. Further information is needed to attest third party commissioning of electrical/mechanical systems has been considered or established. Source: Iniciativas de Uso Eficiente de la Energía (IUEE) Proporcion de Consumo de Energia (PCE) Proyecto mejora de consumo de energía con LED (PMCE) Plan de Conservación (PC)	Documentation is needed to show long-term energy systems monitoring plans and to demonstrate the use of a commissioning authority independent of both the design and construction team. Additional documentation stating the location, purpose, and type of monitoring equipment installed, and how the monitoring equipment may enable more efficient operations over the industry norm will help achieve a higher level.

RA3.1 Protect Fresh Water Availability	**2**	**Improved** A negative net impact on freshwater availability, quantity and quality was reduced by taking several measures during both construction and operation phases. During the construction phase the water used is not from water sources or local networks cistern trucks with pre-treated water, not suitable for human consumption. The Rimac River is main water source of the L1ML area of influence, located in the Rimac River basin and to a lesser extent, in the Lurin River basin. With respect to groundwater, the Lima aquifer recharges with the waters of the rivers Chillon and Rimac, and some contribution from the Surco river. River Rimac's main sources of recharge are through existing crop fields in the valleys of Chillon and Rimac, and upstream filtration areas (RE, p. 19- 20). The L1ML reforestation program could contribute to groundwater recharge since water used for irrigation of parks and gardens in the districts where Rimac River runs contribute to some extent to Lima aquifer recharge (LBSA, p. 68). The management of the wastewater effluent resulting from project activities can not be disposed by dumping untreated into water bodies or soil (RE, p. 30). There is ongoing research to implement a small pilot wastewater treatment plant in the L1ML railway yard in Villa EL Salvador to reuse the water in the reforestation areas (PI, p.7 and PTA, p. 5). The reforestation program is currently using local networks cistern trucks with pre-treated water (ISA, p. 10). <u>Source:</u> Proyectos de investigacion (PI) Planta de Tratamiento de Agua (PTA) Resumen Ejecutivo EIA (RE) Cap. IV Linea Base Socio Ambiental (LBSA) Informe Socio Ambiental Julio-Septiembre 2013 (ISA)	There is a lack of documentation supporting that a water availability assessment was realized at the scale of the whole L1ML project. An assessment on the project water requirements is needed to show average peak demands, long term needs, inventory of opportunities for water reuse or groundwater recharge on site, calculations of the volume of freshwater discharge after use, and location of discharge and impact of discharge on receiving water quality and quantity.
RA3.2 Reduce Potable Water Consumption	**4**	**Improved** The L1ML project team encourages the use of recycled water in the reforestation program in order to reduce potable water consumption. In order to establish the use of greywater the L1ML project team must review and analyze the national legal framework, specifically the Departmental Resolution No. 0291-2009-ANA, that enacts provisions relating to the granting of discharges and reuses of treated wastewater (RE, p. 4). During the construction phase the water used is not from water sources but from local networks cistern trucks with pre-treated non-potable water. The periodic wetting of soil should be done at least twice daily to avoid excessive emissions of particulate matter especially in not vegetated areas, areas with constant machinery traffic, areas with construction activities, close to urban areas, etc. (LBSA, p. 49). The L1ML rail yard is another big water consumer in the project because of the water consuming activities such as the washing of trains, irrigation purposes and industrial use (PTA, p. 10). There is ongoing research to implement a small pilot wastewater treatment plant in the L1ML railway yard in Villa EL Salvador to reuse the water in the reforestation areas (PI, p.7 and PTA, p. 5). The reforestation program is currently using local networks cistern trucks with pre-treated water.	It is necessary to provide documentation that explains the extents that the project team and owner conducted planning or design reviews to identify potable water reduction strategies during operation and maintenance of the L1ML, and to what extents do the alternatives such as non-potable water, recycled water and storm water were considered. A higher level of achievement can be obtained if additional documentation demonstrates feasibility

		Source: Proyectos de investigacion (PI) Planta de Tratamiento de Agua (PTA) Resumen Ejecutivo EIA (RE) Cap. IV Linea Base Socio Ambiental (LBSA) Cap. I Marco Legal e Institucional (MLI) Cap. VII Identificacion y Evaluacion de Impactos Ambientales (IEIA)	and cost analysis studies to determine the most effective methods for potable water reduction as well as attesting the percentage in reduction in comparison with industry norms.
RA3.3 Monitor Water Systems	**1**	**Improved** An initial water system monitoring program was implemented before the construction phase of the L1ML to check water systems performance during operations and their impacts on receiving waters. The construction of L1ML can alter the quality of River Rímac waters and through the Environmental Impact Studies (EIA) the project must meet regulations stated in the Monitoring Surface Water Quality Program (IEIA, p. 21). The EIA establishes preventive, corrective and/or mitigation measures when there are high probabilities that the water sources will be compromised as happens in the areas where the L1ML crosses the basin. The study water monitoring was performed by a third party, CIMM PERU S.A. conducted in accordance with the provisions of the protocol monitoring of liquid effluents (RM No. 026-2000-ITINCI/DM), and analyzed parameters within the provisions of the National Standards for Environmental Water Quality, (S.D. 002-2008-MINAM)(LBSA, p.72). As there is the possibility of effluents being discharged into a water body, a monitoring entity must assess the initial conditions to determine the state of the water resource (MLI, p. 29). The results of initial water quality analysis established that the Rímac River waters exceed the values established by the ECA issued by DS MINAM No. 002-2008 (IEIA, p. 87). Source: Proyectos de investigacion (PI) Planta de Tratamiento de Agua (PTA) Resumen Ejecutivo EIA (RE) Cap. IV Linea Base Socio Ambiental (LBSA) Cap. VII Identificacion y Evaluacion de Impactos Ambientales (IEIA)	Additional documentation is needed to state that the owner and project team engaged an independent entity to monitor or oversee the monitoring of the whole system or periodically check the monitoring of the project. For higher achievement levels, documentation establishing the extent that the project design incorporated means to monitor water performance during operations, and to what extent will the project integrate operations and impact monitoring to mitigate negative impacts and improve efficiency.
RA0.0 Innovate Or Exceed Credit Requirements	**0**	*N/A*	
	40		

