Document of
The World Bank

FOR OFFICIAL USE ONLY

Report No.: PAD1281

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN

IN THE AMOUNT OF US$102.5 MILLION

TO THE

EMPRESA MUNICIPAL DE AGUA POTABLE Y ALCANTARILLADO DE GUAYAQUIL, EP EMAPAG EP

WITH THE GUARANTEE OF THE REPUBLIC OF ECUADOR

FOR A

GUAYAQUIL WASTEWATER MANAGEMENT PROJECT

April 1, 2015

Water Global Practice
Latin America and Caribbean

CURRENCY EQUIVALENTS
Currency Unit = US$

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

BA	Beneficiary Assessment
BOD	Biochemical Oxygen Demand
CEPT	Chemically Enhanced Primary Treatment
CGE	Contraloría General del Estado (*Comptroller General Office*)
DA	Designated Account
DAF	Dissolved Air Flotation
ECAPAG	Empresa Cantonal de Agua Potable y Alcantarillado de Guayaquil *(Local Drinking Water and Sanitary Sewerage Utility of Guayaquil)*
EIB	European Investment Bank
EMAPAG EP	Empresa Municipal de Agua Potable y Alcantarillado de Guayaquil (*Municipal Drinking Water and Sanitary Sewerage Utility of Guayaquil)*
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FM	Financial Management
GDP	Gross Domestic Product
GoE	Government of Ecuador
GRM	Grievance Redress Mechanism
GRS	Grievance Redress Service
HOI	Human Opportunity Index
IBRD	International Bank for Reconstruction and Development
ICB	International Competitive Bidding
IDB	Inter-American Development Bank
IE	Impact Evaluation
IFI	International Financing Institution
IFR	Interim Financial Report
IS	Implementation Support
LA	Loan Agreement
MAE	Ministerio de Ambiente del Ecuador *(Ministry of Environment)*
MDP	Municipal Development Plan
MIDUVI	Ministerio de Desarrollo Urbano y Vivienda del Ecuador (*Ministry of Housing and Urban Development*)
MoF	Ministerio de Finanzas del Ecuador (*Ministry of Finance)*
NCADE	National Norm on Environmental Quality and Effluent Discharges
NCB	National Competitive Bidding
NDP	National Development Plan
NPV	Net Present Value
OM	Operational Manual

O&M	Operation and Maintenance
PDO	Project Development Objective
PIU	Project Implementation Unit
RAP	Remedial Resettlement Action Plan
SBD	Standard Bidding Document
SENAGUA	Secretaría del Agua (*National Water Secretariat*)
SENPLADES	Secretaría Nacional de Planificación (*National Planning Secretariat*)
SOE	Statement of Expenditure
ToR	Terms of Reference
TSS	Total Suspended Solids
UDAF	Unidad de Administración Financiera de EMAPAG EP (*EMAPAG EP's Finance Directorate*)
VAT	Value Added Tax
WSS	Water Supply and Sanitation
WSP	Water and Sanitation Program
WWTP	Wastewater Treatment Plant

Regional Vice President:	Jorge Familiar
Country Director:	Alberto Rodríguez
Senior Global Practice Director:	Junaid Kamal Ahmad
Practice Manager:	Wambui G. Gichuri
Task Team Leaders:	Patricia Lopez and Oscar Alvarado

ECUADOR
GUAYAQUIL WASTEWATER MANAGEMENT PROJECT

TABLE OF CONTENTS

Page

I. **STRATEGIC CONTEXT 1**
A. Country Context 1
B. Sectoral and Institutional Context 1
C. Higher-Level Objectives to which the Project Contributes 4

II. **PROJECT DEVELOPMENT OBJECTIVES 5**
A. PDO 5
B. Project Beneficiaries 5
C. PDO Level Results Indicators 5

III. **PROJECT DESCRIPTION 6**
A. Project Components 6
B. Project Financing 7

IV. **IMPLEMENTATION 8**
A. Institutional and Implementation Arrangements 8
B. Results Monitoring and Evaluation 8
C. Sustainability 9

V. **KEY RISKS 9**
A. Overall Risk Rating and Explanation of Key Risks 9

VI. **APPRAISAL SUMMARY 11**
A. Economic and Financial Analysis 11
B. Technical 12
C. Financial Management 13
D. Procurement 13
E. Social (including Safeguards) 14
F. Environment (including Safeguards) 15
G. Grievance Redress 16

Annex 1: Results Framework and Monitoring 17

Annex 2: Detailed Project Description **22**

Appendix 1 to Annex 2: Study of Alternatives and Choice of Technology for the Las Esclusas WWTP **28**

Annex 3: Implementation Arrangements **33**

Annex 4: Implementation Support Plan **49**

Annex 5: Financial Analysis of the Borrower and WSS Services Operator **53**

Annex 6: Economic and Financial Analysis **56**

PAD DATA SHEET

Ecuador

Guayaquil Wastewater Management Project (P151439)

PROJECT APPRAISAL DOCUMENT

LATIN AMERICA AND CARIBBEAN

Water Global Practice

Report No.: PAD1281

Basic Information			
Project ID P151439	EA Category A - Full Assessment		Team Leader(s) Patricia Lopez Martinez / Oscar Alvarado
Lending Instrument Investment Project Financing	Fragile and/or Capacity Constraints [ ]		
	Financial Intermediaries [ ]		
	Series of Projects [ ]		
Project Implementation Start Date 22-Apr-2015	Project Implementation End Date 15-Sep-2019		
Expected Effectiveness Date 15-Sep-2015	Expected Closing Date 31-Dec-2019		
Joint IFC No			
Practice Manager/Manager Wambui G. Gichuri	Senior Global Practice Director Junaid Kamal Ahmad	Country Director Alberto Rodriguez	Regional Vice President Jorge Familiar

Borrower: EMAPAG EP					
Responsible Agency: EMAPAG EP					
Contact:	Jose Luis Santos		Title:	Gerente General EMAPAG EP	
Telephone No.:	593-42681315230		Email:	jsantos@emapag-ep.gob.ec	

Project Financing Data(in USD Million)					
[X] Loan	[ ] IDA Grant	[ ] Guarantee			
[ ] Credit	[ ] Grant	[ ] Other			
Total Project Cost:	247.80		Total Bank Financing:	102.50	
Financing Gap:	0.00				

Financing Source	Amount
Borrower	42.80
International Bank for Reconstruction and Development	102.50
EC European Investment Bank	102.50
Total	247.80

Expected Disbursements (in USD Million)

Fiscal Year	2016	2017	2018	2019	2020
Annual	10.93	42.75	32.25	12.56	4.01
Cumulative	10.93	53.68	85.93	98.49	102.50

Institutional Data

Practice Area (Lead)

Water

Contributing Practice Areas

Cross Cutting Topics

[ ] Climate Change
[ ] Fragile, Conflict & Violence
[ ] Gender
[ ] Jobs
[X] Public Private Partnership

Sectors / Climate Change

Sector (Maximum 5 and total % must equal 100)

Major Sector	Sector	%	Adaptation Co-benefits %	Mitigation Co-benefits %
Water, sanitation and flood protection	Wastewater Treatment and Disposal	70		
Water, sanitation and flood protection	Wastewater Collection and Transportation	30		
Total		100		

☑ I certify that there is no Adaptation and Mitigation Climate Change Co-benefits information applicable to this project.

Themes

Theme (Maximum 5 and total % must equal 100)

Major theme	Theme	%
Environment and natural resources management	Pollution management and environmental health	50
Urban development	City-wide Infrastructure and Service Delivery	50
Total		100

Proposed Development Objective(s)

The Project Development Objective (PDO) is to increase access to improved sanitation services and to reduce wastewater pollution in selected areas of the City of Guayaquil.

Components

Component Name	**Cost (USD Millions)**
Component 1: Installation of Household Connections	18.00
Component 2: Rehabilitation of Sewerage Network	37.00
Component 3: Wastewater Treatment and Disposal Facilities	161.00
Component 4: Project Management and Administration, including Communication Plan and Management of Social, Environmental and Safety Issues	5.40

Systematic Operations Risk- Rating Tool (SORT)

Risk Category	**Rating**
1. Political and Governance	Substantial
2. Macroeconomic	Substantial
3. Sector Strategies and Policies	Substantial
4. Technical Design of Project or Program	Moderate
5. Institutional Capacity for Implementation and Sustainability	Moderate
6. Fiduciary	Substantial
7. Environment and Social	Substantial
8. Stakeholders	Moderate
9. Other	
OVERALL	Substantial

Compliance

Policy

Does the project depart from the CAS in content or in other significant respects?	Yes [ ] No [X]

Does the project require any waivers of Bank policies?	Yes [ ]	No [X]
Have these been approved by Bank management?	Yes [ ]	No [ ]
Is approval for any policy waiver sought from the Board?	Yes [ ]	No [X]
Does the project meet the Regional criteria for readiness for implementation?	Yes [X]	No [ ]

Safeguard Policies Triggered by the Project	**Yes**	**No**
Environmental Assessment OP/BP 4.01	**X**	
Natural Habitats OP/BP 4.04	**X**	
Forests OP/BP 4.36		**X**
Pest Management OP 4.09		**X**
Physical Cultural Resources OP/BP 4.11	**X**	
Indigenous Peoples OP/BP 4.10		**X**
Involuntary Resettlement OP/BP 4.12	**X**	
Safety of Dams OP/BP 4.37		**X**
Projects on International Waterways OP/BP 7.50		**X**
Projects in Disputed Areas OP/BP 7.60		**X**

Legal Covenants

Name	**Recurrent**	**Due Date**	**Frequency**
Loan Agreement Schedule 2, Section I.A.4.		31-Dec-2017	

Description of Covenant

The Borrower, not later than December 31, 2017, shall enter into an agreement with Interagua (the Transfer Agreement) for the purposes of transferring to Interagua, for its operation and maintenance, the new facilities and sewer mains to be constructed under the Project.

Name	**Recurrent**	**Due Date**	**Frequency**
Loan Agreement, Schedule 2, Section I. C. 4.		31-Dec-2017	

Description of Covenant

The Borrower, not later than December 31, 2017, will prepare, in a manner acceptable to the Bank, a master plan for the future management and final disposal/reuse of biosolids generated by the new wastewater treatment plant “Las Esclusas” to be constructed under Part 3(a) (i) of the Project.

Name	**Recurrent**	**Due Date**	**Frequency**
Loan Agreement, Schedule 2, Section I. A. 3.		30-Sep-2017	

Description of Covenant

The Borrower shall on a date to be agreed with the Bank, but in no case later than twenty-four (24) months after the Effectiveness Date, carry out a review with the Bank on the overall progress and implementation arrangements in the execution of the Project and set out the measures and take any remedial action as a result of such review, as agreed with the Bank.

Conditions

Source Of Fund	Name	Type
IBRD		Disbursement

Description of Condition

Loan Agreement, Schedule 2, Section IV. B. 1. (b)

Notwithstanding the provisions of Part A of Section IV of the Loan Agreement, no withdrawal shall be made: (b) for payments made prior to the date of the Loan Agreement, except that withdrawals up to an aggregate amount not to exceed $20,500,000 equivalent may be made for payments made prior to this date but on or after January 5, 2015, for Eligible Expenditures under Categories (1), (2), and (4);

Source Of Fund	Name	Type
IBRD		Disbursement

Description of Condition

Loan Agreement, Schedule 2, Section IV. B. 1. (c)

Notwithstanding the provisions of Part A of Section IV of the Loan Agreement, no withdrawal shall be made: (c) for payments under Categories (3) (a) and (3) (b) unless the Co-financing Agreement has been executed and delivered and all conditions precedent to its effectiveness or to the right of the Borrower to make withdrawals under it have been fulfilled.

Team Composition

Bank Staff

Name	Role	Title	Unit
Patricia Lopez Martinez	Team Leader	Senior Infrastructure Finance Specialist	GWADR
Jose Yukio Rasmussen Kuroiwa	Procurement Specialist	Senior Procurement Specialist	GGODR
Ana Lucia Jimenez Nieto	Financial Management Specialist	Financial Management Specialist	GGODR
Barbara Paola Cedillo Lopez	Team Member	Temporary	GWADR
Carlos Vargas Bejarano	Safeguards Specialist	E T Consultant	GENDR
Mariana Margarita Montiel	Counsel	Senior Counsel	LEGLE
Martin Henry Lenihan	Safeguards Specialist	Senior Social Development Specialist	GSURR

Oscar E. Alvarado	Co team Leader	Senior Water & Sanitation Spec.	GWADR
Robert H. Montgomery	Safeguards Specialist	Lead Environment Specialist	GENDR
Zael Sanz Uriarte	Team Member	Water & Sanitation Specialist	GWASL

Extended Team

Name	Title	Office Phone	Location
Luz Maria Gonzalez	Economist and Financial specialist		Ohio

Locations

Country	First Administrative Division	Location	Planned	Actual	Comments

Consultants (Will be disclosed in the Monthly Operational Summary)

Consulting services to be determined

I. STRATEGIC CONTEXT

A. Country Context

1. **During the last decade, Ecuador has seen a period of political stability and growth combined with falling inequality, which has led to important gains in reducing poverty and promoting shared prosperity.** During the period 2003–2013, gross domestic product (GDP) per capita growth[1] in Ecuador was above regional average levels (2.7 percent versus 2.5 percent) with progress in reducing inequality exceeding regional trends. Growth has leveled in the last years but remained strong at 3.4 percent year-on-year in the third quarter of 2014 and is above the projected regional average of 0.8 percent for 2014.[2] Income distribution has significantly improved, as expressed by the Gini coefficient, declining from 0.54 in December 2006 to 0.47 in December 2014. Between 2006 and 2014, income poverty at the national poverty line fell from 37.6 percent to 22.5 percent, while extreme poverty fell from 16.9 percent to 7.7 percent. Notwithstanding these significant strides in poverty reduction and growth of the middle class, more than half of Ecuador's 15.7 million inhabitants remain poor or vulnerable to falling back into poverty.

2. **Guayaquil accounts for about 18.2 percent[3] of Ecuador's GDP, but poverty levels are high compared to other main Ecuadoran cities.** Poverty (measured by income) in Guayaquil was 12.7 percent in December 2014, the highest among five of the largest Ecuadoran cities by population: Machala (11.9 percent), Ambato (7.3 percent), Quito (7.5 percent), and Cuenca (7.8 percent). More poor people live in Guayaquil than in any other urban area in Ecuador because Guayaquil is the biggest city in the country with 2.35 million people (of which almost 300,000 are living below the national poverty line).[4]

3. **During the last six years, the Government of Ecuador (GoE) has invested heavily in the infrastructure and social sectors in an effort to stimulate growth, reduce inequality, and promote inclusion.** As Ecuador's urban areas continue to expand, with urbanization levels reaching 65 percent in 2010,[5] increased resources and attention are needed for housing, infrastructure, and urban services, particularly in the two major cities of Quito and Guayaquil. The GoE has placed increasing access to improved water supply and sanitation (WSS) services at the core of its Poverty Eradication Strategy and its National Development Plan (NDP), the '*Plan Nacional para el Buen Vivir 2013-2017*'.

B. Sectoral and Institutional Context

4. **Although access to water and improved sanitation services in Ecuador has experienced great progress over the last decade, the level and quality of service provided remains low in comparison with the regional average.** In 2010, the share of Ecuadoran

[1] *Source:* World Development Indicators. The World Bank.
[2] Global Economic Prospects. The World Bank, January 2015.
[3] *Banco Central del Ecuador*. 2011.
[4] Defined as the percentage of the population living on or less than US$2.7 a day.
[5] *Source:* 2010 Census *Instituto Nacional de Estadística Ecuatoriano* (INEC).

households connected to a public drinking water distribution network was 72 percent in urban areas and 27 percent in rural areas,[6] while the average in the Latin American and Caribbean region was 94 percent and 62 percent, respectively. Coverage of sewer systems (54 percent in total, 71 percent in cities, and 23 percent in rural communities) and wastewater treatment (24 percent in urban areas)[7] are also low. The overall quality of service varies significantly across cities and regions. With a few exceptions (Quito, Cuenca, Ibarra, Guayaquil), the service generally requires significant improvements in terms of continuity, efficiency, resilience, and sustainability. It is estimated that the economic cost of inadequate WSS services in Ecuador is US$97 million per year.[8]

5. **The recently created National Secretariat for Water (*Secretaría del Agua* [SENAGUA])[9] heads the water and sanitation sector's institutional framework** at the national level, with responsibility for developing and applying policies, standards, norms, and regulations for water resources in general and for the provision of WSS services in particular. Municipal governments are responsible for the provision of WSS services within their area of jurisdiction, either directly or through delegation to a public company or community-based organizations.