NATURAL WORLD			
	LIMA METRO LINE 1, PERU		**RECOMMENDATIONS**
NW1.1 Preserve Prime Habitat	**9**	**Superior** The L1ML avoids areas of high ecological value since it is located in areas of urban use, in an elevated viaduct that runs along the centerline berm of main avenues. The elevated rail runs along existing roads in a south-north axis crossing the River Rímac and its watershed. The siting of the project not only avoids the use of lands characterized as prime habitat, but it is specifically within largely derelict and underutilized spaces of the city such as the middle of an existing road. The L1ML is a project of considerable size with a direct area of influence of 868.528 ha and an indirect area of influence of 15,786.805 ha. The L1ML is being constructed in the site that was chosen for it when construction started in 1986. At the time, only Atocongo station was completed; most of the site and pillar structures remained unfinished and unused for approximately 20 years, rendering the area insecure. The project also includes a reforestation initiative to convert the berm underneath the rail viaduct into a biological corridor linking neighboring green areas in Lima. Source: Plan de Conservación 2013 Plan de Manejo Socio Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1, Tramo 1: Villa El Salvador – Grau Proyecto de Tesis Arborización	Provide third-party documentation of proof that the project avoids development on prime habitat land and that no sensitive areas are located on-site. Provide a site plan showing appropriately sized buffer zones and/or any prime habitat areas that will be enhanced through a restoration plan or a site plan signed by a qualified natural resources professional.
NW1.2 Preserve Wetlands and Surface Water	**0**	**No Score**	To receive a higher level of achievement documentation stating that a vegetation and soil protection zone was implemented to protect wetlands or water bodies located at the L1ML site. If there is restoration of previously degraded buffer zones, documentation with a restoration plan and site map outlining locations of restoration and proof of action

		Although the L1ML is an elevated viaduct when it traverses the River Rímac watershed, the project does not avoid development or has a buffer zone of more than 50 feet. Development activities within the watershed include the construction of the elevated viaduct structure, removal of vegetation, grading, filling and excavation. The River Rímac watershed is one of the most important watersheds in Perú since it is located inside the metropolitan area of Lima, its waters are the source of drinking water for about 7.6 million inhabitants, source for agriculture and energy as the river feeds five major hydroelectric dams: Huampaní, Matucana Huinco, Barbiblanca and John Carosio. The waters of the Rímac exceed the maximum level of contaminants set by the Environmental Quality Standards (ECA) specially in the districts of El Augustino and San Juan de Lurigancho due to the presence of organic waste, dumping of domestic sewage , discharge of chemicals , among others. Section 2 from Grau station to San Juan de Lurigancho, currently under construction, compromises areas belonging to the River Rímac watershed with the removal of the greenery on its riverbanks for the construction of the elevated rail viaduct. The affected area comprises the riverbanks in front of the Edegel company grounds to the beginning of the Próceres de la Independencia Avenue and the bridge Vía de Evitamiento (Km 23+200 to Km 23+700). During construction not only would water quality be affected by sedimentation, but also with the operation of heavy machinery and earthworks expected to increment the levels of particulate material, gas emissions and noise levels. There are some mitigation strategies such as taking the provisions of Pacri (Directrices para la Elaboración y Aplicación de Planes de Compensación y Reasentamiento Involuntario para Proyectos de Infraestructura de Transporte), perform regular maintenance of vehicles and machinery used to avoid the risk of spillage of fuels and lubricants and limit generation of noise, moisten the soil in areas taken over by the project, place a perimeter fence to minimize dust generation, and meet the Monitoring Program Surface Water Quality established by the Peruvian government. The mitigation strategies meet the local codes but there is not documentation submitted that supports a proposed or existing vegetation and soil protection zone (VSPZ) to protect, buffer, enhance and restore the River Rímac bank areas. The environmental impact studies declare that the impact on the quality of water is in a short stretch and temporary hence considered negative and light in magnitude. <u>Source:</u> Programa de Monitoreo de la Calidad de Aguas Superficiales Directrices para la Elaboración y Aplicación de Planes de Compensación y Reasentamiento Involuntario para Proyectos de Infraestructura de Transporte ECA D.S. No 002-2008 MINAM.	types will be needed. Restoration must include stabilization of stream channel or shoreline and reforestation with native plant communities.

NW1.3 Preserve Prime Farmland	**12**	**Conserving** The environmental impact studies (IEIA) do not identify areas with prime farmland in its L1ML project evaluation. Since the L1ML site is urban in nature as it occupies the central berms in major roadways in Lima, no soils in the L1ML site are designated as prime farmland soils, unique farmland, or farmlands of statewide importance. The location of the L1ML is in a previously urban developed site outside areas of prime farmland. There is interest in providing areas for urban agriculture within the L1ML area of influence. According to the Metropolitan Program for Urban Agriculture in the Metropolitan Municipality of Lima, areas with the L1ML site will be transformed into urban agriculture sites. The urban agriculture program is not a major restoration into prime farmland, but it affects three locations within the direct influence area, totaling around 20000 m2 with water access that will be near Parque Industrial station, and in the integral park close to Micaela Bastidas and Mariano Melgar. Source: Proyecto "Mi Huerta" Resumen Ejecutivo (RE) Cap. II Descripcion del Proyecto Cap. VI Identificacion y Evaluacion de Impactos Ambientales (IEIA)	Documentation showing results of government studies and soil surveys is needed to attest that no soils in the L1ML site are designated as prime farmland soils, unique farmland, or farmlands of statewide importance.
NW1.4 Avoid Adverse Geology	**5**	**Conserving** The L1ML avoids development in adverse geologic formations and safeguard aquifers to reduce natural hazards risk and preserve high quality groundwater resources. The Environmental Impact studies do not identify nor delineate any major earthquake fault along the L1ML site. There is a high level of seismic activity according to the Seismic Zoning Map of the Geophysical Institute of Peru because the city of Lima is placed on the alluvial fan of the river Rímac and Chillón on the Central Coast Region of Peru (IEIA, p. 9). The L1ML project would be most vulnerable only during its construction phase to contaminants spillage into ground water because of earthworks, and to the occurrence of earthquakes while building the structure, but not after since it must comply with the earthquake resistant design requirements of the standard category A of Peruvian Standards for Earthquakes (DP, p. 20). The predominant soil type is San Cristobal (Lythic Xeric Torriorthents), a loamy soil with coarse fragments, good drainage and rapid permeability. In the area between Km. 20+942.83 and Km. 33+800 the soil is loamy with good drainage and rapid permeability, which makes it more vulnerable in terms of possible spills of oils, lubricants and fuels (EIASM, p.84). The Environmental Impact study deem the spillage risks impact negative and of light magnitude as the site is located in urban land, although adverse impacts on groundwater are not discussed extensively in the documentation. The earthworks, grading and excavation are part of the work needed for the construction of the foundations of the viaduct and represent the most risks in soil affectation and groundwater contamination. The main risks constitute accidental spills of oils, greases and fuels by the use of machinery and heavy vehicles. Spillage risks can result from concrete pouring during construction of the viaduct, stations, handicap accessible structures, precast pieces, and the conditioning of the Maneuvers Patio area. Other spillage risks are found in the collection of waste that can be temporarily or partially, in different areas depending on the programming of work. In the same way, activities of moving trees and vehicles could generate spill caused by improper maintenance of the machinery used. During the operation phase the maintenance of the rolling stock, passenger	Documentation is needed to attest that no faults and karst features exist on site, nor do site activities affect underlying aquifers.

		stations and power structures could lead to the alteration of soil quality influenced by random events of oils and grease spills, especially in the areas that do not have adequate soil sealing. Also, the improper disposal of waste generated mainly by packaging of oils and fuels would facilitate the alteration to soil quality of the switchyard and stations. Source: Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho (EIASM), Capítulo VII: Identificación y Evaluación de Impactos Ambientales (EIASM) Línea Base Ambiental (LBA) Cap. VI Identificacion y Evaluacion de Impactos Ambientales (IEIA) Cap. II Descripcion del Proyecto (DP)	
NW1.5 Preserve Floodplain Functions	**0**	**No Score** The L1ML project mitigates the impacts in floodplain functions by impacting the site minimally with the use of an elevated structure. Actions affecting floodplain functions are avoided but are not considered beyond local laws and requirements. The L1Ml has a section located in the River Rímac floodplain, in the San Juan de Lurigancho area. For the construction of this section provisions have been taken to protect the surrounding areas from flooding. Considering that the viaduct structure is elevated, the floodplain functions might not be compromised as the structural impact is minimized. The added elevated impervious surfaces in the viaduct might alter the floodplain infiltration and water quality. A hydrologic model was utilized to study how the flow of waters would behave during construction to conclude that the floodplain functions would not be compromised (MH). The model also helped in deciphering the design of the Rímac RIver edges affected by construction. Source: Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho Cap. VI Identificacion y Evaluacion de Impactos Ambientales (IEIA) Cap. II Descripcion del Proyecto (DP) Modelo Hidraulico (MH)	Further documentation is needed to support this or establish preservation strategies to maintain or enhance habitat, within and along the waterway in the floodplain. Documentation showing location of the project relative to the 100-year or design floodplain, siting choices relative to floodplains and how impacts o the floodplain have been reduced, and documentation that pre- and post-floodplain storage and floodplain elevations show that project does not increase flood elevations outside of project easements and maintain floodplain storage.

NW1.6 Avoid Unsuitable Development on Steep Slopes	**4**	**Conserving** Lima is located on predominantly flat terrain in the Peruvian coastal plain with some isolated hills. Among the different topographical features that the L1Ml site faces is the crossing of the River Rímac watershed which can constitute the most drastic elevation difference with deeper structural footings. The L1ML project is developed in a predominantly flat area in the central berm Lima's main avenues, with platforms running on a level above the ground (IEIA, p.10). Although the project's site is flat and was specifically chosen to run in avenues to avoid relocations, steep slopes and other complications, there is no documentation supporting a site selection process that deliberately identified and avoided high-risk hillsides or steep slopes. The L1ML elevated viaduct runs from south to north avoiding steep slopes. Measures against erosion during the construction phase have been taken, such as silt fencing to minimize the particles going into the water bodies, and soild moistening to avoid dust proliferation. The River Rímac banks are among the most sensitive slopes to change in steepness that can affect the vegetation growth, habitats and cause erosion. Source: Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho Cap. VI Identificacion y Evaluacion de Impactos Ambientales (IEIA) Cap. II Descripcion del Proyecto (DP)	Documentation of the process used to identify high-risk hillsides or steep slopes and their location relative to the final site selected will help maintain this level. Further documentation such as plans showing lack of drastic topographic alterations are needed to corroborate the project avoided development on steep slopes, avoided excessive erosion and minimized drastic topographic alterations.
NW1.7 Preserve Greenfields	**10**	**Conserving** The location of the L1ML is considered a greyfield, as it is in a 100% previously developed area principally located in the berms of the avenues that make up the viaduct's south to north axis. Its structure only occupies areas for the pillars of the elevated viaducts and station. Section 1 has been built or partially built since the 1980s making most of the site an eyesore for almost 20 years. In the projected section 2 of the L1ML (Km. 23+000 and Km. 23+800) most construction work will take place along the avenues Grau, Locumba and Próceres de la Independencia. The current land use of the direct area of influence is mainly urban residential (LBSA, p. 87). The L1ML is located in previously developed land designated for traffic use, specifically in the avenues central berms that are man-made green areas. The berms along Heroes de la Independencia Avenue are the greenest and count with the presence of trees and bushes and are frequented by a large number of formal and informal traders. Source: Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho EIA, Cap. IV, Linea Base Socio Ambiental (LBSA) Cap. VI Identificacion y Evaluacion de Impactos Ambientales (IEIA) Cap. II Descripcion del Proyecto (DP)	Documentation showing the percentage of the developed area of the site that was formerly developed and may be classified as a greyfield will prove helpful. Further information will help know the exact area of the previously developed land repurposed. Higher achievement level is possible if some areas considered brownfields are being remediated by showing proof of brownfield status and approved remediation measures.