6. **Guayaquil's Municipal Development Plan (MDP)[10] identifies access to affordable, improved wastewater management services as a key element of its social inclusion and urban regeneration policies.** The MDP, in alignment with the *Plan Nacional para el Buen Vivir* 2013-2017 (NDP), has the following as part of its development objectives: (a) the reduction of inequalities in terms of access to affordable and quality basic services, and (b) the regeneration of degraded urban areas and environmental assets as a driver for economic growth, social inclusion, and competitiveness improvement. In this regard, the MDP establishes the goal of reaching universal access to sewerage wastewater collection and identifies the regeneration of the Estero Salado and riparian neighborhoods as a key development objective.

7. **In the City of Guayaquil, WSS services are provided through a public-private partnership (PPP) arrangement with a private operator.** Since 2001, a 30-year concession contract was awarded to a private consortium, Interagua,[11] for the provision of WSS services within the city. ECAPAG EP was later transformed into a regulatory agency, today called *Empresa Municipal de Agua Potable y Alcantarillado de Guayaquil* (EMAPAG EP), which is in charge of supervising and controlling Interagua's performance, among other functions. **During the last thirteen years, access to water and sanitation and the quality of services has significantly improved in the City of Guayaquil.** According to the audits performed by the

[6] *Instituto Nacional de Estadísticas y Censos*; 2010 census data.
[7] Water and Sanitation Program. 2007. *Saneamiento para el Desarrollo: ¿Cómo estamos en 21 países de América Latina y el Caribe?* LATINOSAN 2007.
[8] SENPLADES.
[9] The responsibility over WSS services was recently transferred to SENAGUA from the Ministry of Housing and Urban Development (MIDUVI).
[10] '*Plan de Desarrollo del Cantón de Guayaquil*', promulgated on January 2, 2012.
[11] Interagua is an international consortium integrated by Proactiva Medioambiente (today a 100 percent subsidiary of Veolia, a French multinational); Hidalgo & Hidalgo and Equivía (two Ecuadoran firms); and Fanalca (a Colombian company).

National Audit Office between 2001 and 2009:[12] (a) water supply distribution network coverage has increased from 30 to 95 percent; (b) the sewerage network coverage has reached 80 percent city-wide; (c) unaccounted water was reduced by 14 percent; and (d) staff-to-connection ratio decreased from 6/1,000 to 3/1,000. During these years, billing and delinquency rates also improved significantly (delinquency decreased from 50 percent in 2001 to 10 percent in 2006), contributing, together with the enlargement of the client base and improvements in productivity, to enhancing the financial sustainability of the services. Nonetheless, two important challenges regarding sanitation services remain: (a) just 20 percent of the wastewater generated is currently being adequately treated and (b) effective access (actual connections to the sewerage network) is about 85 percent of potential service coverage under the current network extension.

8. **To meet the ambitious environmental and access to basic services goals set by the MDP and the NDP, EMAPAG EP and Interagua have designed a comprehensive wastewater management investment program to be implemented within this decade.** In 2010, EMAPAG EP commissioned a feasibility study for the treatment of 100 percent of the wastewater of the city of Guayaquil,[13] which concluded with the preparation of the detailed engineering design of the wastewater treatment plants (WWTPs) of Las Esclusas (covering the southern districts, with around 1.2 million inhabitants) and Los Merinos (covering the northern districts with 1.3 million inhabitants).

9. **Although the City of Guayaquil is allocating substantial resources to the WSS sector, it needs to significantly increase its investment pace to implement sustainable wastewater management services in the City.** The costs of improving urban sanitation to attain universal sewerage and wastewater treatment coverage are estimated to be US$541 million until 2020. Interagua's annual investment commitments are, on average, US$21.5 million (both for water and sanitation services), and EMAPAG EP currently complements this investment effort with an average annual investment flow of US$30 million financed by the municipality.

10. **Project design and the role of the Bank.** Based on its experience in other parts of Latin America and globally, the Bank has promoted and facilitated the incorporation of a holistic approach to wastewater management, particularly in the following areas:

(a) **Broadening the initial scope of the Project** from a sheer wastewater treatment infrastructure financing to include a component focusing on sewerage network rehabilitation and coverage extension to the poor.

(b) **Building on the existing methodology in Guayaquil for social intervention and the promotion of public awareness on sanitation**, which is considered best practice, and providing tools for this knowledge to be shared with other utilities at the regional and global levels. The Project will also explore possibilities to enhance social equity

[12] Contraloría General del Estado. 2009. "*Informe general a la concesión de los servicios de agua potable, alcantarillado y saneamiento del Cantón de Guayaquil, otorgada por la Empresa Cantonal de Agua Potable y Alcantarillado de Guayaquil, ECAPAG, a favor de Interagua. (DIAPA-0037-2009).*"

[13] Feasibility Study for the Wastewater Treatment of the City of Guayaquil, Hansen & Sawyer.

and poverty reduction outcomes by providing financing for a pilot which will involve the community in the installation of household connections.[14]

(c) **Including the development of knowledge tools and instruments to monitor water quality** in the city's water bodies, which is expected to enhance and promote environmental benefits and increase accountability for pollution and increased environmental awareness.

(d) **Developing an integrated urban water management approach** for the planning of urban development in growing areas of the city which are currently less consolidated and require interventions in urban drainage and wastewater management.

11. Finally, the Bank is supporting SENAGUA, the single water authority in the country, with the formulation of a national strategy for water and sanitation which includes the calculation of investment needs and the development of specific strategies for developing rural and urban water, sanitation, and wastewater management nationwide.

C. Higher-Level Objectives to which the Project Contributes

12. **The proposed Project is fully consistent with the World Bank's Interim Strategy Note for Ecuador for the period 2014–2015[15]**, discussed at the World Bank Board on April 9, 2013, which identified access to basic services at the subnational levels as a key priority to contribute to the country's goal for inclusive and sustainable growth.[16] The Project is also consistent with the country's NDP, where two out of its twelve key objectives outline access to WSS as key intermediate priorities to ensure quality of life and social cohesion for its citizens.

13. **The Project will contribute to supporting the achievement of the MDP and the NDP targets by extending access and actual connections to sewerage services to at least 120,000 people** and benefiting around one million people with wastewater treatment services. T. Furthermore, the positive environmental externalities of improvements in sanitation practices are high as they make cities more clean and competitive and create a healthy environment for the population. The Project will make a **significant contribution to Guayaquil's municipal compliance with Ecuadoran environmental regulations** related to the quality of the effluent discharged to and the water quality in superficial water bodies.[17] In this respect, the Project will contribute to: (a) **the ecological recuperation and conservation of the city's water bodies**, specifically the Guayas River and the Estero Salado estuary, by reducing current discharges and infiltration of untreated domestic wastewater; (b) potential **health and hygiene improvements** stemming from increased access to a safe sanitation solution and education in hygiene practices;

[14] This pilot will include technical assistance for training and legal advice for the setting up of neighborhood-level cooperatives as legal entities with capacity to enter into a contractual agreement with EMAPAG EP for the installation of household connections. This arrangement will be based on successful experiences in other regional cities like Medellin.

[15] Report No. 65114-EC

[16] The ISN focuses on providing investment project financing in three strategic areas. The proposed project is consistent with the first two, namely, Sustainable and Inclusive Growth and Access to Social Protection and Quality Services for All.

[17] This compliance was a requirement from the National Audit Office to allow the ongoing concession with Interagua for the provision of the WSS to continue operating, following the 2008 Constitution which forbid private sector participation in the provision of the WSS services.

and (c) **poverty reduction and increased shared prosperity**, as the Project will have a positive impact on living conditions of poor households who are not connecting to the sewer system due to financial constraints. The Project is also likely to generate employment opportunities during the construction phase, which would benefit the local economy.

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

14. The Project Development Objective (PDO) is to increase access to improved sanitation services[18] and to reduce wastewater pollution in selected areas of the city of Guayaquil.

B. Project Beneficiaries

15. The proposed Project will benefit over one million residents in the southern districts of Guayaquil and, in particular, the residents of Suburbio Oeste, Isla Trinitaria, Sector Guasmo and Casco Central, riparian districts of the Estero Salado where sewer mains will be rehabilitated and new household connections will be installed and where poor households (the vast majority in the area)[19] will enjoy eased conditions to get connected to the sewer network. The Project is expected to increase access to wastewater collection services for at least 120,000 people. The percentage of people below the poverty threshold in the Project's intervention area for Component 1 (household connections) is above 20 percent.[20] An important ecological improvement will take place in the Guayas River, which will receive less pollution as the wastewater will be treated before its discharge into the river, and in the Estero Salado, which will also receive fewer pollutants due to infiltration, thanks to the network rehabilitation and new household connections.

C. PDO Level Results Indicators

16. The PDO level results indicators and target values are as follows:

(a) At least 120,000 people in urban areas provided with access to improved sanitation services under the Project, of whom 20 percent are poor.
(b) At least 8,000 tons of Biochemical Oxygen Demand (BOD) pollution loads removed annually by the Las Esclusas WWTP supported under the Project once the WWTP is in operation and as measured at the outlet of the WWTP.

[18] For the purposes of the proposed Project, improved sanitation means a household connection to the sewerage network whereby wastewater receives proper treatment in compliance with environmental regulation before discharge.
[19] According to the 'Social Information System' of the municipal government of Guayaquil, in 2006, the Trinitaria and Suburbio Oeste districts were among the 30 districts of the city with the highest percentage of population living in extreme poverty (between 18 and 32 percent of the population) and among the seven districts with the highest percentage of population living below the poverty line (between 55 and 70 percent of the population).
[20] Project Beneficiary Assessment undertaken by EMAPAG EP.

(c) Operating ratio for Interagua to be kept in a range below 0.90 during the life of the Project (indicating that all operating costs are covered by revenues from tariffs and an operating margin of at least 10 percent is achieved).[21]

(d) Total Project beneficiaries of over one million, of which around 50 percent are female beneficiaries.

III. PROJECT DESCRIPTION

A. Project Components

17. **The proposed Project will achieve the above-mentioned objectives through the implementation of four components.** The pre-investment cost, including the preparation and development of feasibility studies, environmental impact assessment, and final designs,[22] as well as acquisition of the land required for the construction of the new WWTP is being financed by the Municipality of Guayaquil through EMAPAG EP for a total amount of US$6.5 million.

18. **Component 1: Installation of household connections (US$18 million, of which US$2.8 million IBRD).** This component will provide support for the increasing of effective access to sewerage collection services within Selected Areas of the City of Guayaquil, through the installation and rehabilitation of household connections. Part of the household connections cost including the cost of required indoor works like piping, flooring, and others—will be partially subsidized and financed by EMAPAG EP (clients will pay EMAPAG EP the non-subsidized segment in installments through the water bill).

19. **Component 2: Rehabilitation of sewerage network (US$37 million, 100 percent IBRD).** This component will finance the rehabilitation of the sewerage network (including sections of the primary, secondary and tertiary network) in La Chala basin (Suburbio Oeste area), which is riparian to the Estero Salado estuary. This component of the Project aims at reducing infiltrations in the south sewerage subsystem, thus contributing to the reduction of contamination of the Estero Salado estuary from domestic wastewater.

20. **Component 3: Wastewater treatment and disposal facilities (US$161 million, of which US$58.5 million IBRD).** The objective of this component is to treat 100 percent of the domestic wastewater of the southern districts of the City of Guayaquil within the design year of 2045, in order to meet current environmental standards for discharges into the Guayas River. This component will finance the construction of: (i) a new wastewater treatment plant, called "Las Esclusas", to manage an average flow in dry and wet weather of 2.7 l/s and 3.5l/s, respectively; (ii) the associated pumping and transmission facilities at Guasmo-H pumping station; (iii) pumping and transmission facilities at La Pradera pre-treatment station, and (iv) the construction of a sludge digester; and (v) the specialized independent supervision of the construction of the facilities described above.

[21] Achievement of this target value would be guaranteed by each five-year agreement between EMAPAG EP and Interagua.

[22] The studies completed to date are available in the Project files.

21. **Component 4: Project management and administration, including communication plan and management of social, environmental, and safety issues (US$5.4 million of which US$4.2 million IBRD).** This component will provide support for: (i) activities associated with overall Project management by the Borrower, including those pertaining to the management of social, environmental and safety matters under the Project; (ii) Project-related audits; (iii) monitoring and evaluation activities; (iv) necessary equipment; (v) minor works required for the refurbishment of the PIU's office; (vi) technical assistance; and (vii) training. Specifically, this component will fund (a) studies to set up systems for the monitoring of the Guayas River and of the Estero Salado water quality;23 master plan for the management and final disposal or reuse of the bio solids to be produced at the Las Esclusas WWTP and other planned WWTPs; (c) communication campaigns and technical assistance for community development and training; (d) a Project IE; and (e) an integrated urban water management study for the planning and development of infrastructure in a growing flood-prone area of the city of Guayaquil (Sistema Tres) which requires interventions in urban drainage and wastewater management.

B. Project Financing

22. The lending instrument is an Investment Project Financing for 5 years, with a total Project cost of US$ 247.80 million and total Bank Financing in the amount of US$102.5 million.

23. The Project will be co-financed by EMAPAG EP (17 percent), the IBRD (41.5 percent), and the European Investment Bank (EIB) (41.5 percent). The specific contracts to be financed by each of the banks have been agreed upon with EMAPAG EP. The agreement is that there will be co-financing from both banks in only one of the Project-financed contracts, under Component 3. This is the contract for the construction of the Las Esclusas WWTP and the Guasmo H transportation pipeline and pumping station, to be co-financed on a *paripasu* of 52 percent from the IBRD loan and 48 percent from the EIB loan. With regard to this contract, the EIB has agreed to: (a) using Bank Procurement Guidelines for the procurement process; (b) following the procedures agreed with EMAPAG EP for the bidding documents review and no objection; and (c) applying the same financial management (FM), reporting, and auditing requirements as set forth in the Project Operational Manual (OM).

Project Cost and Financing (US$ million)

Project Components	Project Cost	EMAPAG EP Financing	EIB Financing	IBRD Financing	% IBRD Financing
Component 1: Installation of household connections	18	15.20	0	2.80	16
Component 2: Rehabilitation of primary sewerage network	37	0	0	37	100
Component 3: Wastewater treatment and disposal facilities	161	0	102.50	58.50	36

[23] The scope of this study is to be defined during project preparation and the objective is to enable monitoring of the Guayas River water quality at different points, which in turn will enable measuring of the benefits of the Las Esclusas WWTP and other future treatment plants on the water quality of the Guayas River.

Project Components	Project Cost	EMAPAG EP Financing	EIB Financing	IBRD Financing	% IBRD Financing
Component 4: Project management and administration, communication plan and management of social, environmental, and safety issues	5.40	1.20	0	4.20	78
Total	**221.40**	**16.40**	**102.50**	**102.50**	**46**
Value added tax (VAT) (12%)	26.40	26.40	0	0	0
Total Project Costs	**247.80**	**42.80**	**102.50**	**102.50**	**41.50**
Total Financing Required	**247.80**	**42.80**	**102.50**	**102.50**	**41.50**

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

24. **Borrower and Executing agency.** The Autonomous Decentralized Government of the Municipality of Guayaquil has delegated the financing, execution, and management of the Project to EMAPAG EP, a public municipal enterprise, 100 percent owned by the municipality. EMAPAG EP will be the Borrower of the proposed loan, with a sovereign guarantee from the GoE to be granted by the Ministry of Finance (MoF) and a solidarity guarantee from the Municipality of Guayaquil.

25. **Implementation arrangements.** A Project Implementation Unit (PIU) established under EMAPAG EP's General Manager will be responsible for day-to-day Project implementation and overall coordination, procurement, FM, as well as for management and supervision of the results framework, monitoring, and Project IE. The PIU will function with its own general coordinator and will be staffed with technical and fiduciary specialists as well as dedicated environmental and social safeguards staff, with support from EMAPAG EP (particularly from the Finance, Legal, and Social Directorates). Annex 3 describes the implementation arrangements in further detail.

26. **Operational arrangements.** Once constructed, the infrastructure financed under the Project will be operated by Interagua, the private operator under a 30-year concession with EMAPAG EP. A **specific transfer agreement between EMAPAG EP and Interagua** will be developed detailing the procedures for transferring the newly developed assets under the Project to Interagua.