NW2.1 Manage Stormwater	**0**	**No Score** The impact of infrastructure on stormwater runoff quantity and quality has not been minimized nor an assessment of infiltration and evapotranspiration capacity of the site in predevelopment stage has been submitted. Although there is an almost absence of precipitation in Lima, with only 7mm of precipitation per year, but sudden rain events can happen. it is considered to be one of the metropolitan areas with the lowest amount of precipitation n the world. Due to the lack of rain, Lima is unprepared when sudden heavy rains events do occur and the city confronts havoc in the form of flooding, landslides, huaycos or avalanches in higher elevations. Development causes change to the natural flow of runoff on a site. Although the L1ML is an elevated viaduct with most of its structure above ground, an increase in the quantity of impervious surfaces will increase the volume of stormwater runoff by having less areas for water to infiltrate into the ground. The climatic characteristics of the study area, correspond to the geographical setting of the coastal strip that is mainly influenced by the Humboldt marine current with cold water from the South Pacific. This defines the trends in the behavior of meteorological parameters. Scarce rainfall varying from 0-10 mm, whereas the temperature is between 16°C and 22°C, and the weather presents arid and humid features (LSA, p. 88). Source: Cap. IV Línea Socio Ambiental (LSA)	In order to achieve higher levels in this category, further documentation is needed to affirm assessments in predevelopment runoff quantity and quality, if the project employs low impact development (LID), increases stormwater storage capacity or counts with an enhanced stormwater management.
NW2.2 Reduce Pesticides and Fertilizer Impacts	**0**	**No Score** Maintenance of green areas includes the use of unspecified fertilizers and pesticides. The M1ML project aims to recover and improve the landscape quality of the green areas around it. The size of the green areas is estimated 115,000 m2 which include: indoor and outdoor gardens in the stations (26,000 m2), the berm beneath the elevated viaduct (89,000 m2) from the future Jorge Chavez station to Av Grau station. Among the maintenance plan the following measures will be taken: a minimum of two scheduled irrigations per week is contemplated, the grass will be kept between 7 to 14 cm tall, fertilizers will be used to ensure nutrients in the lawn. Two types of fertilizers will be utilized: chemical and organic, and pesticides will also be used to control pests, diseases and protect the soil from degradation (PMSA, p. 79). The reforestation efforts in the L1ML, especially in the Micaela Bastidas area consist of converting informal dumping areas into green areas that would require the use of fertilizers and pesticides. Source: Informe de Forestación en Micaela Bastidas Plan de Manejo Socio Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao, Linea1 (PMSA)	Documentation with which operational policies will be put in place to control the application of fertilizers and pesticides is needed. Further documentation is needed to specify the types and amounts of pesticides and fertilizers to be employed in the green areas and reforestation areas in order to asses the impact of such practice.

NW2.3 Prevent Surface and Groundwater Contamination	**1**	**Improved** The L1ML project team has contemplated the incorporation of several measures to prevent pollutants from contaminating surface and groundwater and monitor impacts over operations. During the construction phase the waters of the River Rímac will be affected by the construction, earthworks, excavation, clearing and leveling of land. The particulate matter emitted from these activities could settle and alter the river by increasing the concentration of the turbidity of the water. The use of equipment and/or machinery and heavy vehicles for construction and operation activities could also cause spillage of fats, oils and fuels, which could affect the quality of surface water. Before the L1ML section 1 construction. the river waters have exceeded the maximum contamination set by the Standard Environmental Qualities (ECA) due to the presence of organic waste, dumping of domestic sewage, discharge of chemicals, among others, which are washed by the waters of the river, towards the lower basin. The section of the river Rímac in the districts of El Augustino and San Juan de Lurigancho is also affected by the dumping of solid waste by the local people and informal recyclers. The following mitigation measures are taken during the construction phase to avoid the risk of spillage of fuels and lubricants such as perform regular maintenance of vehicles and machinery used, moisten the work areas and placing a perimeter fence to minimize the generation of dust. The impact on the quality of water during construction is considered of negative impact as it occurs in a short stretch and short amount of time. Source: Cap. VI Identificacion y Evaluacion de Impactos Ambientales (IEIA) Cap. II Descripcion del Proyecto (DP) Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho (EIA)	Documentation must attest that adequate and responsive surface and groundwater quantity and quality monitoring systems have been incorporated into the project design. Further documentation will be needed to corroborate that designs, plans, and programs are instituted to prevent spills and leaks to surface and groundwater contamination.

NW3.1 Preserve Species Biodiversity	**2**	**Improved** Biodiversity is protected by preserving and restoring green areas in the L1ML influence area. During the Environmental Impact Study (EIA), the project team and local agencies helped identify existing habitats, to ensure them and compensate for losses. There are mitigation measures to maintain and restore habitat quality and area. Peru is one of the countries in the world with most biodiversity reaching to about 1,800 species of birds reported or 18.5% of all birds on the planet and 45% of neotropical species, in Lima and near its coast it is possible to find over 300 species (LBSA, p.105). In the L1ML area of influence 44 species of trees, 14 species of birds, 24 species of phytoplankton, 12 species of zooplankton and 7 species of benthic macro-invertebrates were identified (CR, p. 1-2). In the L1ML direct area of influence, the area of the River Rímac is where most biodiversity is observed. The construction of the elevated viaduct will increase the levels of noise contamination, and contamination in the air and water. The temporary displacement of local birds that congregate daily in the areas around the river is expected. Among the most affected bird species are the Larus dominicanus “gaviota”, the Columbina cruziana “tortolita”(turtledove), the Coragyps atratus “gallinazo”, and the Parabuteo unicinctus “gavilan” (hawk) International Union for Conservation of Nature (IUCN) protected species in category LC (Least Concern) (LBSA, p. 124). It is estimated that these birds will return after construction work is finished (EIA). At large, L1Ml construction activities foster the loss of the green central berms areas with shrubs that are employed by the local birds for the location of their nests and/or temporary places to rest. This negative habitat impact is estimated to affect the most abundant species Columbus livia or "common pigeon" (EIA). It is considered that the noise levels generated would not have a significant impact on the local avifauna, because at present the areas where the project is implemented, have already high noise levels due to high traffic and local business which according to environmental monitoring performed exceed the values set out in the National Environmental Quality Standards for Noise (EIA). It is estimated that the displacement of the birds should not be significant because of the existing green areas close to the project within less than 100m such as the Huiracocha Zonal Park. These characteristics allow classifying the environmental impact and the nature and magnitude negative with light magnitude (EIA). The L1ML direct area of influence has 11 hectares of green areas with 44 identified tree species of which 2 trees from the species Cedrela odorata, protected by national legislation are found. The Cedrela odorata is protected by the national legislation DS N ° 043-2006-AG and registered by the IUCN as vulnerable (LBSA, p. 104-105). However, it is important to note that these two trees are in areas common green areas or parks that will not be affected by the implementation and development project (LBSA, p. 104).	For higher achievement level would be needed further documentation or maps showing areas of important habitat, a site plan and narrative illustrating mitigation or restoration measures, a monitoring plan ensuring mitigation measures, and documentation of habitat improvement, increase in habitat size or in connectivity.

		Source: Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho (EIA) National Environmental Quality Standards for Noise Cap. IV Linea Base Socio Ambiental parte I y II (LBSA) Resumen Ejecutivo (RE) Conclusiones y Recomendaciones (CR) Plan de Manejo Socio Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao, Linea1	
NW 3.2 Control Invasive Species	**5**	**Superior** For the L1ML reforestation program, locally appropriate plants are identified and used, while noxious plants are identified and removed. There is invasive species control is in the maintenance of the areas surrounding the stations and its approaches, substations, viaduct, pedestrian walkways and / or vehicle and road areas that will generally be kept clean by eradicating invasive weeds and waste generated by passengers (DP, p. 71). Eradication probably consists of using pesticides and physical removal of weeds (PMSA, p. 79). Although invasive species will be eradicated, a comprehensive multi year management plan to control them is not mentioned in the documentation submitted. The arborization (reforestation) thesis work (PTA) promotes the development of a biological corridor along the L1ML with an appropriate mix of native forest species that thrive in urban ecosystems (PTA, p. 54). In the advances for its implementation a comprehensive assessment of the existing trees was realized according to height, species and health. The areas where the elevated viaduct will be constructed, specifically between Caja de Agua station and Bayovar station will remove large tree specimens ranging from 1 to 6 meters which species have been identified: Tipuana tipu , Schinus molle, Ficus nítida. These trees species are considered ornamental in Lima and it has been contemplated to relocate them to other areas along the viaduct or in parks located in the District Municipality of San Juan de Lurigancho. The impact of introducing these trees to other areas is not considered noxious. Source: Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho Cap. VI Identificacion y Evaluacion de Impactos Ambientales (IEIA) Cap. II Descripcion del Proyecto (DP) Proyecto de Tesis Arborizacion (PTA) Plan de Manejo Socio Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao, Linea1 (PMSA)	Further information that includes a list of invasive species in the region, a map of all invasive species found, documentation that all species introduced to the site are non-invasive regarding the vegetation to be introduced or relocated will be helpful. More information regarding the invasive species management control plan is needed. For higher achievement level a comprehensive multi year management plant to control invasive species would be needed.

NW3.3 Restore Disturbed Soils	**10**	**Restorative** The soils disturbed during construction and operation of the L1ML are planned to be restored to bring back ecological and hydrological functions. Soil restoration goes beyond the extent required by regulations and construction permits. A comprehensive soils disturbance study, as part of the thesis implementation program, was carried out during a field tour in order to qualify every available open space in the L1ML site for reforestation. The study was done by classifying the current characteristics of the soil, sampling and identifying them into three main types according to their status and current use: 5 ha of bare soil, 10 ha of vegetated soil, and 2.5 ha of bare soil with high urban impact (ATACS, p.1-28). During the construction phase, initiatives to prevent soil disturbance have been utilized. For instance, the top soil layer is saved, stored during construction and reused in the reforestation program. During excavations material should be placed at distance not less than 1.50 meters from the boundary of the excavation, for security purposes and to facilitate the return of excavated material (DP, p. 51). The reforestation of green areas is the main means to restore disturbed soils in the L1ML site, the program begins by evaluating plant trees along the projected viaduct, in coordination with the municipalities for removal and pruning as appropriate, removal of vegetation (grass), retirement and conservation of organic soil and finally reforestation (trees and grass) or return affected coverage (trees and grass) to the corresponding district municipalities (DP, p. 61-62). Source: Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho Cap. IV Linea Base Socio Ambiental parte I y II (LBSA) Resumen Ejecutivo (RE) Conclusiones y Recomendaciones (CR) Avances Tesis Ambiental Caracterización de Suelos (ATACS) Cap. II Descripcion del Proyecto (DP) Plan de Manejo Socio Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao, Linea1 (PMSA)	Additional documentation of soil disturbance and restoration activities, calculations showing that 100% of disturbed soils are restored, documentation of soil reuse will help support this level of achievement.
NW3.4 Maintain wetland and surface water functions.	**3**	**Improved** The L1ML traverses waterways and riparian areas of the River Rímac that provide ecosystem functions without disrupting its connectivity. The project implementation impact is minimal during the operation phase and maintains the hydrologic connection in the Rímac River. Local regulation also supports the prevention of negative environmental impacts by protecting streams, wetlands, water bodies and their riparian areas. It is expected that the water quality is compromised during the construction phase, and some mitigation strategies have been taken but no meaningful action is taken to maintain or restore ecosystem functions of waterways on the project. Source: Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho Cap. IV Linea Base Socio Ambiental parte I y II (LBSA) Resumen Ejecutivo (RE) Conclusiones y Recomendaciones (CR)	Further documentation will be needed to show that the River Rímac is connected to its riparian floodplain at a six-month to two-year frequency flow event. Higher achievement level can be obtained if documentation supports that the project maintains or enhances water quality and/or habitat, and/ or sediment transport. Also documentation stating that the project maintains all the four ecosystem functions specified and fully

			restores any disturbed ecosystem function will help achieve the highest level.
	0	*N/A*	
	61		