B. Results Monitoring and Evaluation

27. **EMAPAG EP will prepare semiannual progress reports during Project implementation.** These reports will describe the progress made and current status of all components and activities and specifically, progress towards achievement of the PDO and other content specified in the Project OM. A Project IE, funded under Component 4, will aim to measure the impact of the proposed Project in terms of improving health and living conditions for the beneficiary population. Other monitoring tools will be designed during implementation to

capture project results with respect to improvements in the environmental and ecological conditions of the city's water bodies.

C. Sustainability

28. As per the concession contract signed between EMAPAG EP and Interagua, the latter will be responsible for the operation and maintenance (O&M) of all wastewater treatment facilities and sewer mains to be constructed within the concession period (until 2031). In order to ensure a smooth transfer process of the newly developed assets, Interagua will be participating in the supervision of the construction and the start-up tests for the commissioning and reception of the works.

29. **The provisions contained in the concession contract regarding revision of the tariff charged for water and sanitation services would ensure the financial sustainability of the service provision.** It has been agreed with EMAPAG EP, as part of the proposed Project, that the operating ratio for Interagua will be kept at all times below 0.90 during implementation of the Project.

V. KEY RISKS

A. Overall Risk Rating and Explanation of Key Risks

30. The overall implementation risk is considered to be Substantial, given the risks associated with sector strategies and policies and fiduciary, social, and environmental issues that may come up and cause implementation delays and risks to PDO achievement. The main issues and risks and corresponding mitigation measures are described below and in the Appraisal Summary section:

(a) **Sector strategies and policies risk.** This is rated Substantial, given a potential regulatory risk to EMAPAG EP and the Interagua concession contract, considering that the National Constitution of the State of Ecuador from 2008 limits the provision of WSS services to publicly owned companies or community-based organizations.[24] The concession passed in 2009 an audit (mandatory as per the Constitution for preexisting delegations of WSS services to private operators) and was allowed to continue. However, and while this risk has been mitigated, given that SENAGUA, the newly sector authority and policy maker has been recently established and requires significant institutional strengthening, the rating for this risk continues to be Substantial.

(b) **Fiduciary risks.** This risk has been rated Substantial considering that EMAPAG EP does not have direct experience in implementing externally financed projects, the fact that the Project involves the procurement of large complex works following international bidding processes, and other challenges described in the FM and procurement assessments included in the Appraisal section below. The proposed mitigation measures are included in the respective sections.

[24] Article 318 of the National Constitution.

(c) **Environmental and social risks.** The main risks leading to a "Substantial" risk rating are:

(i) *Potential opposition to the required tariff increase to ensure financial sustainability of the investment, as has happened in other Bank financed projects.* This risk is considered low. According to the studies performed by Interagua and EMAPAG EP, the sanitation tariff charged to customers will have to be increased on average from 80 percent to around 95 percent of the charge made for water. The current water tariff is US$0.58 per m^3 on average, and for sewerage, it is US$0.42 per m^3. The average monthly bill of water and sewerage for residential customers is US$14. The increase in the sewerage tariff will increase the monthly bill for water and sewerage to about US$15 per month. The municipality plans to progressively introduce this increase. In particular, the tariff increase will not have a significant impact on poor customers for whom the monthly bill of US$5.4 per 10 m^3 for water and sewerage, will increase to US$5.9 per month.

(ii) *Lack of up-front buy-in from households in connecting to the sewer network, which global experience has shown elsewhere.* Based on the successful previous experience of EMAPAG EP with programs and connection campaigns aimed at promoting the installation of household connections in other poor urban areas of Guayaquil and the results of the beneficiary survey,[25] the risk of lack of household buy-in is considered low at this stage.

(iii) *Potential delays in the expansion of sanitary landfill for sludge disposal.* Should the capacity of the existing landfill be exhausted and the planned expansion of the municipal sanitary landfill be delayed, the solution identified for disposal of the biosolids generated by the plant in the sanitary landfill would be jeopardized. As a mitigation measure, and given the fact that the volume arriving from the WWTP represents a minimal addition to the existing capacity of the landfill (less than two percent), a certification from the municipal authorities will be issued, by which there will be a commitment to receive the biosolids from the WWTP in the existing sanitary landfill for at least the first ten years of operation.

(iv) *Potential complaints from land expropriation process.* The WWTP financed under Component 3 will be located on a site which has been the property of six different private owners. Expropriation begun in 2011. The municipality has already proceeded with the payment of compensation amounts (held in trust by the court) and has legal entitlement to the land. However, four court cases have delayed its finalization. However, given that the municipality has agreed to pay full replacement costs (using market comparators) for the assets being acquired, and that in the one case where this is being appealed the costs have been validated by a court appointed independent expert, it is considered that land acquisition no

[25] A survey of 400 households within the Project beneficiary areas was conducted during Project preparation to seek the opinion of the homeowners about the prospects of getting connected to the sewerage service. Thirty percent answered that they would be ready to get connected immediately and only three percent declared uncertainty about connecting to the sewer system in the near future.

longer entails a significant risk to the Project's implementation. The municipality already has the tenure of the land, and the pending decision from the Courts on the final amount of the compensation for the one outstanding case will be binding for both parties and cannot be contested, so there are no expected risks to project implementation.

VI. APPRAISAL SUMMARY

A. Economic and Financial Analysis

31. The economic analysis was carried out in qualitative terms. Positive externalities of improved environment and reduced health risks are expected due largely to: (a) sewerage expansion and rehabilitation, which will improve the quality of life of poor residents in the area, and also contribute to reducing the pollution of the Estero Salado (an important environmental asset); and (b) treatment of all wastewater collected in the whole southern area of Guayaquil, which will have an important ecological improvement in the Guayas River. However, these benefits are difficult to quantify. Thus, instead of a cost-benefit approach, a cost-effectiveness approach has been taken for the economic analysis.

32. There are requirements at the national level for on-site sewage disposal solutions, as well as for standards that the effluents have to meet. The Ministry of Environment (MAE) and the Municipality have established that only sewerage connections are allowed in the area, as other solutions are increasing pollution, due to poor maintenance and high water table in the area. For the effluents, the law has established limits for certain parameters. The cost-effectiveness analysis took into consideration the regulations and selected among different alternatives the most cost effective solution. For sewerage expansion, the solution was simple, as the network already exists; however, to make the connections feasible, the households have to adjust the in-house connection and some pipes need rehabilitation. The alternatives considered for sewerage consisted of adjustment and rehabilitation. For wastewater treatment the following alternatives were analyzed: (a) CEPT; (b) Dissolved Air Flotation (DAF); and (c) High rate clarification. Associated investment and operating costs were estimated through a lifecycle analysis for the alternatives for a 30-year period. The CEPT option is not only the most cost-effective alternative but also allows adding units of biological and anaerobic treatment for secondary treatment when limits for effluents are stricter. The chosen alternative has an expected unit cost (US$ 86 per capita) similar to the ones obtained in other countries that have applied the same type of treatment. Two projects in Colombia applied this technology, Canaveralejo and Salitre, with resulting costs per capita of US$ 84 and US$ 110[26] respectively.

33. The financial evaluation examines whether sufficient funds will be generated for the municipality, EMAPAG EP, and Interaguas to meet all their financial obligations. It also examines, the source of these funds: either coming from user charges or from public budget. Funds and financial obligations were included in the financial analysis of the municipality, EMAPAG EP and Interagua, taking into account the institutional arrangements for Project implementation, in which Interagua will be in charge of operating the works with its own

[26] The costs are adjusted to inflation to express them in 2015 prices

revenues, and the municipality of Guayaquil, through EMAPAG EP, will execute the investments and pay for them.

34. The financial analysis of EMAPAG EP and the municipality show strong results and that the municipality's finances will enable the contracting of additional new loans for US$205 million (from the Bank and the EIB), as the projected debt stock and associated debt service ratios would be far lower than the legal ceiling established in Ecuador. It also shows that EMAPAG EP's revenues[27] will be enough to service the loans required to finance the proposed Project.

35. The financial projections for Interagua include O&M costs of the works to be constructed under the proposed Project.[28] The results show that current tariffs will not be enough to cover the additional cost of operation of the wastewater treatment system. An increase in tariffs is needed to make the Project financially sustainable. Results suggest that the sewerage tariff should increase from the current 80 percent to 95 percent of water charges.

B. Technical

36. Detailed feasibility studies have been prepared by a multidisciplinary team of engineers, wastewater treatment process specialists, and economists within a specialist international firm with quality control from EMAPAG EP and Interagua. The feasibility studies were prepared to ensure that the investments are sound from an engineering and design standpoint and that a least-cost solution has been adopted among the different alternatives to achieve the Project objectives. During Project preparation, the Bank team has reviewed the feasibility studies to confirm the technical viability and appropriateness of the CEPT as the adopted technical option for wastewater treatment (Annex 2 includes further discussion on the selection of technical options). Recommendations were used to refine the overall Project objectives, scope, and approach, as well as specific criteria to be used in the detailed design. The detailed feasibility study reports are available in the Project files.

37. Based on the Bank's global experience in other similar projects in measuring BOD removal and/or reduction of fecal coliform, the proposed Project includes indicators whose monitoring is under the full the control of EMAPAG EP (that is, measured at the WWTP outlet and not in estuary) to avoid difficulties in the attribution of benefits to the Project.

38. **Flood risk and climate change preparedness.** Given that Guayaquil suffers from a high flood risk, appropriate flood risk management and climate change adaptation measures have been considered in the feasibility study and Project design and will be incorporated in the bidding documents. The design has considered elevations for all civil works, including pathways,

[27] Considering the US$30 million funds transferred by the municipality every year to EMAPAG EP and existing commitment to continue doing so.
[28] About US$8 million per year.

buildings, walls, and electromechanical equipment of at least one meter above the current level of the river Guayas on a high flow scenario (100 years recurrence).[29]

C. Financial Management

39. As part of Project preparation, an assessment of EMAPAG EP was carried out to evaluate the adequacy of FM arrangements foreseen under the Project. EMAPAG EP's Finance Directorate, in coordination with the PIU staff, will assume responsibility for the FM tasks required for Project implementation. Main challenges are related to: (a) EMAPAG EP's lack of experience implementing Bank-financed projects and overall, externally financed projects; (b) co-financing of project activities through several sources of financing which require strong and robust budgeting, accounting and funds flow arrangements, including internal controls, that at the same time can ensure proper recording of project transactions for the provision of reliable information for monitoring purposes; (c) harmonization of operational processes and procedures as relates to financial reporting and auditing arrangements with the EIB; and (d) risk of availability of local counterpart financing which may delay payments. The proposed FM arrangements are considered acceptable to the Bank. Proposed FM and disbursements arrangements are reflected in the OM.

D. Procurement

40. **Procurement activities will be carried out by EMAPAG EP through the PIU.** As part of Project preparation, an assessment of the procurement capacity of the implementing entity was carried out by the Bank in August and November 2014. This assessment recommended the establishment of a PIU with an adequate definition of the following: (a) organizational structure; (b) facilities and support capacity; (c) qualifications and experience of the staff that will work in procurement; (d) record-keeping and filing systems; (e) procurement planning and monitoring/control systems; and (f) capacity to meet the Bank's procurement contract reporting requirements. For procurement activities, the PIU will be staffed with a dedicated procurement specialist and three or four contract managers supported by EMAPAG EP's technical and administrative staff. There are risks related to the procurement capacity of EMAPAG EP, as the technical and fiduciary teams do not have adequate knowledge of Bank procurement and contracting procedures. The following suggested corrective measures were agreed: (a) inclusion of procurement and contracting procedures within the Project OM; and (b) close monitoring by the Bank, particularly during the first two years of Project implementation. Additional details are available in Annex 3.

41. **The Project is expected to have International Competitive Bidding (ICB), including a prequalification** for the Las Esclusas WWTP and the Guasmo H pumping station and transmission pipeline; an ICB for the La Pradera transmission pipeline (trenchless construction method); another ICB for the rehabilitation of the sewerage network; and the related international consulting services (firms) for the supervision (*fiscalización*) of the works financed

[29] Taking into consideration sea-level rise predictions from the U.S. Army Corps of Engineers (USACE) and U.S. National Research Council (NRC) III curves which predict a sea level rise of 0.9 m by 2075.

by the Bank. Some international contracts for individual consultants may be required to provide specific additional technical capacity as applicable.

E. Social (including Safeguards)

42. **A Beneficiary Assessment (BA) for Components 1 and 2 was undertaken during Project preparation.** The assessment surveyed 400 households for a socioeconomic characterization and an analysis of their sanitation solutions and hygiene practices, among others, as well as their willingness and capacity to connect to the sewerage network. Over 20 percent of the surveyed residents are currently receiving conditional cash transfers from the National Government (*Bono de Desarrollo Humano*). The monthly income of around 17 percent of surveyed households is below the minimum monthly wage established by law.[30] While the most important neighborhood problem cited by respondents was crime and delinquency, access to sanitation was ranked as the second most important (ahead of disease, unemployment, and lack of transport). Additional BAs are planned during Project implementation, to collect information on a wider array of topics and from a broader sample. These surveys and the Project's impact evaluation baseline, which will be undertaken during the first year of Project implementation, will generate an important base of social information to inform Project outcomes and future decision making.

43. **Citizen engagement and Grievance Redress Mechanism.** EMAPAG EP will implement a comprehensive program of citizen engagement for Components 1 and 2. This will include a series of socialization meetings at the neighborhood level, followed by targeted training and communication campaigns on the benefits and on how to properly use the sewerage system, and a program of social certification of the works completed in the household. The Project includes a tiered system of grievance redress with focal points and registers managed by the contractors and by EMAPAG EP, who is ultimately responsible for managing the grievance redress mechanism (GRM) and for answering concerns even before the contractors come on board. The GRM for the project will also handle complaints about resettlement issues. The Project's GRM has been included in the Environmental and Social Management Plans (ESMPs) and in the Project OM and posted in EMAPAG EP's website, alongside with contact information for responsible parties and for addressing concerns.

44. **Gender inclusion.** During Project preparation, gender disaggregated information was collected on household sanitation needs as part of the BA. Component 1 of the Project will include communication and training activities on the proper usage of the sewerage system, which will be primarily targeted to female household members. Results indicators will include gender disaggregated information on participation in Component 1 training activities and gender disaggregated findings on perceived impacts of the Project collected as part of implementation stage BAs. See Annex 3 for additional details on gender inclusion considerations

45. **Safeguards.** OP 4.12 - Involuntary Resettlement is triggered because the municipality is expropriating the land required for the WWTP and future expansion (40.74 ha). Because the expropriation process has been ongoing since 2011, with four cases going to court, the client has

[30] Other data and results of the BA will be processed and included in the appraisal PAD.

prepared and disclosed a remedial Resettlement Action Plan (RAP). This RAP outlines the land acquisition and resettlement impacts of the Project, the degree to which the expropriation process adheres to the requirements of OP 4.12, the additional measures necessary to meet these requirements, and the implementation arrangements necessary to deliver compensation and resettlement assistance. The RAP has been disclosed in the Bank's external website on February 20, 2015. Annex 3 includes additional information on land acquisition and resettlement.

F. Environment (including Safeguards)

46. **The proposed Project has been classified as Environmental Category A due to the type and size of Component 3**, the construction of a 3.6 m^3/s WWTP. Project-financed works in Component 2 have relatively moderate potential negative environmental impacts and can be readily mitigated with standard measures. Even less impacts are associated with works in Component 1. The overall Project impact is expected to be positive due to the improved effluent quality that will be discharged into the Guayas River and the reduction of untreated wastewater that is presently leaking from the existing sewer system and affecting shallow ground and surrounding surface water bodies, like the Estero Salado estuary. The effluent quality from the Las Esclusas WWTP to be financed under the Project will allow compliance with current environmental regulations in Ecuador.[31] EMAPAG EP has planned for the future expansion of the WWTP to enable secondary treatment if it is required by the Ecuadoran environmental regulations later during the life of the Project. Main environmental risks relate to potential failure of the WWTP to properly operate (which would result in impacts similar to present conditions), failure to properly dispose of biosolids from the WWTP, and failure to adequately mitigate environmental and social impacts on local population during construction of sewer rehabilitation works in Component 2.

47. **An Environmental and Social Impact Assessment (ESIA) has been developed for the proposed WWTP (Component 3).** The ESIA includes an assessment of impacts, including mathematical modeling of potential downstream impacts during plant operation, and an ESMP. Alternative analyses in terms of WWTP technological and design options and site locations were conducted as part of the regional water planning work, the WWTP feasibility study and Project design, and the ESIA. The analysis of alternatives and selection of site locations for the treatment plant was conducted in 2004 as part of the Master Plan for Water Supply and Sewerage Services of Guayaquil, which was updated in 2011. The potential risk of flooding at the WWTP has been addressed in the Project design. For works under Components 1 and 2 sewer connections to households and rehabilitation of main sewer lines), an ESMP was developed for each component and includes an assessment of potential impacts and proposed mitigation and monitoring measures. (See annex 3 for additional details.)

48. **The Component 3 draft ESIA was disseminated and consulted locally from September 18 to October 8, 2014,** and included a formal public audience, several permanent Public Information Centers, and informal informative meetings. Public consultations were coordinated and approved by an independent facilitator appointed by the MAE. Main comments

[31] The National Norm on Environmental Quality and Effluent Discharges sets the maximum limits for effluent quality standard at: BOD_5 = 100 mg/L; SST = 100 mg/L; total coliform = 100 NMP/100 ml.

received focused on requests for proper maintenance of the sewerage collection and transportation systems to avoid blockages and overflows, statements expressing acceptance and support for the Project, concerns about proper odor control from the WWTP, concerns over ensuring timely completion of the works, and concerns about inconveniences that could be caused by rupture of street pavement, among others. The draft ESIA was also reviewed by three independent experts. Comments were addressed in an updated ESIA. The ESMPs for Components 1 and 2 were also consulted in the beneficiary neighborhoods in January 2015, and comments were incorporated in the final versions of the documents. The ESIA has been disclosed in the Bank's external website on December 16, 2014 and the ESMPs on February 27, 2015.

49. **As part of Component 4, the Bank and EMAPAG EP identified measures to enhance and promote positive environmental benefits**, especially funds to support the development and establishment of a water quality monitoring system for both the Guayas River and the Estero Salado estuary and the development of a master plan for the management of biosolids generated from all the city's WWTPs. This component also includes environmental safeguards supervision by the PIU in EMAPAG EP and established in the Project OM.

50. **For Component 3, while no potential significant impacts on physical cultural resources were identified in the ESIA**, OP/BP 4.11 Physical Cultural Resources is triggered and an archeological monitoring program and chance-find procedure are included in the ESMP as a preventive measure. The ESMPs for Components 2 and 3 include a chance-find procedure. While the works should have a positive environmental impact on the Guayas River and the Estero Salado estuary, **OP/BP 4.04 - Natural Habitats has been triggered on a precautionary basis** due to Components 1 and 2 and their proximity to the Estero Salado estuary. Applicable measures will be included in the ESMPs as needed.

G. Grievance Redress

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

ANNEX 1: RESULTS FRAMEWORK AND MONITORING

ECUADOR
EC GUAYAQUIL WASTEWATER MANAGEMENT PROJECT (P151439)

Project Development Objectives	The PDO is to increase access to improved sanitation services and to reduce wastewater pollution in selected areas of the city of Guayaquil.
These results are at	Project Level

Project Development Objective Indicators

Indicator Name	Core	Unit of Measure	Baseline	Cumulative Target Values[32]						Frequency	Data Source/ Methodology	Responsibility for Data Collection
				2015	2016	2017	2018	2019	End Target			
People in urban areas provided with access to improved sanitation[33] services under the project		Number	0	0	0	45,000	90,000	120,000	120,000	Biannual	Progress reports (based on social survey results)	EMAPAG EP
Share of poor people in urban areas provided with access to improved sanitation services under the project		%	0	0	0	20	20	20	20	Biannual	Progress reports (based on social survey results)	EMAPAG EP

[32] Most of these target values are preliminary estimates and will be determined once the baseline study is completed in project areas.
[33] For the purposes of this Project, improved sanitation services means a household connection to the sewerage network, whereby wastewater received proper treatment in compliance with environmental regulations before discharge. The connection to the sewer system will include the effective closure of existing on-site solution (including cleaning and sealing).

Volume (mass) of BOD pollution load reduction achieved under the project	☒	Tons	0	0	0	0	4,000	8,000	8,000	Biannual	Audited technical report of Interagua's operation	EMAPAG EP
Water & sanitation utility operating ratio [34]	☐	Percentage	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	Biannual	Audited financial statements of Interagua	EMAPAG EP
Direct project beneficiaries	☒	Number	0	0	0	45,000	590,000	1,000,000	1,000,000	Biannual	Progress reports (based on social survey results)	EMAPAG EP
Female beneficiaries	☒	Number	0	0	0	22,950	300,900	510,000	510,000	Biannual	Progress Reports (based on social survey results)	EMAPAG EP

Intermediate Results Indicators												
				Cumulative Target Values								Responsibility for
Indicator Name	Core	Unit of Measure	Baseline	2015	2016	2017	2018	2019	End Target	Frequency	Data Source/ Methodology	Data Collection
Component 1: Installation of household connections												
New household sewer connections constructed under the project	☒	Number	0	0	0	10,000	20,000	27,000	27,000	Biannual	Progress reports (based on social survey results)	EMAPAG EP

[34] Operating expenses (including depreciation) / Operating revenues.

Intermediate Results Indicators												
Indicator Name	Core	Unit of Measure	Baseline	Cumulative Target Values						Frequency	Data Source/ Methodology	Responsibility for Data Collection
				2015	2016	2017	2018	2019	End Target			
People trained to improve hygiene behavior or sanitation practices under the Project	☒	Number	0	4,000	11,250	22,500	22,500	22,500	22,500	Biannual	Progress reports (based on social surveys results)	EMAPAG EP
People trained (Female) to improve hygiene behavior or sanitation practices under the Project	☒	Number	0	2,080	5,850	11,700	11,700	11,700	11,700	Biannual	Progress reports (based on social surveys results)	EMAPAG EP
Component 2: Rehabilitation of sewerage network												
Reduction of the average wastewater flow pumped in the La Chala pumping station[35]	☐	Percentage	0	0	0	5	15	25	25	Biannual	Audited technical report of Interagua's operation	EMAPAG EP
Reduction of the annually reported repair tickets in the La Chala sector sewer main system[36]	☐	Percentage	0	0	0	10	25	50	50	Biannual	Audited Technical Report of Interagua's operation	EMAPAG EP
Length of sewer mains rehabilitated under the project	☐	Meters	0	0	0	15,000	30,000	40,000	40,000	Biannual	Progress of work approved by the	EMAPAG EP

[35] The flow pumped currently is 7,398 m^3/day

[36] The reported repair tickets are currently 10,500 claims/year.

Intermediate Results Indicators												
Indicator Name	Core	Unit of Measure	Baseline	Cumulative Target Values						Frequency	Data Source/ Methodology	Responsibility for Data Collection
				2015	2016	2017	2018	2019	End Target			
											independent supervisor	
Component 3: Wastewater treatment and disposal facilities												
Start of construction of the Las Esclusas WWTP		Yes/No	No	No	Yes	Yes	Yes	Yes	Yes	Once	Progress of work approved by the independent supervisor	EMAPAG EP
Commissioning of the Las Esclusas WWTP		Yes/No	No	No	No	No	Yes	Yes	Yes	Once	Progress of work approved by the independent supervisor	EMAPAG EP
Share of the monthly average effluent from the Las Esclusas WWTP outlet discharged into the Guayas River is compliant with regulatory quality standard for BOD, TSS (mg/L) and total coliforms	☐	Percentage	0	0	0	0	50	100	100	Biannual	Audited technical report of Interagua's operation or monthly average of daily quality tests[37]	EMAPAG EP
Component 4: Project management and administration, including communication plan and management of social, environmental, and safety issues												

[37] Daily tests will indicate the daily concentration in the effluent at the WWTP's outlet. These values will be averaged by month and the effluent must comply with the indicated standards on a monthly average basis.

Intermediate Results Indicators												
Indicator Name	Core	Unit of Measure	Baseline	Cumulative Target Values						Frequency	Data Source/ Methodology	Responsibility for Data Collection
				2015	2016	2017	2018	2019	End Target			
Water quality monitoring system for the Guayas River finalized and system operational (i.e., a model has been prepared and calibrated)	☐	Yes/No	No	No	No	No	Yes	Yes	Yes	Biannual	Progress reports	EMAPAG EP
Water quality monitoring system for the Estero Salado estuary (i.e., a model has been prepared and calibrated)	☐	Yes/No	No	No	No	No	Yes	Yes	Yes	Biannual	Progress reports	EMAPAG EP
Master plan for the management and final disposal or reuse of biosolids from WWTP finalized	☐	Yes/No	No	No	No	No	Yes	Yes	Yes	Biannual	Progress reports	EMAPAG EP
Citizen engagement: Number of beneficiary households that sign a certification that they are satisfied with the works carried out in their houses[38]		Number	0	0	0	9,700	19,400	26,190	26,190	Biannual	Progress reports	EMAPAG EP
Share of surveyed beneficiaries (gender disaggregated) that feel project investments reflect their needs		Percentage	0	0	0	85	85	85	85	Biannual	Progress reports	EMAPAG EP

[38] The signature of this certification is part of EMAPAG EP's existing methodology.

ANNEX 2: DETAILED PROJECT DESCRIPTION

ECUADOR

GUAYAQUIL WASTEWATER MANAGEMENT PROJECT

1. The Project Development Objective (PDO) is to increase access to improved sanitation services and to reduce wastewater pollution in selected areas of the city of Guayaquil.

2. The proposed Project will achieve the objectives through the implementation of four components. The pre-investment cost, including the preparation and development of feasibility studies, environmental impact assessment, and final designs,[39] as well as acquisition of the land required for the construction of the new wastewater treatment plant (WWTP) is being financed by the municipality of Guayaquil, through EMAPAG EP, for a total amount of US$6.5 million. This cost will be considered as counterpart financing for the Project.

Component 1: Installation of household connections (US$18 million, with US$2.8 million of IBRD loan financing).

3. This Component will finance the installation and rehabilitation of household connections in specific areas within the southern districts of the City of Guayaquil. These districts are equipped with a dense sewerage collection network which, although requiring rehabilitation of main collectors to reduce infiltration, reaches and could serve all inhabited areas. Nonetheless, despite a network coverage of almost 100 percent, just 82 percent of the households of the area are currently connected to the system. Most of the remaining 18 percent (around 30,000 families) are poor households located in "Suburbio Oeste", "Guasmo", and "Trinitaria", riparian districts of the "Estero Salado" estuary, where household toilets discharge directly to the estuary or to reportedly poorly constructed and maintained pits or septic tanks, which contributes to the degradation of the Estero Salado estuary.[40] These families have not been connected despite having a sewer passing in front of their households – and despite legal mandate to do so - mainly because of the cost of the connection fee,[41] but also because of technical issues (toilets mostly located at the back of their houses or at a lower level than the condominial sewer branch) and lack of information about their entitlement to enjoy a social tariff and/or about the benefits that getting connected would bring them in terms of livelihood improvement.[42]

[39] The studies completed to date are available in the Project files.

[40] In order to address domestic discharges coming from neighborhoods which are riparian to the Estuary on the Northern side, there are three ongoing projects managed by EMAPAG EP to connect around 25,000 households to the sewerage network currently under implementation. These projects, combined the household connection component financed by the proposed Project and the *Guayaquil Ecológico* program jointly financed by the GoE and the Municipality of Guayaquil, are jointly expected to completely eliminate domestic discharges to the Estuary.

[41] This cost is US$500 and includes the cost of emptying and sealing of the septic tank or other on-site sanitation solution.

[42] According to the draft beneficiary survey conducted during project preparation, out of the total number of households that use onsite sanitation solutions in the "Suburbio Oeste" district, 17% are not connected to the sewer network due to lack of information on how to proceed to demand the service, 31% due to financial constraints and 4% due to land tenure issues

4. This component of the Project aims at increasing effective access to sewerage collection services in the southern districts of Guayaquil to reach a rate of around 100 percent. To achieve this objective, household connection costs -including the cost of required indoor works like piping, flooring and others – will be partially subsidized and financed by EMAPAG EP (clients will pay to EMAPAG EP the nonsubsidised segment in installments through the water bill). In parallel, a communication campaign will be launched to inform the beneficiaries about this initiative and its benefits and to promote improved hygiene and maintenance practices required to ensure the proper functioning of the condominial sewer system. The design of this component will be developed based on previous successful experiences with connection campaigns led by EMAPAG EP, which managed to increase effective access to piped sanitation up to 98 percent in other districts of the city with high poverty rates.

5. Component 1 corresponds to 30,000 household connections, of which 15,000 connections will be completed in a first phase corresponding to the properties located in Guasmo, Trinitara Island and the city center. This is outside the area where sewerage will be rehabilitated (Component 2). This connection will be completed during the period 2016 - 2017; the other 15,000 connections will be completed after the rehabilitation during the period 2018-2019. Each phase (15,000 connections) will have three contracts. EMAPAG EP's community management team will join the process to gain access to the premises for the contractor to complete the connection. Once the household connection is completed, EMAPAG EP's community management team will sign a certificate with the user which certifies that the connection has been established satisfactorily.

Component 2: Rehabilitation of sewerage network (US$37 million, 100 percent financed by IBRD).

6. This component will finance the rehabilitation of the sewerage network (including sections of the primary, secondary and tertiary network) in La Chala basin (Suburbio Oeste area), which is riparian to the Estero Salado estuary. This component of the Project aims at reducing infiltrations in the south sewerage subsystem, thus contributing to the reduction of contamination of the Estero Salado estuary from domestic wastewater. It is estimated that of the total volume of wastewater collected and pumped into the pumping station of La Chala, about 25 percent is water infiltration, thus increasing pumping costs.

7. This project component represents the elements shown in Table 1 below:

Table 2.1 Elements of the Rehabilitation Component of La Chala sub-basin

Sub basin	Area Ha	No. Chambers	Collectors m	Branches m	Suspenders m	No. Users
B21	585.68	206	18,221.33	174,889.09	7,571.46	22,660
B22	173.88	27	5484.55	55,135.34	2,826.52	6786
B23	351.12	32	11,412.40	98,074.53	4,966.14	14,641
B24	231.35	31	6305.68	77,230.37	4,966.14	8345
TOTAL	**1,342.04**	**478**	**41,405.33**	**404,598.90**	**19,410.21**	**52,432**

8. To avoid affecting both vehicular and pedestrian traffic, this renovation will be done through cutting edge technologies without the need for ditches or broken pavement. The technologies to be used are described as follows:

- Pipe Bursting Rehabilitation. – This method of rehabilitation uses the existing pipe to pass a new tube of high density polyethylene. During the process, the existing pipe is replaced, leaving the new pipe with the possibility of increasing its diameter.
- CIPP (Cured in Place Pipe). The Cured in Place Pipe technology is a method used to correct irregular structural or operational defects in the operation of existing pipelines. This technology involves the insertion of a sleeve, generally of polyester fiber, previously impregnated with a resin and subject to a curing process with steam, hot water or UV rays.

9. The network renewal option through the opening of ditches and replacement of the existing pipeline will be considered only when the rehabilitation options described above cannot be executed and the environmental conditions are permitting, looking to cause the least environmental and social impact.

Component 3: Wastewater treatment and disposal facilities (US$161 million, with US$58.5 million of IBRD loan financing).

10. This component will finance the construction of a new wastewater treatment plant (WWTP), called "Las Esclusas", and associated pumping and transmission facilities to treat 100 percent of the wastewater collected in the southern districts of the City of Guayaquil within the design year of 2045. The objective of this component is to treat domestic wastewater to meet current environmental standards for discharges into a water body.

11. Wastewater generated in the south subsystem is currently collected in two main sewers: (i) the "Guasmo" main sewer, which conducts an average flow in dry weather of 0.60 m3/s into the "Guasmo H" pump station, from where wastewater is pumped directly into the Guayas River through a 180 meters long pipeline and an underwater outfall diffuser; and (ii) the "Parson's Sur" main sewer, which conducts on dry weather 2.10 m3/s into the "La Pradera" pre-treatment station (equipped with a mechanized pre-treatment, a disinfection system that is presently out of service and an underwater outfall diffuser). Therefore, wastewater is currently discharged into the Guayas River with none or very little treatment, failing to comply with the contaminants concentration thresholds established in the National Norm on Environmental Quality and Effluent Discharges (NCADE in its Spanish acronym).[43]

12. To address this situation, EMAPAG EP plans to construct a new wastewater treatment plant in the proximity of the current point of discharge to the Guasmo main sewer, which will treat all the sewerage collected in the south subsystem and will require:

[43] The National Norm on Environmental Quality and Effluent Discharges (NCADE) sets the maximum limits for effluent quality standard at: BOD_5 = 100 mg/l; SST=100 mg/l; Total Coliforms=100 NMP/100 ml. The effluent discharged at Guasmo H does not comply with these limits as DBO and SST concentration in the raw wastewater is very high; The effluent discharged at La Pradera does comply with the NCADE most of the time given the high dilution of the water that arrives into the facility due to ground water infiltration into the sewerage system.