CLIMATE AND RISK			
	LIMA METRO LINE 1, PERU		**RECOMMENDATIONS**
1.1 Reduce Greenhouse Gas Emissions	**13**	**Superior** The L1ML project produces 41 to 80% reductions in carbon emissions as compared to other public mass transportation systems in Lima. The M1ML was designed as an electrical train system in order to improve the mobility of citizens and improve air quality in Lima, which is the fifth largest city in Latin America. The trains of the L1ML are electrically operated constituting in zero greenhouse gas emissions. According to the Autoridad Autónoma del Tren Eléctrico (AATE) the L1ML's section 1 has helped stop emissions of 32,000 tons of CO2 emitted in the city per year (GA, p.1). The Atmospheric Sanitation Comprehensive Plan (PISA 2002) states that vehicle units are responsible for approximately 90% of air pollution. Of these, the main sources for automotive pollutant are carbon monoxide, nitrogen oxides, volatile organic compounds (VOCs), lead, among others. In Lima the automotive fleet grows 7% on average per year with almost no control in emission of greenhouse gases due to the lack of maintenance of vehicles and poor technical revisions. In Lima public vans or combis constitute the most used mode of collective transportation with 40% usage from people that work or study outside home (ELCV, p.12). Public vans are one of the most polluting forms of transportation producing about 2 kg of CO2 every 12 km traveled (GA, p.4). In 10 months of operation, the L1ML has mobilized more than 26 million customers in section 1 with an average distance of 22 kilometers. If these customers had been mobilized in public vans, 2,166,666 kg of Co2 would have produced plus the route would have been a third longer, or 33 km per trip (GA, p.4). When multiplying the more than two million trips public vans make in 33 miles, around 12 million kg of Co2 would have been produced to transport the 26 million customers riding the L1ML in its 10 months of operation (GA, p.4). To avoid the production of CO2 would have had to plant nearly 600,000 trees, equivalent to 6,000 hectares. The reforestation program is also aimed to reduce CO2 emissions. In the 10 months of operation approximately 329,200 m2 of green areas have been maintained through irrigation and pruning of bushes and grasses found in and around the stations. In addition 7,100 m2 have been reforested with Syngonium podophyllum, Wedelia trilobata and grasses such as Brachiarias s.p. with the aim of trap and hold particulate contaminants (dust, ash, pollen and smoke) which causes damage to the human lungs, as well as reducing the levels of C02 and return oxygen to the atmosphere (GA, p.2). *Source:* Gestión Ambiental L1ML (GA) Encuesta Lima Cómo Vamos 2012 (ELCV)	Further documentation regarding the green house emissions from electric trains maintenance, stations, reforestation cistern-trucks and the main structure will be helpful to attest this level of achievement and have a better view of the impact in greenhouse gas emissions.

CR1.2 Reduce Air Pollutant Emissions	**12**	**Conserving** The L1Ml not only achieves a negligible air pollution impacts and net zero production of criteria of pollutants, but implements measures to improve existing air quality to a level higher than pre-development by reducing air pollution through reforestation strategies. The L1ML is the first metro line in Lima and makes part of a larger mass transportation project of 5 more metro lines and the Metropolitano Bus Rapid Transit (MBRT). Mass transportation reduces potentially the amount of cars, taxis, mototaxis, public vans or combis that circulate in Lima thus reducing the air pollutant emissions indirectly. The Air Quality Monitoring Sub Program will verify compliance with the regulations and trends of air quality change. For carrying out the monitoring, staff will be trained and the sample analysis will be send to a laboratory accredited by INDECOPI. The methodology used is based on EPA Method 40 CFR 50 for specific standards of air quality monitoring (PMSA, p. 162). The monitoring is more comprehensive than the Peruvian Environmental Quality Standards (ECA) requires to monitor: sulphur dioxide SO2, volatile organic compounds (VOC), hydrocarbons (HT), particulate material with diameter less than 2.5 micron (PM2.5). The 13 monitoring locations along the L1ML look for levels of air pollutants identified by local code (D.S. Nº 003-2008-MINAM / D.S. Nº 074-2001-PCM): PM-10 (24 hr)150 dg/m3, PM-2.5 (24 hr) 50 dg/m3, SO2 (24 hr) 80 dg/m3, H2S (24 hr) 150 dg/m3, CO (8 hr) 10,000 dg/m3, NO2 (1 hr) 200 dg/m3, lead 1.5 dg/m3 (PMSA, p. 161). Air pollution constitutes one of the most harmful to health and one of the problems that affect the most the citizens of Lima (ELCV, p.11). The Atmospheric Sanitation Comprehensive Plan (PISA 2002) states that vehicle units are responsible for approximately 90% of air pollution producing mostly carbon monoxide, nitrogen oxides, volatile organic compounds (VOCs), lead, among others. In Lima the automotive fleet grows 7% on average per year with almost no control in emission of greenhouse gases due to the lack of maintenance of vehicles and poor technical revisions. In 10 months of operation, the L1ML has mobilized more than 26 million customers in section 1 with an average distance of 22 kilometers reducing about 2,166,666 kg of Co2 produced by other forms of transportation like public vans or combis in a longer distance for the same trip, or 33 km per trip (GA, p.4). During construction the following mitigation measures are taken during the construction phase such as perform regular maintenance of vehicles and machinery used, moisten the work areas and place a perimeter fence to minimize the generation of dust (EIA). The L1ML also has a reforestation program aimed to reduce air pollutants and CO2 emissions especially in the south of Lima where most roads are not paved and dust control is a main concern (DSDI, p.44 and GA, p.1). In the 10 months of operation approximately 329,200 m2 of green areas have been maintained through irrigating and pruning of bushes and grasses found in and around the stations. In addition 7,100 m2 have been reforested with Syngonium podophyllum, Wedelia trilobata and grasses such as Brachiarias s.p. with the aim of trap and hold particulate contaminants (dust, ash, pollen and smoke) which causes damage to the human lungs, as well as reducing the levels of C02 and return oxygen to the atmosphere (GA, p.2).	Additional documentation supporting that the L1ML does not emit air pollutants such as in the AC system in the train cars and facilities will maintain this achievement level. Documentation of strategies implemented to reduce the six criteria air pollutants to required levels will be helpful. Also documentation regarding the mitigation measures and code regulations to improve air quality during construction will be helpful to attest this level of achievement. Surveys from neighbors in south Lima will be helpful to attest the reforestation initiatives are working in reducing dust and improving air quality.