- The adaptation of the Guasmo H pump station and the construction of a new pipeline to drive pumped water to the new treatment facility in Las Esclusas WWTP;
- The decommissioning of La Pradera pre-treatment station, the construction of a new pump station in the premises, and the construction of a pipeline to drive pumped water to the new treatment facility in Las Esclusas WWTP;
- Construction of Las Esclusas WWTP, a new treatment facility to manage an average flow in dry and wet weather of 2.7 l/s and 3.5l/s, respectively. The facility will be equipped with mechanized pretreatment, chemically enhanced primary treatment (CEPT), disinfection system, underwater outfall diffuser and hypochlorite production; and
- Construction of a sludge digester.[44]

13. Different technological alternatives were analyzed by HS and EMAPAG EP to develop the design of the treatment facility and were discussed with the Bank team. The CEPT option was retained since it allows to consistently meet the regulatory authorized limits set for the Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD) and all other pollutant concentrations and eases the implementation of effective odor control measures. Moreover, the CEPT technology has extensively and successfully been adopted worldwide in municipal wastewater treatment plants of similar size, which effluent does not require a complex treatment process, considering effluent characteristics, applicable wastewater discharge standards[45] and the dilution capacity of receiving water body.[46] However, Las Esclusas treatment facility is being designed to allow for a secondary treatment system to be incorporated into the treatment process in the future, should it be required. The feasibility study included the thorough analysis of secondary treatment process alternatives, including aerobic and anaerobic processes.[47]

14. *Sludge Management:* Depending on working conditions and on actual contaminants concentrations of the raw wastewater, the treatment and sludge management process may generate up to 80 tons per day of biosolids that would be disposed in the municipal landfill. The landfill is currently receiving and managing over 4,500 tons of biosolids per day, so the volume arriving from the WWTP represents a minimal addition to the existing capacity. An agreement to dispose of the biosolids is under negotiation between EMAPAG EP and the company running the municipal landfill,[48] which has all required environmental permits to receive this type of waste.[49]

---

[44] The Project considers the co-generation of energy (740kw/h) from methane gas generated from the sludge digestion process to be used at the WWTP site; the economic incentives to sell to the grid are not clear at this stage and this possibility will be further explored during project preparation.

[45] The CEPT process was considered adequate given that the $BOD_{5\ and}$ SST reduction level required (once the waters from the two sub-basins of Guasmo and La Pradera are merged) is not very high, on average 20% for BOD_5 and 5 % for SST (from current levels of BOD_5 = 156 mg/l; SST=130 mg/l. in dry weather and BOD_5 = 126 mg/l; SST=105 mg/l in wet weather). In principle, the CEPT process has the capacity to reduce up to 75% of the BOD and 90% of the SST, which means the process could comply with an even stricter standard, if effluent quality is not altered.

[46] The feasibility study prepared by H&S has confirmed that residual chlorine (total and free) would be well below acceptable parameters and therefore that there is no risk for the formation of THM.

[47] The secondary treatment alternatives analyzed by HS included 19 processes, including aerobic and anaerobic solutions. The Trickling filters process was selected as the most cost-effective and preferred option for secondary treatment.

[48] Consorcio ILM Las Iguanas.

[49] An expansion of the existing municipal sanitary landfill is under design (studies have been finalized and should be approved by the Municipality by March 2015) and the Municipality's plan is to start the bidding process for the

The primary sludge generated from the wastewater treatment process would be pressed, dewatered and stabilized before transportation and final disposal at the sanitary landfill. A Master Plan study for the management of biosolids generated from Las Esclusas and other future WWTPs will be financed under Component 4. This study will look at options for the reutilization of sludge through the production of compost (using secondary dewatering and structuring mix processes).

Component 4: Project management and administration, including communication plan and management of social, environmental, and safety issues (US$5.4 million with US$4.2 million of IBRD loan financing).

15. This component will finance activities associated with overall Project management by EMAPAG EP, including Project-related audits, monitoring and evaluation, equipment and training to strengthen the implementing entity, as well as individual consultants. It will include support to EMAPAG EP related to the management of environmental and social issues and safeguards. Specifically, this component will fund: a) a study to set up a system for the physic-chemical, bacteriological and limnologic monitoring of the River Guayas' water quality;[50] b) a study to set up a system for the physic-chemical, bacteriological and limnologic monitoring of the Estero Salado estuary water quality in relation with Project Components 1 and 2; c) a Master Plan for the management and final disposal or reutilization of the biosolids, which will be produced at Las Esclusas WWTP and other planned WWTPs (Los Merinos, Asuncion City and others); and d) a Project Impact Evaluation Assessment.

16. *Monitoring of Water Bodies Project:* The objective of the project is to be in compliance with the environmental standards of wastewater discharges in the central–south sector of Guayaquil. Therefore, in order to assess the impact of the project in terms of water quality, the implementation of a program to monitor the quality of the Estero Salado and Rio Guayas water bodies was included, by which the quality improvements are defined.

17. *Bio-solids Management Master Plan Project:* A Bio-solid Solid Master Plan Study was included with the objective of maximizing the utilization of bio-solids generated in existing and future WWTPs in Guayaquil, and / or define the best alternative for reuse or disposal. This implementation will reduce the threat of depletion of the lifespan of the Guayaquil landfill. The study should characterize bio-solids, as depending on its quality, priority is given to one or another alternative use. Analysis of physical, chemical, agrologic and microbiological parameters of sludge currently generated in existing wastewater treatment plants, should be carried out.

---

works in the coming months. The existing municipal sanitary landfill has the capacity to continue operating at current volumes for at least five years (which at current landfill exploitation rate would represent give enough capacity to receive the biosolids generated from Las Esclusas Treatment Plant for about 280 years of operation, if this was the only biosolid received at the landfill). As part of Project preparation, an agreement from the municipal authorities is being sought by which there will be a commitment to receive the biosolids from the WWTP in the existing sanitary landfill for at least the first 10-15 years of operation of the WWTP (i.e guaranteeing the space currently available to this effect).

[50] The scope of this study if to be defined during Project preparation and the objective is to enable monitoring of the River Guayas water quality in different points which in turn will enable measuring the benefits of Las Esclusas WWTP and other future treatment plants in the Guayas River's water quality.

18. *Comprehensive Urban Management Project:* With approximately 250,000 low-income beneficiaries, the north-west of Guayaquil represents the typical urban conglomerate product of migration and disordered land parceling in an irregular topography with slopes of up to 80 meters and areas at risk; conditions that create difficulties for the provision of various basic services. Therefore, it is essential to conduct a comprehensive study of urban water management as a measure to plan the development of the sector's infrastructure with the purpose of solving the problem of storm water management.

19. The Project would also include *a Non-lending Technical Assistance Activity* to improve the capacity of EMAPAG EP to provide better sanitation services to the poor, financed with funds from the Water and Sanitation Program (WSP). The WSP activity will support technical assistance directed at the improvement of the mechanisms currently employed by Interagua and EMAPAG EP to promote the installation of sewerage household connections among the population. These existing mechanisms, which focus on the creation of financial incentives accompanied with an effective communication campaign, have demonstrated in the past their usefulness to achieve close to 100 percent sewerage service connection rates, but failed to promote among the targeted population the sealing of septic tanks and cesspools that should be decommissioned when connected to the public sewer network. This work is expected to study the reasons behind this failure and explore the socio-economic characteristics of the households in question and identify bottlenecks towards an effective closure of existing on-site solutions. EMAPAG EP is also looking for unconventional solutions to provide sustainable quality sanitation services to other peri-urban communities where conventional sewer systems are not technically, financially or socially viable. In this context, the Bank will provide technical and financial support to identify and adapt to the local reality alternatives, having successfully been implemented globally in similar contexts[51].

20. *Flood Risk and Climate Change Preparedness:* Given that Guayaquil suffers from a significant flood risk level, the incorporation of appropriate flood risk management measures in the bidding documents will be a special area of focus during Project preparation and early implementation. This assessment will cover any climate change adaptation measures that are deemed necessary.

[51] For example in Lima City, through planned RAS for delivery options of water and sanitation services in peri-urban areas.

APPENDIX 1 TO ANNEX 2: STUDY OF ALTERNATIVES AND CHOICE OF TECHNOLOGY FOR THE LAS ESCLUSAS WWTP

ECUADOR
GUAYAQUIL WASTEWATER MANAGEMENT PROJECT

Choice of Technology for the WWTP: Description of the Selection Methodology Employed

1. As part of the feasibility study for the treatment of the wastewater generated in the city of Guayaquil, an analysis of alternative technologies was undertaken for the treatment of the wastewater flows collected in the main four wastewater catch basins of the sewer system of the city: the Guasmo H, La Pradera, Los Merinos, and Progreso subsystems.

2. The selection of the treatment technology to be employed in the different subsystems was undertaken using multicriteria decision-making analysis methods and following the recommendations of the 'Water Environment Federation' included in its guidelines for the 'Design of Municipal Treatment Plants'. The technology selection methodology employed comprises the following four steps: (a) **identification** of alternative technologies; (b) **qualitative screening** of alternative technologies according to five criteria (including Capex and Opex cost, complexity of the operation, demonstrated international experience in facilities of similar scale, land requirements and adaptability to the local context); (c) **performance simulation** and pre-dimensioning of prescreened technologies; and (d) **quantitative comparative analysis** and selection of the preferred technology according to economic criteria (comparison of full-cost life cycle for the different alternatives) and other technical and environmental criteria, applying a weight coefficient to the score obtained for each of the criteria.

3. For the analysis of technologies to treat the wastewater in the southern part of the city (Guasmo H and La Pradera catch basins), the influent characteristics in each basin was analyzed. The analysis showed that characteristics of the wastewater collected in the Guasmo H subsystem would require secondary treatment to bring the TSS and BOD concentrations down to permitted levels. However, since wastewater collected in the subsystem of La Pradera is quite diluted, mixing and treating both effluents together would satisfy applicable environmental standards by applying just a physical-chemical treatment process. **Therefore, it was decided that the wastewater collected in these two subsystems will be mixed and treated in a new facility—Las Esclusas WWTP—which at the first stage, will be equipped just with primary treatment.** Although this solution entails the construction of a transmission pipeline from the existing La Pradera pretreatment station to the future location of Las Esclusas treatment facility,[52] it reduces investment costs, allows for a simpler treatment process to be adopted, and for greater flexibility to adapt the treatment facility to future changes on applicable environmental standards and characteristics of the wastewater effluent.

4. For the selection of the primary treatment process at Las Esclusas WWTP, four primary treatment technologies were identified: (a) Rotating milli-screens; (b) CEPT; (c) chemically

[52] The size of the plot where the La Pradera pretreatment station is located does not allow for the construction of a new treatment facility that is able to treat the combined wastewater flows.

assisted DAF; and (d) High Rate Clarification.[53] Following the **qualitative prescreening** of these primary treatment technologies, just two of the four identified primary treatment processes were recommended for their adoption for the La Esclusas WWTP: the preliminary treatment with rotating milli-screens and the CEPT processes (the chemically assisted DAF and High Rate Clarification options were discarded given their higher Capex and Opex and greater complexity of the operation). The next step of the methodology (assessing ability of prescreened technologies to bring wastewater contaminants' concentrations down to permitted levels) concluded that, of these two, **just the CEPT option would ensure EMAPAG EP's and Interagua's ability to consistently comply with applicable environmental standards.**

5. Based on the above, the CEPT alternative was selected for the Las Esclusas WWTP. It is important to note that, although during the dry season the CEPT system will require chemical additions to comply with environmental standards, it is expected that during most part of the year, flocculants and coagulants will not be required. On the other hand, the CEPT option, with a BOD removal capacity of 40 percent with chemical additions (versus 9.3 percent of the preliminary treatment with milli-screens) allows postponing the construction of a secondary treatment process due to an eventual increase in contaminant concentrations in the raw wastewater derived from a reduction of ground water infiltrations into the sewer system.

6. During the preparation of this lending operation, the above-described qualitative evaluation was complemented with the calculation of the full life-cycle cost for the three identified primary treatment options. The results of these calculations confirmed the qualitative analysis previously undertaken.

7. For secondary treatment options, 19 secondary treatment technologies were analyzed following the above described methodology. Following the qualitative screening, the three prescreened technologies were (a) activated sludge with diffused aeration; (b) trickling filters with plastic media; and (c) trickling filters with solids' contact chamber. According to the simulation conducted, these three technologies allow for a similarly satisfactory treatment performance, and therefore, all three were subject to the quantitative comparative analysis. As a result of this last step of the comparative evaluation process, the trickling filters with plastic media were identified as the most favorable option to be adopted in the future to deal with a hypothetical tightening of permitted effluent quality standard.

Discussions on Choice of Technology during the Preparation of the Lending Operation

8. During the lending operation preparation phase, a number of additional alternatives were discussed as part of the technical appraisal process. These alternatives can be summarized in the two groups below:

(a) Agree with environmental authorities on a calendar for a progressive fulfillment of wastewater discharge standard conditions and construct in a first phase—and as part of this lending operation—a preliminary treatment system equipped with rotating milli-

[53] Although the High Rate Clarification process is similar to CEPT, it was considered as an independent alternative for technology evaluation purposes due to its physical size and different operating requirements.

screens. This alternative was dismissed because EMAPAG EP already has been granted with a moratorium to the wastewater discharge conditions established in the environmental legislation and because it poses certain political issues. In this regard, the regulation, promulgated in 1999 and updated in 2005, already contemplated an already expired period for the municipalities to comply with the wastewater discharge standards. On the other hand, something to note is that the 2008 New Political Constitution of the State and the new Water Law allow for the participation of the private sector in WSS service provision just in exceptional circumstances. Since Guayaquil is one of the few municipalities where this responsibility has been delegated to a private company, the city and the utility are being scrutinized for compliance with environmental and other national regulations to assess the continuity of the concession contract.

(b) Construct both the primary and secondary treatment processes under this operation. The two particular alternatives discussed and conclusions reached were the following:

(i) *Advanced preliminary treatment followed by covered anaerobic lagoons*. Solids build up in the anaerobic lagoon bottom and must be periodically removed. Dredging anaerobic digested solids from the lagoon bottom is not a practical option for a plant located in a metropolitan area. The Las Esclusas WWTP plant site has high groundwater levels during high-tide conditions in the Guayas River, and therefore, the construction of deep lagoons is not feasible. Covered anaerobic lagoons would also require a large area and the adoption of this treatment solution would significantly limit the flexibility to deal with unforeseen changes in environmental regulations and influent characteristics. Covered anaerobic lagoons have environmental issues with methane generation and odor release. For all these reasons this alternative was dismissed.

(ii) *Advanced preliminary treatment followed by Upflow Anaerobic Sludge Blanket (UASB).* This alternative presents complex operational issues when adopted to treat such large quantities of wastewater in an urban area, in particular, the handling of the generation of bio-gases (CH_4 and H_2S) and the risk of inconsistent compliance of this system with the SST requirements in the effluent. Likewise, associated life-cycle costs are high when compared with the CEPT alternative, as illustrated by the net present value (NPV) calculations undertaken.

9. The possibility of contracting together the design and the construction of the Las Esclusas treatment plant under a Design and Build (D&B); Design, Build, and Operate (DBO); and other contract types (which would leave the technology choice open to the bidders) or allowing alternative bids to come in at the bidding phase besides CEPT, was also proposed by the Bank during preparation. However, given that a detailed CEPT process with engineering drawings has been prepared, the possibility of requiring an alternative design was dismissed. There are also legal and procedural regulations that have advised against this procurement approach to be adopted for the Project. In this regard, it is important to note that the SENAGUA (National Water Secretariat) and the MAE are in the process of issuing, respectively, the so-called 'technical viability' and environmental licensing of the project on the basis of the existing pre-design. A change in technology would imply significant delays in fulfilling all these required steps.