		Source: Gestión Ambiental L1ML (GA) Encuesta Lima Cómo Vamos 2012 (ELCV) Diagnóstico Social de los Distritos de Influencia (DSDI) Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho (EIA)	
CR2.1 Assess Climate Threat	**0**	**No Score** There is no mention of a comprehensive climate impact assessment and adaptation plan developed that includes vulnerability assessment, risk assessment and adaptation assessment in collaboration with the local emergency management department and meetings with the local community. *Source:* Resumen Ejecutivo (RE) Conclusiones y Recomendaciones (CR) Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho (EIA)	Include at least a comprehensive climate threat assessment done for the L1ML project that anticipates impacts in long-term weather patterns, changes in extreme weather events and natural hazards, increased sea levels and increased desertification.
CR2.2 Avoid Traps And Vulnerabilities	**0**	**No Score** Traps and vulnerabilities that could create high, long-term costs and risks for the affected communities can be avoided by providing assessments and recommendations. There is a lack of documentation supporting that the team identified potential approaches and practices that address possible resource constraints and vulnerabilities that the community could face in the future due to climate change. *Source:*Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho (EIA) Resumen Ejecutivo (RE) Conclusiones y Recomendaciones (CR)	Documentation that identifies and assess possible changes in key engineering design variables can help achieve an improved or enhanced level. Higher levels can be achieved by providing documentation outlining potential traps and vulnerabilities and associated costs and risks, and if documentation also shows the extent to which project concepts, configuration and design have taken into account the need to reduce identified significant risks, traps, vulnerabilities with substantial costs and other negatives.

CR2.3 Prepare For Long-Term Adaptability	**0**	**No Score** Infrastructure systems can be prepared to be resilient to the consequences of long-term climate change, perform adequately under altered climate conditions, or adapt to other long-term change scenarios. Considering Lima's vulnerability to sudden rain events, expected to occur more often with climate change, no comprehensive climate change consequences preparations seems to have been done in the L1ML neither have it considered aspects such as sea rise in cities, extended droughts, among others. *Source:* Resumen Ejecutivo (RE) Conclusiones y Recomendaciones (CR) Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho (EIA)	For obtaining achievement in this credit, documentation must support the identification of specific measures taken to address the potential consequences of long-term climate change such as sea level rise, increased intensity and frequency of extreme weather events, extended droughts, heat waves, increased ambient temperature, desertification, water and energy shortages, shortages of critical materials. Also the identification of siting or design features that increase alternative supply options for water, energy or other materials is critical to the operation of the constructed works. For higher achievement level plans, designs, documents that show restoration and rehabilitation efforts for the long term change effects listed above.
CR2.4 Prepare For Short-Term Hazards	**3**	**Improved** The L1ML team has considered natural and man-made hazards that are possible in the region and researched the frequency and severity of these disasters. The Social and Environmental Management Program is an umbrella plan with various programs that deal with natural and man-made hazards: Remediation of Environmental Passives Program (REPP), Loss Prevention and Contingencies Program (LPCP), and the Health and Safety Program (HSP). The REPP has various strategies to increase resilience and long-term recovery from disasters through the following subprograms: Preventive, Mitigating and Corrective Measures Program, Management of Solid Waste, Liquids and Effluents Program, Materials Management and Hazardous Substances Program, Atmospheric Emission Control and Noise Program, and Protection and Conservation of Green Areas Program (PMSA, p.2-3). The Solid Waste Environmental Management Plan (SWEMP) establishes measures to avoid and/or decrease the likelihood of labor incidents in order to protect the lives of workers and road infrastructure for possible occurrences of natural events and/or generated by man by chance, during the construction phase and operation of the project. The SWEMP looks for different types of hazards that can be accidental, technical or/and human related. For instance among the accidental hazards include unforeseen explosions, fires and accidents (electrocution, falls, blows, burns, etc. The technical hazards include delays in construction schedules, unexpected geotechnical conditions and failures in the supply of inputs, among others. The human related hazards may	There is an awareness of likely natural hazards in the area and several plans of contingency for the emergencies. For higher levels, further documentation is needed attesting that plans and designs have been created and implemented to safeguard against 1 in 50 year hazards, 1 in 100 year hazards and / or a list of incorporated strategies used and how they minimize the risk of future hazards using environmental restoration.

		be delays in the work, local and regional stoppages, strikes, public order difficulties, etc (SWEMP, p.148). The city of Lima has a high seismic threat and has been completely destroyed by earthquakes in 1586, 1687 and 1746. In the central districts of Lima there have been registered earthquakes with maximum intensity grade of VII M.M., in the coastal outskirt districts intensities can reach IX M.M. and can also be hit by a tsunami (DSDI, p.23). The structural instability, overcrowding, precarious construction/maintenance of housing amplify the seismic threat in Lima as it is estimated that around 20,000 houses would collapse and the debris and narrow streets would difficult the rescue efforts (DSDI, p.24). For instance, the census data in Cercado de Lima district, a very high seismic threat area, registers about 500,000 residents and 10,000 vendors that mobilize daily 2 million people during 6.5 hours. In addition these areas register high levels of poverty, unemployment and violence. In case of earthquakes, the L1ML has performed the identification and marking of direct evacuation routes as well as safe areas inside and outside of offices, passenger stations, and switching yard. Evacuation routes will be free of objects and / or machinery that slow and / or hinder the early departure of staff. Simulacrum will be held biannually the occurrence of these events . To this effect shall convene the National Police and the Fire General Body found within the Project Influence Area. The elements hanging from the ceilings in the facilities of passenger stations, camp, switching yard, such as fluorescent lighting bulbs have been secured firmly (SWEMP, p.145). *Source:* Plan de Manejo Socio Ambiental del Sistema Eléctrico de Transporte Masivo de Lima y Callao, Linea1 (PMSA) Diagnóstico Social de los Distritos de Influencia (DSDI) Residuos Sólidos Plan de Manejo Ambiental (SWEMP)	
CR2.5 Manage Heat Island Effects	**0**	**No Score** There is no consideration for heat islands effects management in the L1ML project. Heat island effects are created when many hard surfaces, such as rooftops and pavements absorb a large percentage of the incident solar radiation, heating surfaces and the surrounding air altering the microclimate around them. This effect can lead to increased energy consumption for additional cooling and its cumulative impact can contribute to larger climate related effects. Heat islands effects in the L1ML can be managed by minimizing surfaces with a high solar reflectance index (SRI) to reduce localized heat accumulation and manage microclimates. *Source:* Resumen Ejecutivo (RE) Conclusiones y Recomendaciones (CR) Estudio de Impacto Ambiental Semi Detallado del Sistema Eléctrico de Transporte Masivo de Lima y Callao. Línea 1, Tramo 2: Grau – San Juan de Lurigancho (EIA)	Documentation stating that the project meets heat islands requirements through shading or minimum SRI requirements for the designated percentage of hardscapes can help achieve a better score. Drawings showing all non-roof non-vegetated areas of the site and surfacing material and calculations demonstrating at least 40%, 70%, or 90% of the hardscape project meets the requirements can help in achieving higher levels.
CR0.0 Innovate Or Exceed Credit Requirements	**0**	*N/A*	
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OVERALL:	**374**	**LIMA METRO LINE 1, PERU**