10. On the other hand, in the particular case of the Las Esclusas WWTP, the advantages that adopting this procurement approach of allowing alternatives bids would bring, are limited. This is due to the fact that enforced effluent quality standards can be met with a physical-chemical treatment process with no secondary treatment, and therefore, the technological range from which the bidders would choose from would be quite narrow. Wastewater generated in the south subsystem is currently collected in two sewer mains: (a) the Guasmo sewer main, which conducts an average flow in dry weather of 0.60 m^3/s into the Guasmo H pumping station from where wastewater is pumped directly into the Guayas River through a 180 m long pipeline and an underwater outfall diffuser, and (b) the Parson's Sur sewer main, which conducts 2.10 m^3/s in dry weather into the La Pradera pretreatment station (equipped with a mechanized pretreatment, a disinfection system that is presently out of service and an underwater outfall diffuser). **Therefore, wastewater is currently discharged into the Guayas River with very little or no treatment**, failing to comply with the contaminants concentration thresholds established in the National Norm on Environmental Quality and Effluent Discharges (NCADE in its Spanish acronym).[54] To address this situation, EMAPAG EP will construct, through this Project, a new WWTP, Las Esclusas WWTP, near the current point of discharge of the Guasmo sewer main, which will treat all the sewerage collected in the south subsystem.

11. *Wastewater treatment.* Different alternative technologies for the wastewater treatment were analyzed by EMAPAG EP before the Bank's involvement to develop the design of the treatment facility and these were discussed with the Bank during preparation. The Chemically Enhanced Primary Treatment (CEPT) option was retained after an alternative analysis was conducted since it will allow the municipality of Guayaquil to consistently meet the national regulatory authorized limits set for the Total Suspended Solids (TSS) below 100 percent and BOD below 100 percent and all other pollutant concentrations. CEPT is also considered a flexible technology which can easily be adapted to changes in influent operating characteristics or potential future stricter standards. The feasibility study commissioned by EMAPAG EP included a thorough analysis of 19 secondary treatment process alternatives, including aerobic and anaerobic processes.[55] There is sufficient space and several options to install secondary treatment in the future.

12. *Sludge-to-energy process.* The primary sludge generated from the wastewater treatment process would be pressed, dewatered, and then stabilized through an anaerobic digestion process. Depending on working conditions and on actual contaminant concentrations of the raw wastewater, the treatment process may generate up to 94 tons of primary sludge. The WWTP feasibility study and design includes the construction of a cogeneration facility using the digester gas from the anaerobic digestion to produce electrical power (up to 1.3 MW) and heat. The electricity generated will be used to offset power demands within the treatment facility.

[54] The NCADE sets the maximum limits for effluent quality standard at: BOD_5 = 100 mg/L; SST = 100 mg/L; Total coliform =100 NMP/100 ml. The effluent discharged at Guasmo H does not comply with these limits as BOD and TSS concentration in the raw wastewater is very high. The effluent discharged at La Pradera does comply with the NCADE most of the time, given the high dilution of the water that arrives into the facility due to ground water infiltration into the sewerage system.

[55] The secondary treatment alternatives analyzed had 19 processes, including aerobic and anaerobic solutions. The trickling filters process was selected as the most cost-effective and preferred option for secondary treatment.

Specifications for a minimum amount of electricity generation will be included in the bidding documents for the WWTP.[56]

13. *Disposal of biosolids.* The sludge management process described above may generate up to 80 tons per day of biosolids that will be transported and disposed in the municipal landfill. The standard that has to be met for the sludge to be received at the landfill is a maximum humidity of 70 percent. The landfill is currently receiving and managing over 4,500 tons of biosolids per day, so the volume arriving from the WWTP represents a minimal addition to the existing capacity. The municipal landfill has all the required environmental permits to receive this type of waste. The Municipality has issued a certification with the commitment to receive the biosolids from the Las Esclusas WWTP in the current landfill for at least the first ten years of operation.[57] A master plan study for the future management of biosolids generated from Las Esclusas and other future WWTPs will be financed under Component 4.

[56] The cogeneration process has been studied in detail in a preliminary engineering report for cogeneration.

[57] An expansion of the existing municipal sanitary landfill is under design (studies have been finalized and should be approved by the municipality by March 2015). The municipality's plan is to start the bidding process for the works in the coming months. The existing municipal sanitary landfill has the capacity to continue operating at current volumes for at least five additional years without the planned expansion (which at current landfill exploitation rate would represent enough capacity to receive the biosolids generated from the Las Esclusas treatment plant for about 280 years of operation, if this were the only biosolids received at the landfill).

ANNEX 3: IMPLEMENTATION ARRANGEMENTS

ECUADOR
GUAYAQUIL WASTEWATER MANAGEMENT PROJECT

Project Institutional and Implementation Arrangements

Project administration mechanisms

1. *Borrower and executing agency.* The Autonomous Decentralized Government of Guayaquil has delegated the financing, execution, and management of the project to EMAPAG EP, a public municipal enterprise, 100 percent owned by the municipality. EMAPAG EP will be the borrower of the proposed loan, with a sovereign guarantee from the GoE to be granted by the MoF and a solidarity guarantee from the Municipality of Guayaquil.

2. *Implementation arrangements.* A PIU established under EMAPAG EP's General Manager will be responsible for day-to-day Project implementation and overall coordination, procurement, FM as well as for managing and supervising the results framework, monitoring, and impact evaluation. The PIU will function with its own General Coordinator with the support of technical staff from EMAPAG EP (particularly from the Finance Directorate) and will be staffed with procurement and FM specialists as well as dedicated environmental and social safeguards staff.

3. *Operation arrangements.* Once constructed, the infrastructure financed under the project will be operated by Interagua, a private operator under a 30-year concession with EMAPAG EP.

Financial Management and Disbursements Arrangements

4. *Organization and staffing.* EMAPAG EP's Finance Directorate, the *Unidad de Administración Financiera* (UDAF), in coordination with the FM specialist, will be responsible for budgeting and treasury functions under the project. The FM professional will be responsible for: (a) preparing the annual project budget; (b) accounting processes; (c) reviewing supporting documentation and payment requests (prior control) to UDAF; (d) preparing project financial reporting (including statements of expenditures [SOEs]); (e) keeping track of the timely disbursement of approved loan proceeds; (f) contract accounting; and (g) coordinating auditing requirements. UDAF will be responsible for carrying out commitments and payments processes. The FM specialist will be financed with local counterpart funds. Depending on the level of execution and demanding activities, composition of the Project FM team may require some adjustments to be coordinated with the Bank. Detailed roles and responsibilities are being reflected in the PIU Organization and Functions Proposal[58] and the OM.

5. *Programming and budgeting.* Public municipal entities are required to follow local requirements regulated by COPLAFIP;[59] Budgeting Technical Norms; Budgetary classification for the Public Sector; COOTAD;[60] and *Ley Organica de Empresas Públicas* (Public Enterprises

[58] *Propuesta de Organico Funcional UCM-E* prepared by EMAPAG EP. Available in the Project files.
[59] *Codigo Organico de la Finanzas Publicas.*
[60] *Código Orgánico de Organización Territorial, Autonomía y Descentralización.*

Organic Law) for the preparation, formulation, and execution of the annual budget. Budgets of state-owned enterprises shall be subject to their own plans, within the framework of the National Development Plan.

6. The PIU will prepare the Project Annual Program (POA) and formulate the Project budget within the calendar established by EMAPAG EP. In coordination with UDAF, the Project budget will be incorporated into EMAPAG EP's institutional budget, which is later approved by EMAPAG EP's General Manager and its Board and sent to the municipality of Guayaquil. The FM specialist will use the integrated FM system, called Erco, for budget execution, which will allow recording of project transactions classified by financing source, component, subcomponent, and type of expenditure. Budgeting reports will consider project activities structure and financing source.

7. *Accounting and information system.* EMAPAG EP has to follow the regulatory FM framework, COPLAFIP, including the use of governmental accounting standards, the use of accrual accounting basis, the chart of accounts applicable for the public sector, and the use of an FM system (developed on the basis of e-Sigef).

8. Project transactions will be recorded and processed through Erco, which produces budgeting reports (*cedulas presupuestarias*) identifying project transactions at a detailed level, as explained in the Programming and Budgeting section. Additional detailed information, such as payments by contracts, will be recorded in a Microsoft Excel spreadsheet and this information will be updated and reconciled on a monthly basis with Erco.

9. *Internal control.* EMAPAG EP has to comply with local internal control standards issued by the *Contraloria General del Estado* (CGE) and their *Reglamento Orgánico Funcional*. For project purposes, Components 2 and 3 will have specific contract administrators, this due to technical complexity, and high level of expertise required. Specific processes agreed for project implementation include (a) PIU's technical team will receive and review progress certificates and external supervisor reports (of civil works) and upon approval will send them for approval of the corresponding contract administrator; (b) Project FM specialist will (i) ensure the payment is adequately supported; (ii) set out budgeting account/s to be utilized under such payment; and (iii) specify the percentage to be paid by financing source; (c) UDAF will review adequateness of information and carry out the *commitment* process in Erco; (d) the FM specialist will record transaction, *accrual,* into the accounting module of Erco; and (e) UDAF will process payments. EMAPAG EP will use the scanning documentation system called Onbase for all project documentation.

10. *Internal audit.* The project will be subject to internal reviews by the internal audit unit of the EMAPAG EP. Observations will be required to be implemented by the PIU and UDAF on a timely basis. The external auditor will also coordinate with internal audit and take into account their observations during the audit work.

11. *Financial reporting.* The FM specialist in coordination with UDAF will have the responsibility for the preparation of project financial statements acceptable to the Bank. Project financial reports (harmonized with EIB) will be prepared on the basis of the information

provided by Erco system, (budgeting report) and detailed information recorded in Excel spreadsheets (additional information of payments by activities/contracts).

12. *Semiannual interim financial reports (IFRs)* will include loan proceeds and local counterpart funds and will be prepared in local currency (U.S. dollars) and submitted to the Bank no later than 45 days after the end of each calendar semester. They will include (a) a Statement of Sources and Uses of funds; (b) Statement of Cumulative Investments; (c) Designated Account (DA) reconciliation; (d) budgeting report; and (e) explanatory notes to the financial statements. *Annual financial statements,* including (a) and (b), will be prepared by EMAPAG EP to be audited, as specified above. The form of the project financial statements and complementary reports was reviewed and agreed with the Bank and included in the OM.

13. *Audit arrangements.*[61] Specific harmonized auditing arrangements were discussed with BEI and EMAPAG EP as part of project preparation and they include: (a) following the MOU,[62] where the CGE is responsible for selection and appointment of an acceptable, independent private auditor for the project; (b) agreement of audit ToR to be prepared by the EMAPAG EP and approved only by the Bank; (c) agreement on a single list of acceptable audit firms for all co-financiers; and (d) agreement to receive single audit report to be reviewed by both Banks.

14. Audited project financial statements, including: (a) opinion on the project's financial statements; and (b) internal control management letter, are required to be submitted for Bank's review, within six months after the end of each borrower's fiscal year or any other period required and agreed with the Bank. Audit of annual project financial statements will be conducted in accordance with International Standards on Auditing (ISAs) issued by the International Federation of Accountants (IFAC). Audit costs will be financed with loan proceeds. The ToR should be sent for the Bank's no objection not later than *four months after effectiveness*. EMAPG EP will confirm the appointment of the auditor for the first three years of project implementation no later than the first audit period /year ends. In accordance with the Bank's Access to Information policy, the audited financial statements of the project will be made publicly available.

15. *Funds flow.* A DA will be opened in the Central Bank to receive Bank loan proceeds. A separate bank account will be opened in the Central Bank to receive loan proceeds from BEI. Additionally a separate bank account will be opened in the Central Bank to receive deposits from local counterpart, which will finance PIU staff and some contracts under Components 1 and 4.

16. For payment processing, EMAPAG EP will withdraw the required amount from each special bank account (including DA), to carry out payments to consultants, contractors and suppliers, based on a financial programming and considering Bank disbursement percentages. All payments will be processed through the Interbank Payment System (SPI) of the Banco Central del Ecuador (Ecuador's Central Bank), which allows cash transfers from public entities' bank accounts, to beneficiaries' bank accounts. As previously mentioned, accounting and

[61] Local audit requirements are set out in the *Ley Orgánica de Empresas Públicas* and *Gaceta Oficial* No.42 on the constitution of EMAPAG EP of October 1, 2012, where the CGE is authorized to carry out financial audits to public entities.

[62] Memorandum of Understanding signed between the CGE and the World Bank in 2007.

budgeting records will allow the control of payments made out by component and each financing source, and such information will be used to prepare SOEs and for reconciling and control purposes.

17. *Disbursements.* The Bank will disburse loan proceeds using the methods of advance, direct payments, and reimbursement. Under the advance method, advances of loan proceeds from the Bank will be made to the DA opened in the Central Bank of Ecuador. The FM specialist will prepare withdrawal applications in coordination with UDAF. Disbursements will be based on SOEs, prepared on the basis of budgeting reports (*cedulas presupuestarias)*, which includes information of commitments, accrual (*devengado*), and payments carried out by main component/activity and financing source, all issued from Erco, and complementary information by contracts/guaranties maintained in Excel will also be used to prepare SOEs for disbursement purposes.

18. Advances may be made to the DA as long as the aggregate amount advanced does not exceed the ceiling of US$1,000,000. This calculation took into account the disbursement schedule for the first 6 months, excluding those payments under Component 3, which are expected to be carried out through direct payments, as requested by EMAPAG EP to the Bank. The frequency of reporting eligible expenditures paid from the DA, as well as supporting documentation required will be established in the Disbursement Letter.

19. All supporting documentation of the project (original records evidencing eligible expenditures, receipts, and supplier invoices) will remain at the EMAPAG EP and copies of the payment will remain at the PIU for ex post reviews from the Bank and external auditors.

20. Retroactive financing is available up to an aggregate amount not to exceed US$20.5 million, but will depend on activities which have followed Bank procurement guidelines and previously agreed with the project. Loan proceeds would be disbursed against the following expenditure categories:

Table 3.1: Table of Loan Proceeds

Category	Amount of the Loan Allocated (expressed in USD)	Percentage of Expenditures to be financed (excluding VAT)
(1) Works, non-consulting services and consultants' services under Part 1 of the Project	2,800,000	100%
(2) Works, non-consulting services, and consultants' services under Part 2 of the Project	37,000,000	100%

Category	Amount of the Loan Allocated (expressed in USD)	Percentage of Expenditures to be financed (excluding VAT)
(3) (a) Works and non-consulting services under Part 3(a)(i) of the Project	50,750,000	52%
(3) (b) Consultants' services under Part 3 (b) of the Project	7,750,000	100%
(4) Goods, small works, non-consulting services, consultants' services, Training and Operation Costs under Part 4 of the Project	4,200,000	100%
TOTAL AMOUNT	**102,500,000**	

21. *Supervision.* FM supervision would include on-site and off-site supervisions. On-site supervision missions will be carried out twice a year to the extent possible during the first year and later frequency will be calibrated on the basis of the project performance. Off-site supervisions will comprise desk reviews of IFRs and audited financial statements.

Procurement

22. Procurement activities will be carried out by EMAPAG EP through the PIU. As part of project preparation, an assessment of the procurement capacity of the implementing agency was carried out by the project team, dated August and November 2014, and it was agreed that the PIU would have: (a) an established organizational structure approved by the Bank; (b) working facilities and support capacity; (c) adequate qualifications and experience of the staff that will work in procurement; (d) adequate record-keeping and filing systems; (e) procurement planning and monitoring/control systems in place; and (f) capacity to meet the Bank's procurement contract reporting requirements.

23. For the procurement activities, the PIU will be staffed with a dedicated procurement specialist, and three or four contract managers supported by the EMAPAG EP's technical and administrative staff. Procurement risks are related to the procurement capacity of EMAPAG EP, as the technical and fiduciary teams do not have sufficient knowledge of Bank procurement procedures and contracting. Based on the information available at the time of the assessment, the preliminary procurement risk is deemed Substantial. The main findings are:

(a) Procurement risks are related to the upcoming creation of the PIU and the procurement capacity of the institution, as the technical and fiduciary teams do not have adequate knowledge of Bank procurement procedures and contract monitoring.
(b) Additional risks include poor quality of works and delays in completion of works due to (i) contractors winning at significantly lower prices than engineer's estimates; and (ii) inadequate management of large contracts due to lack of proper experience from the

EMAPAG EP side. Mitigating measures include the following: (i) all interim bills from the contractor will be substantiated with test results conforming to the Quality Assurance Plan (QAP) and Request For Inspection (RFI) form for acceptance of the work, and signed by the EMAPAG EP's technical representative; (ii) frequent monitoring (at least monthly for each contract) on quality assurance and physical progress, Bank consultants and project support consultants, based on the annual monitoring plan; (iii) the PIU, with the support of the Bank, will verify all justifications for any variation in price before executing the works; and (iv) gearing up in the PIU through the Contract Administrators to acquire proper contract management skills to face large and complex works.

24. The suggested corrective measures that were agreed upon are (a) adoption of a project OM including, among other things, procurement and contracting procedures; (b) additional provisions related to project implementation under the procurement point of view included in LA; and (c) close monitoring by the Bank, particularly during the first two years of project implementation.

25. Procurement for the proposed project will be carried out in accordance with the World Bank's 'Guidelines: Procurement under IBRD Loans, IDA Credits and Grants by World Bank Borrowers'; 'Guidelines: Selection and Employment of Consultants under IBRD Loans, IDA Credits and Grants by World Bank Borrowers', both dated January 2011 (revised July 2014); "Guidelines on Preventing and Combating Fraud and Corruption in Projects Financed by IBRD Loans and IDA Credits and Grants", dated October 15, 2006 (revised in January 2011); and the provisions stipulated in the Legal Agreement. For each contract to be financed by the loan, the different procurement methods or consultant selection methods, the need for pre-qualification, estimated costs, prior review requirements, and timeframe, are agreed between the recipient and the Bank in the Procurement Plan. The Procurement Plan will be updated at least annually or as required to reflect the actual project implementation needs and improvements in institutional capacity.

26. *Procurement of w*orks. Packages of International Competitive Bidding (ICB) are foreseen for the construction of large works. Packages amounting to under US$3,000,000 in the aggregate may be procured using National Competitive Bidding (NCB) processes. Shopping procedures may be used for contracts of up to US$250,000 (only in emergency cases). Procurement of works for NCB or Shopping methods would be based on bidding documents satisfactory to the Bank.

27. *Procurement of goods and non-consulting services.* Goods procured under the proposed project would include, among other things, civil construction goods necessary to carry out the project activities and goods (equipment, furniture, and materials) purchased for the implementation of each component. Procurement of goods will be done using the Bank's standard bidding documents (SBD) for ICB and bidding documents satisfactory to the Bank for NCB or Shopping methods.

28. All procurement notices shall be advertised on the project's website, the EMAPAG EP's website, and at least one local newspaper of wide national circulation. ICB notices and contract award information shall be advertised in the United Nations Development Business online

(UNDB online) in accordance with provisions of paragraph 2.60 of the Bank's Procurement Guidelines.

29. *Selection of consultants.* Consulting firm services may be contracted for supervision (*Fiscalización*), audits, and evaluations. The procurement of consulting firms will be carried out using Bank standard Request for Proposal (RFP) documents. International firms should have the opportunity to participate in all solicitations above US$200,000. Short lists of consultants for services estimated to cost less than US$200,000 equivalent per contract may be composed entirely of national consultants (firms registered or incorporated in the country) in accordance with the provisions of paragraph 2.7 of the Consultant Guidelines. Consulting firms would be selected following Quality- and Cost-based Selection (QCBS) for all contracts in the estimated amount of more than US$200,000.

30. *Selection of individual consultant services.* Individual consultant services will be contracted mostly for project management and for technical advice, mainly in the substantive matters of the project, but also for design, supervision, and technical assistance. The ToR, job descriptions, minimum qualifications, terms of employment, selection procedures, and the extent of Bank review of these procedures to contract and documents are described in the OM and the contract shall be included in the Procurement Plan.

31. A project website, an EMAPAG EP's website, and a national newspaper shall be used to advertise expressions of interest as the basis for developing short lists of consulting firms and individual consultants, and to publish information on awarded contracts in accordance with the provisions of paragraph 2.31 of the Consultant Guidelines and as mandated by local legislation. Contracts expected to cost more than US$300,000 shall be advertised in UNDB online.

32. *Training.* This would include expenditures (other than those for consultants' services) incurred by the borrower to finance logistics for workshops, meetings and seminars as well as reasonable transportation costs and per diem of trainees and trainers (if applicable), training registration fees, and rental of training facilities and equipment. Procurement would be done using NCB and shopping procedures as discussed below. Direct Contracting (paragraph 3.8 of the Procurement Guidelines) may be used for the payment of registration fees, up to a ceiling amount to be established annually in the Procurement Plan.

33. *Operating costs.* The project will finance incremental operational costs of implementing institutions and the operational costs of the PIU, including salaries, travel costs, and subsistence for missions of project staff (excluding civil servants); establishment and operation of the monitoring and supervision, technical and financial audits; O&M of project offices, including utilities and telecommunication; and acquisition and O&M of office and field equipment needed for project activities. These operating costs will be administered in accordance with the Bank's Procurement Guidelines, as appropriate. Procurement also will be carried out using the Bank's SBD or national SBD agreed with the Bank.

34. *Operational Manual.* The OM includes all procedures, rules, and standards for the implementation of all aspects of the project including, but not limited to, institutional arrangements; operation of the PIU; project planning and M&E; social and environmental

management, reporting, communication, and human resources; procurement; administrative and FM; and procedures for amending the OM.

35. *Procurement Plan.* A Procurement Plan covering the first 18 months of project implementation has been agreed upon by the borrower and the project team. It is expected to have an ICB, including a prequalification for the Las Esclusas WWTP and the Guasmo H pumping station and transmission pipeline; an ICB for the La Pradera transmission pipeline (trenchless construction method); another ICB for the rehabilitation of the sewerage network; and the related international consulting services (firms) for the supervision (*fiscalización*) of the works financed by the Bank. Some international contracts for individual consultants may be required to provide specific additional technical capacity as applicable.

36. *Frequency of procurement implementation support.* In addition to prior review implementation support missions to be carried out by the Bank, the capacity assessment has recommended semiannual missions, including field visits for the contract implementation and monitoring, and post reviews of procurement actions. Those contracts subject to post review will be reviewed by the Bank, and based on the findings of these reviews and the proposed ratings, the Bank may determine the revision of the prior review requirements.

Environmental and Social (including safeguards)

Social

37. During project preparation, EMAPAG EP agreed to put in place mitigation measures and implementation arrangements for the following social management issues:

38. *Social safeguards***.** There are no **indigenous people** present in the project area that meet the criteria defined by the policy. According to the 2010 census, less than 1.4 percent of the population of Guayaquil identify themselves as indigenous. This population is not concentrated in the project area nor do they have a collective attachment to land which is used for urban residential or industrial purposes. Therefore, the Bank's operational policy on Indigenous Peoples does not apply.

39. The Bank's operational policy on **Involuntary Resettlement** does apply as the municipality is still in the process of expropriating the 40.74 ha required for the construction of the WWTP under Component 3. The WWTP will be located on a site which has been the property of six different private owners. Expropriation begun in 2011. The municipality has already proceeded with the payment of compensation amounts (held in trust by the court) and has legal entitlement to the land. However, four court cases have delayed its finalization. Of these, two cases went to court because the owners could not be located (one was outside the country and the other was a company in liquidation; in these cases, the market value of the land was confirmed by a court appointed expert and the compensation amounts are held in trust by the court and can be collected at any time by the affected parties). Two other property owners contested the original valuations in court and a decision on these claims is still pending. In one of these two cases, additional payments have already been agreed as a mitigation measure in order to compensate for structures in the land. In the other case, a court appointed valuation expert has confirmed the original replacement value assessed by the municipality. The owners of the land

have followed one more instance to appeal to the courts for a higher value and final appeal sentence expected in April 2015. However, according to Ecuador's legal framework, the expropriation decision itself cannot be contested, and the trials can only rule on the amount of the compensation to be granted to the former landlords. Therefore, given that the municipality has agreed to pay full replacement costs (using market comparators) for the assets being acquired, and that in the one case where this is being appealed the costs have been validated by a court appointed independent expert, it is considered that land acquisition no longer entails a significant risk to the Project's implementation. The municipality already has the tenure of the land, and the pending decision from the Courts on the final amount of the compensation for the one outstanding case will be binding for both parties and cannot be contested. The municipality has already set aside the funds for any additional payment that the judge may determine within the regulatory framework.

40. The Bank team reviewed the expropriation process being conducted, and required EMAPAG EP to prepare and disclose an RAP which summarized the land acquisition and resettlement impacts of the project, the degree to which the expropriation process adhered to the requirements of OP 4.12, the additional measures necessary to meet the requirements of OP 4.12, and the implementation arrangements necessary to deliver compensation and resettlement assistance. The RAP describes how, in all but one case, the process adhered to the requirements of OP 4.12 with properties being valued at full replacement cost (using market comparators), with an offer of an additional ten percent being made. However, for one property the initial valuation did not take into account the economic impact on the owner, nor the presence of a residential structure occupied by an employee of the owner. The RAP describes the agreement reached with the owner of this site to compensate for these impacts, the site occupant was physically displaced and resettled in an alternative location and was able to maintain her employment. **The RAP also describes describe the negotiation and consultation process** with the owners and occupant, the grievance redress system in place, and the timetable and responsibilities for carrying out the additional mitigation measures required.

41. Activities planned under Components 1 and 2 (domestic connections and sewer lines) will not result in any resettlement impacts anticipated under OP 4.12. The works will be conducted using trenchless technology which minimizes the disruption of pavements and roadways. Also, a visual inspection by the implementing agency and the task team, of the zone of intervention, confirmed that the right of way was not encroached upon. While there are a small number ambulatory vendors dispersed throughout the target neighborhoods, they are genuinely mobile and can relocate immediately following discussions with the contractor (as specified under the ESMPs).

42. In terms of associated facilities, the task team conducted due diligence site visits to the landfill being expanded that will receive the solid waste generated by the WWTP. These visits, along with discussions with the municipal lawyer responsible for expropriation, confirmed that the land necessary for this expansion are now the property of the municipality and that they are unoccupied vacant land areas, and that full market price was paid for their purchase. It was furthermore confirmed that temporary land acquisition will not be necessary to source aggregate or other construction material, as private quarries have been pre-identified for this purpose.

43. *Beneficiary Assessment.* A BA for Components 1 and 2 was completed during project preparation. This involved a survey of a random sample 400 households in the project area, and collected information on their socioeconomic characteristics, their sanitation solutions and hygiene practices, as well as their willingness and capacity to connect to the sanitation network. The initial results indicate that the vast majority of households were not connected to the sanitation system. While over 40 percent were ready connect, a significant proportion of the households' surveyed needed additional information (17 percent) or to resolve financial problems (31 percent). While the most important neighborhood problem cited by respondents was crime and delinquency, access to sanitation was ranked as the second most important (ahead of disease, unemployment, lack of transport). Additional BAs will be conducted during project implementation and will collect information from a larger sample on a wider array of issues, including the willingness to pay for the adjusted tariff and the positive health and environmental impacts of the project.

44. *Citizen engagement and Grievance Redress Mechanisms.* The implementing agency will pursue a comprehensive program of citizen engagement throughout project implementation with a strong emphasis on Components 1 and 2. This program is outlined in the social management chapter of the project OM. The engagement process begins with community meetings convened by EMAPAG EP's citizen participation team. These meetings engage with the main neighborhood groups located in the project zone, and the contractors responsible for conducting the works. The purpose of the meetings is to inform the communities on the objective of the project, to scope out potential problems and opportunities (for example, for local employment) during implementation, and to present the grievance redress system that will be put in place by the contractor and EMAPAG EP. This is followed by a program of community-based training for household members on the proper usage of the system. A program of social certification will also be implemented, whereby individual beneficiary households certify that they are satisfied with the works conducted in their houses. This process is crucial to the social sustainability of the project, and ensures the contractor is accountable for the plumbing works conducted within the household. EMAPAG EP has successfully implemented this system of social certification in the past, getting signed beneficiary certification in over 95 percent of beneficiary households. Furthermore, throughout the process of conducting the works, the contractors will be required to have a focal point responsible for managing and registering grievances that arise (required by the ESMP), addressing those that can be addressed, and escalating others to the supervisor or EMAPAG EP. A Grievance Redress Mechanism (GRM) will already be in place before the contractor is selected. Finally, the implementation stage BAs will collect information on the relative satisfaction of the beneficiaries with the system installed.

45. *Gender inclusion.* There are a number of possibilities for including gender considerations in the design and implementation of the project. During preparation, the BA analyzed gender disaggregated information on sanitation solutions, hygiene practices, as well as willingness and capacity to connect to the sewage network. In terms of gender informed actions, it is anticipated that Component 1 of the project will be particularly beneficial to female household members who normally have the main responsibility for managing household issues related to health and hygiene. Therefore, the communication campaign to promote domestic connections to the sanitation system will be primarily targeted to female household members. Similarly, a community-based training program on the proper management of the systems installed in order to optimize environmental and hygiene benefits will be primarily targeted towards female

household members. Gender disaggregated indicators will be collected on the participants in this training program, as well as the perceived positive impacts of the system following installation using follow-up BAs.

46. The implementation capacity of EMAPAG EP and the municipality of Guayaquil, for the social management of this operation is high. EMAPAG EP has a dedicated social management team, the Directorate for Social Communication and Community Management (*Dirección de Comunicación Social - Gestión Comunitaria*) made up of a director, 2 analysts, and 3 assistants. This group has experience in successfully managing the roll out of communication campaigns and community consultation processes, facilitating conflict resolution and grievance redress, building the capacity of community-based organizations, as well as the resettlement of households affected by the works of EMAPAG EP. In order to support the implementation of the social management of this project it has been agreed that two additional social specialists will be recruited. In terms of land acquisition, the municipality of Guayaquil has decades of experience, having established a dedicated area within its legal department in 2002 to work alongside the Valuation and Cadaster Department. The majority of expropriation cases (80 percent) are settled through agreement with the owner, rather than recourse to the judicial system.

Environmental

47. *Environmental impacts and classification:* The proposed project has been classified as Environmental Category A due to the type and size of the Project's Component 3, the construction of a 3.6 m^3/s WWTP. The overall project impact is expected to be positive due to the improved effluent quality that will be discharged into the Guayas River and the reduction of untreated wastewater that is presently leaking from the existing sewer system and affecting shallow ground and surrounding surface water bodies, like the Estero Salado estuary.

48. For Component 3 (Las Esclusas WWTP and works), an ESIA has been developed by an international consulting firm with the support of a local environmental consulting firm. The ToR for the ESIA were approved by the MAE. The ESIA includes an assessment of impacts, including mathematical modeling of potential downstream impacts during plant operation, and an ESMP. The WWTP will treat wastewater from the central and southern districts of Guayaquil located within the La Pradera and Guasmo wastewater sewer watersheds and will be constructed on the southern shore of the Cobina estuary, in the proximity of its intersection with the Guayas River. The Guayas River is one of the largest watersheds in South America draining into the Pacific Ocean, with an extension of 32,130 km^2 partially covering eight provinces of the country.

49. The Guayas River near at the intersection of the Daule and the Babahoyo, located 5 km north of the city, and has a flow that varies from 230 m^3/s in the dry season to 1,500 m^3/s during the rainy season. The river water is saline and its water quality is affected by several wastewater discharges and other pollution sources (for example, storm water runoff) upstream of the project location with none or very limited treatment. The WWTP is part of the municipality of Guayaquil Municipal Plan for the Universalization of Wastewater Management Services, which considers the expansion of the sewer network and the installation of households connections and the rehabilitation and construction of five wastewater treatment facilities—Las Esclusas, Los Merinos (existing lagoon system), Mucho Lote, Puerto Azul, and Mi Lote—to treat all the wastewater generated in the city.

50. The project Component 3 includes a WWTP (mechanized pretreatment, CEPT, disinfection system, underwater outfall diffuser, hypochlorite production, sludge digester, diffuser outfall in Guayas River); adaptation of the Guasmo H pumping station; the construction of a new pipeline to drive pumped water to the new WWTP; decommissioning of the La Pradera pretreatment station; closing of existing discharge; and construction of a new pumping station and pipeline to drive pumped water to the new Las Esclusas WWTP. The design will allow compliance with current environmental regulations in Ecuador.[63]

51. EMAPAG EP has planned for the future expansion of the WWTP to enable secondary treatment, if it was required by Ecuadorean environmental regulations in the future. Alternative analyses in terms of WWTP technological and design options and site locations were conducted as part of the regional water planning work and the WWTP feasibility and project design (see annex 2 for details) and also in the ESIA. The analysis of alternatives and selection of site locations for the treatment plant was conducted in 2004 as part of the Master Plan for Water Supply and Sewerage Services of Guayaquil, which as updated in 2011. The potential risk of flooding at the WWTP has been addressed in the project design. The main potential negative impacts include: removal of topsoil and changes in terrain and topography; contamination by solid or liquid wastes; generation of dust, combustion gases, noise, and vibrations; odor generation; inconveniences caused by urban and traffic congestion; impact on shallow ground quality and groundwater level; impacts on Guayas River water quality; alteration of landscape; worker health and safety; disposal of sludge; and expropriations of land for WWTP.