APPENDIX D: SOURCES

DOCUMENTACION ENTREGADA. (ESPAÑOL)
Información general
Línea 1 Metro de Lima, Misión de la empresa
Línea 1 Metro de Lima, Visión de la Empresa
Línea 1 Metro de Lima, Objetivos corporativos
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Línea 1 Metro de Lima, Plan de Recuperación de Espacios
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Línea 1 Metro de Lima, Proyecto Recuperación Puente 4 y Alrededores
Línea 1 Metro de Lima, Informe Muralización Basta de Bullying
Asociación Cultural Ángeles D1, Informe Proyecto de Responsabilidad Social Asociación Civil Danza Perú y Línea 1 Metro de Lima, 2013
Línea 1 Metro de Lima, Informe de Charlas de Aprendizaje
Línea 1 Metro de Lima, Línea Base de Intervención Social, Educativo y Cultural: Crecer y Compartir con Nuestras Juntas Vecinales
Ipsos Public Affairs, Presentación Reputación Corporativa de Línea 1 del Metro de Lima, 2013
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Línea 1 Metro de Lima, Video Clientes
Línea 1 Metro de Lima, Política de Contratación y Empleo
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Línea 1 Metro de Lima, Visita Presidencial al Tren y Gamarra: Línea 1 como Impulsor del Desarrollo Comercial en Gamarra
Línea 1 Metro de Lima, Diagrama Cultura Metro
Línea 1 Metro de Lima, Informe Mejora Urbana Muralización Tacora: Galería Urbana Tacora
Línea 1 Metro de Lima, Informe del Taller y Jornada Muralista
Línea 1 Metro de Lima, Proyecto mi Huerta
Línea 1 Metro de Lima, Proyecto AlegrARTE Cerro Pumacahua
Línea 1 Metro de Lima, Proyecto Concurso de Buenas Prácticas de Gestión Vecinal
Línea 1 Metro de Lima, Informe Arte Vecinal Compiladas
Línea 1 Metro de Lima, Proyecto Cultura Ciudadana a Rutas Alimentadoras: Educación a Choferes y Clientes de Nuevas Rutas de Transporte
Línea 1 Metro de Lima, Plan de Conservación para el Año 2013, 2013
Línea 1 Metro de Lima and Beatriz Calixto da Costa, Plan de Manejo Socio Ambiental del Sistema Electrico de Transporte Masivo de Lima y Callao Linea 1, Tramo 1: Villa El Salvador – Grau, 2012.
Línea 1 Metro de Lima and Rafael Soto Maúrtua, Proyecto de Tesis Arborización: Plan de Arborización Urbana para el Viaducto y Patio Taller de la Línea 1 Metro de Lima, 2013.
Línea 1 Metro de Lima, Informe Recuperación de Espacios Micaela Bastidas
Línea 1 Metro de Lima, Impacto de Actividades de Cultura Metro en Comunidad
Línea 1 Metro de Lima, Video Muralización
Línea 1 Metro de Lima, Impacto Comunidad Convenio Angeles D1
Línea 1 Metro de Lima, Video 2do Aniversario
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Línea 1 Metro de Lima, Relación de Convenios Institucionales
Línea 1 Metro de Lima, Registro de Organizaciones Vecinales
Línea 1 Metro de Lima, Cooperación Institucional: Campañas y Actividades con Ministerios
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Línea 1 Metro de Lima, Impacto Graffiti
Línea 1 Metro de Lima, Informe de Alameda Cultural
MTC and Consorcio Tren Eléctrico, Memoria Descriptiva de las Obras Provisionales en el Lecho del Rio Rimac, 2013
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Línea 1 Metro de Lima, Semaforizacion y Accesibilidad
Línea 1 Metro de Lima, Noticia Metropolitano y Gamarra
Línea 1 Metro de Lima, Accesibilidad Peatonal
Línea 1 Metro de Lima, Cruzando la Vía de Evitamiento: Plataforma de Seguridad, 2013
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Línea 1 Metro de Lima, Proyecto Mejora de Consumo de Energía con LED: Iluminación de Zona de Boleterias y su Mejoramiento con LEDs
Línea 1 Metro de Lima, Redes de Accesibilidad Peatonal
Línea 1 Metro de Lima, Estacionamiento de Bicicletas en Estaciones
Línea 1 Metro de Lima, Plan Arborizacion Urbana: Avances
Línea 1 Metro de Lima, Informe Socio Ambiental (Enero – Marzo 2013), 2013.
Línea 1 Metro de Lima, Plan de Manejo de Residuos Solidos: Año 2013 - Línea 1 del Metro de Lima, Tramo 1, 2012
Línea 1 Metro de Lima and Vanessa Prado Orellana, Planta de Tratamiento de Aguas residuales con Fines de Riego
Línea 1 Metro de Lima, Proporción de Consumo de Energía
Línea 1 Metro de Lima, Definición Junta Vecinal
Línea 1 Metro de Lima, Programa de Investigación en Ingeniería
Rafael Soto Maúrtua, Plan de Arborización Urbana para el Viaducto y Patio Taller de la Línea 1 Metro de Lima: Alcances
Línea 1 Metro de Lima, Destino del Mes

Línea 1 Metro de Lima, Destino del Mes: Plesbitero
Línea 1 Metro de Lima, Destino del Mes - Las Lomas
Línea 1 Metro de Lima, Destino del Mes - Parque Huascar
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