52. Potential positive impacts identified include reduction of odors in the La Pradera pumping station due to closure; reduction/elimination of overflows of wastewater in the streets; improvement in Guayas River water quality; and local job creation. The ESMP includes the following nine programs (that include 36 environmental measures and 122 activities): Plan for Prevention and Mitigation of Impacts; Handling and Management Plan of Wastes; Monitoring and Measurement Plan; Plan for Restoration of Degraded Areas; Occupational Health and Safety Plan; Community Relationship Plan; Training Plan; Contingency Plan; Abandonment Plan; and Environmental Monitoring Plan. Depending on actual operating conditions in the raw wastewater, the treatment and sludge management process may generate up to 80 to 94 tons per day of biosolids that would be disposed in the municipal landfill. The primary sludge generated from the wastewater treatment process would be pressed, dewatered, and stabilized before transportation and final disposal at the sanitary landfill.

53. An agreement has already been reached between EMAPAG EP and the consortium running the landfill, which has all required environmental permits to receive this waste. The landfill has the capacity to receive municipal waste (4,500 tons/day), including the expected volume of sludge from the plant (an additional 80 tons/day), for at least another five years, based on its current rate of exploitation. The municipality will issue a certification committing to receive the biosolids generated at the WWTP for at least the first ten years of operation of the WWTP, by guaranteeing the space available at the existing landfill. Plans for the future expansion or the construction of a new municipal sanitary landfill are under discussion between

[63] The National Norm on Environmental Quality and Effluent Discharges sets the maximum limits for effluent quality standard at BOD_5 = 100 mg/L; SST = 100 mg/L; Total coliform = 100 NMP/100 ml.

municipal and environmental authorities which will allow the continuation of the sludge disposal in this manner. A master plan study for the management of biosolids generated from Las Esclusas and other future WWTPs will be financed under Component 4. This study will look at options for the reutilization of sludge through the production of compost (using secondary dewatering and structuring mix processes).

54. The draft ESIA was disseminated and consulted locally in September and October 2014 and included a formal public audience, several permanent Public Information Centers, and informal informative meetings. Public consultations were coordinated and approved by an independent Facilitator appointed by the MAE. Main comments received focused on: requests for proper maintenance of the sewerage collection and transportation systems to avoid blockages and overflows, statements expressing acceptance and support for the project, concerns about proper odor control from the WWTP, concerns over ensuring timely completion of the works, and concerns about inconveniences that could be caused by rupture of street pavement amongst others. The draft ESIA was also reviewed by 3 independent experts. Comments were addressed in an updated final ESIA. The ESIA is pending approved by the MAE.

55. For Components 1 and 2, an ESMP was developed for each component and includes an assessment of potential impacts and proposed mitigation and monitoring measures. Component 1 will finance the installation and rehabilitation of household connections in specific areas within the southern districts of the city of Guayaquil, where household toilets discharge directly to the estuary or to reportedly poorly constructed and maintained pits or septic tanks, which contributes to the degradation of the Estero Salado. The works involve establishing a connection from an existing sewer line in the street to a house and the potential environmental impacts are relatively minor. Component 2 involves the rehabilitation of the sewerage network in La Chala basin within the Suburbio Oeste area and will improve sewer efficiency by reducing infiltrations and contribute to the reduction of the contamination of the Estero Salado estuary from domestic wastewater. The works should have relatively minor to moderate potential negative environmental impacts during construction (for example, generation of noise and dust, minor traffic disruption, disposal of waste) and can be readily mitigated with standard measures established in the ESMP, and even less impacts are associated with works in Component 1. The ESMPs include a chance-find procedure applicable natural habitat protection measures, as needed, given the proximity to the works and the Guayas River and the Estero Salado. The draft ESMPs for Components 1 and 2 were disclosed and consulted in January 2015, and revised ESMPs have been prepared by EMAPAG EP. Compliance with the ESMP will be included as part of the construction contracts.

56. As part of Component 4, the Bank and EMAPAG EP identified measures to enhance and promote positive environmental benefits, especially funds to support the development and establishment of a water quality monitoring system for both the Guayas River and the Salado Estuary and the development of master plan for the management of biosolids generated from all the city's WWTPs.

57. EMAPAG EP will be responsible for managing all environmental and social aspects of the project. A PIU established under EMAPAG EP's General Manager will be responsible for day-to-day project implementation, including environmental aspects. The PIU will be staffed with dedicated environmental and social safeguards staff. The O&M will be the responsibility of

Interagua, which is the private consortium to which EMAPAG EP has delegated the management of Guayaquil's drinking water, wastewater, and drainage systems. EMAPAG EP has experience managing environmental safeguards associated to multilateral financing institutions, particularly with *Corporación Andina de Fomento* (CAF) and Inter-American Development Bank (IDB) loans. Interagua has environmental staff, experience managing wastewater treatment facilities and its management system is ISO 14001, ISO 18001, and ISO 9001 certified. Environmental safeguards responsibilities and supervision will be established in the project OM.

58. *Safeguards instruments and Environmental Assessment (EA) process.* An ESIA has been developed for the proposed WWTP (Component 3) in compliance with Ecuador's environmental regulatory framework. As such, the ToR for the ESIA was approved by the MAE. The Bank team has reviewed the scope of the ESIA and found that it's technical and scientific rigor is consistent with the nature of the project and that the methodology used for the identification and analysis of environmental impacts conforms to good national and international practices. The design and location of the WWTP included an alternative analysis in terms of design options and site location. The final ESIA also includes a description of the general strategy developed by government entities that are responsible for water quality in the Guayas River, with a hydrographic basin approach.

59. *Disclosure and consultation.* An advanced draft of the ESIA was published in EMAPAG EP's and the Bank's website on December 16, 2014, for public knowledge and consultation. An earlier draft of the ESIA was also widely disseminated and consulted locally from September 18 to October 8, 2014, in a formal public audience, several permanent Public Information Centers, and informal informative meetings, following national regulations and Bank recommendations. In Ecuador, public consultations are coordinated by a facilitator appointed by the MAE who has an oversight and approving function. According to Ecuadorean regulations and Bank environmental standards, concerns and recommendations from the community must be considered and addressed by EMAPAG EP in the ESIA and the ESMP. All comments received as a result of the public consultation processes, as well the mechanisms to address them, have been included in the ESIA which was publicly disclosed on December 16, 2014 (pending final report from the facilitator from MAE). Of the comments received, around 20 percent were related to requesting proper maintenance of the sewerage collection and transportation systems to avoid blockages and overflows, around 19 percent were expressing acceptance and support for the project, a further 19 percent were expressing concern about proper odor control from the WWTP, around 12 percent expressed concern over ensuring timely completion of the works and around 8 percent expressed concern about inconveniences that could be caused by rupture of street pavement amongst others. These concerns by the community are addressed in the ESMP which has been prepared by EMAPAG EP, differentiating between the construction and operation phases.

60. The ESIA has also been reviewed by a panel of independent qualified national experts as recommended by the Bank team. The ESIA was updated to reflect further revisions and comments provided by the Bank and the panel of experts and disclosed in the Bank's and EMAPAG EP's website on February 26, 2015.

61. For works to be constructed under Components 1 and 2 (for example, sewer connections to residential houses and rehabilitation of main sewer lines), ESMPs have been developed also in

accordance with Ecuadoran regulations for environmental licensing and under ToR reviewed by the Bank team. Overall social impacts of Components 1 and 2 have been assessed both during the preparation of these ESMP and the Beneficiary Survey mentioned above. Final ESMP drafts have been disclosed in the Bank's and EMAPAG EP's website on February 27, 2015.

62. The Bank is exploring options with EMAPAG EP to enhance and promote positive environmental benefits, such as a more comprehensive water quality monitoring program for the Guayas River, promoting the participation of the main users of the river. In this respect, it has been agreed EMAPAG EP that Component 4 of the project will include funds to support the development and establishment of a water quality monitoring system for both the Guayas River and the Estero Salado estuary, as well as a master plan for the management of biosolids generated from the city's WWTPs.

Monitoring & Evaluation

63. The project results framework is included in Annex 1. This framework has been developed in close coordination with EMAPAG EP, who will consolidate the data at the project level and produce semiannual reports to monitor progress. These reports will indicate the progress made under the different components and measure performance against the results indicators established in the results framework. The semiannual progress reports will allow a better monitoring of the implementation of agreed activities by also providing information on (a) investment and disbursement performance over the period covered by the report and an updated disbursement calendar; (b) procurement performance and an updated Procurement Plan for activities under each of the components and subcomponents of the project; (c) accounting and FM performance; (d) progress in the implementation of the ESMP, including problems identified and documentation of positive environmental and social impacts in the areas of intervention; (e) potential developments that could affect project implementation, including a review of the main risks and the impact of mitigation measures envisioned at appraisal; and (f) other operational and administrative information judged relevant by EMAPAG EP or the Bank team accompanying project implementation. The second semiannual report of each calendar year should also include an annual operation plan for the following year. EMAPAG EP progress reports will be presented and submitted to the Bank in accordance with the format established in the project's OM.

64. At the mid-term evaluation of the project, the Bank team and EMAPAG EP will undertake a detailed review of the M&E system to verify fulfillment of the agreed targets and compliance with other contractual commitments and will recommend any necessary corrective action.

65. *Project baseline and impact evaluation:* The project will finance, as part of Component 4, a project baseline and impact assessment. The assessments will enable EMAPAG EP to accurately measure the impact of the project in terms of improvements in customer satisfaction and improvements in living conditions, environmental conditions, and health. The IE methodology will aim to identify a control group within the population for which data is already being collected on which the observed changes in key performance indicators can be empirically compared.

Role of Partners (if applicable)

Name	Institution/Country	Role
European Investment Bank	Luxemburg	Co-financier
Ministry of Finance	Quito, Ecuador	Provide sovereign guarantee for the IBRD and EIB loans.
Decentralized Autonomous Government of Guayaquil	Guayaquil, Ecuador	Provide budget allocation to EMAPAG EP during the life of the project as per municipal certification of December 22, 2014.
MAE	Quito, Ecuador	Provide environmental license for all works. Ensure proposed activities are environmentally sound.
SENAGUA	Quito, Ecuador	Provide technical viability and ensure compliance with sector laws and regulations.

ANNEX 4: IMPLEMENTATION SUPPORT PLAN

ECUADOR
GUAYAQUIL WASTEWATER MANAGEMENT PROJECT

Strategy and Approach for Implementation Support

1. The strategy for Bank project Implementation Support (IS) reflects the nature of the project and its risk profile and aims to support and enhance the quality of the EMAPAG EP's delivery of the proposed project interventions. As such, the IS will focus on technical and institutional aspects, environmental and social issues and safeguards and fiduciary aspects, including FM and in particular, procurement. The IS will also monitor the evolution of the risks identified in the main text of this document, and whether the mitigation measures defined are working adequately to protect the achievement of the PDO.

2. The proposed project will be financed by EMAPAG EP, the IBRD, and the EIB. The implementation of the proposed project includes significant challenges, due to: (a) the size and technical complexity of some of the contracts to be funded under the project; (b) the lack of previous experience in EMAPG EP with the project implementation requirements of the International Financing Institution (IFI); and (c) the concurrence of two international financiers which, despite current efforts to harmonize procedures as much as possible, could lead to some diversity in operational and implementation arrangements.

Implementation Support Plan

3. Given the advanced status of preparation of the key works to be financed (the final engineering design of the Las Esclusas WWTP is underway and expected to be delivered in April 2015 along with the corresponding bidding documents), during the first 12 months of implementation, the focus will be placed on supporting the comprehensiveness and quality of the technical designs and the procurement processes for the contracting of qualified, capable and financially sound contractors through competitive and transparent processes in compliance with Bank procurement guidelines. Another key area of focus for the first year of implementation will be (a) to define the scope of the IE to be undertaken under Component 4 and undertake the baseline for the indicators and variables which are considered under such scope; and (b) to advance on the definition of final scope and in the contracting of the three strategic studies to be funded under Component 4 on water quality monitoring and biosolid management. Training to EMAPAG EP and the PIU on financial management according to Bank's guidelines will also be necessary during the first 12 months.

4. It is expected that the contracting of all works under the project will be finalized or well underway after the first year of project implementation. Therefore the focus of IS during the second year (and onwards) will be on supporting a smooth start of works contract execution and the implementation of ESMPs, as well as providing quality enhancement reviews for the strategic studies under development under Component 4, providing insights from global experience in the monitoring of environmental quality of superficial water bodies and the connection of poor households to the network, as well as learning from EMAPAG EP experience

in the implementation of Component 1. As project implementation progresses, an important area of focus will be the contribution to the planning and development of the next phases of Guayaquil's wastewater management strategy, including the development of future WWTP which will be facilitated through the Bank's engagement in the financing of the proposed project. Lastly, during the last year of project implementation, IS will focus on ensuring that the end-of-project survey/study is undertaken to enable the elaboration of the project's Impact Assessment.

5. At a minimum, IS will include project launch technical visits followed by semiannual IS technical visits (including field visits to the works already under execution) to provide technical support and verify compliance of implementation with the project's OMs as well as promote adjustments to project design, as needed, based on implementation progress. IS will include continuous and regular follow-up with EMAPAG EP from the task team at the Ecuador office. After two years of project implementation or earlier if required, the Bank will conduct the project's midterm review.

Implementation Support Resource Estimate

Time	Focus	Skills Needed	Resource Estimate (staff/weeks)	Partner Role
First twelve months	Review of ongoing prequalification process and then bidding process for the construction of Las Esclusas WWTP, and help the preparation and subsequent review of bidding documents for other contracts	Task Management Technical Specialist Procurement Specialist	16	The EIB will rely largely on Bank's input; the EIB must provide " No Further Comments (No Objection) to bidding documents and contract awards
	Project management and project implementation support coordination	Task Team Leaders	4	
	Environmental safeguards and strategic studies	Environmental Specialists	4	
	FM training and implementation support	FM Specialist	4	
	Social safeguards-RAP implementation support	Social Specialist	4	

Time	Focus	Skills Needed	Resource Estimate (staff/weeks)	Partner Role
12–48 months				
	Project management and project implementation coordination	Task Team Leaders	12 per year	
	Procurement knowledge transfer and implementation support	Procurement Specialist	4 per year	
	FM knowledge transfer and implementation support	FM Specialists	4 per year	
	Social safeguards - implementation support and knowledge transfer	Social Specialists	2–4 per year	
	Environmental safeguards - implementation support coordination	Environmental Specialists	2–4 per year	

Skills Mix Required (annually during Project life)

Skills Needed	Number of Staff Weeks	Number of Trips	Comments
Task Team Leader (Supervision)	8	4–6	Country-based
Co-Task Team Leader (Supervision)	4	2	HQ-based
Water and Sanitation Specialist	4	4–6	Country-based
Technical Expert	4	4	HQ-based
Procurement Specialist	4	4	Regionally based
Financial Management Specialist	4	2	Country-based
Environmental Specialist	4	2	HQ-based
Social Specialist	4	2	HQ-based
Legal Counsel	2	1	Regionally based

Partners

Name	Institution/Country	Role
European Investment Bank	Luxemburg	Co-financier
Ministry of Finance	Quito, Ecuador	Provide sovereign guarantee for the IBRD and EIB loans.
Decentralized Autonomous Government of Guayaquil	Guayaquil, Ecuador	Provide budget allocation to EMAPAG EP during the life of the project as per municipal certification of December 22, 2014.
MAE	Quito, Ecuador	Provide environmental license for all works. Ensure proposed activities are environmentally sound.
SENAGUA	Quito, Ecuador	Provide technical viability and ensure compliance with sector laws and regulations.

ANNEX 5: FINANCIAL ANALYSIS OF THE BORROWER AND WSS SERVICES OPERATOR

ECUADOR
GUAYAQUIL WASTEWATER MANAGEMENT PROJECT

1. This analysis consists of three separate assessments: (a) fiscal analysis of the municipality of Guayaquil, as the entity who owns 100 percent of EMAPAG EP; (b) financial analysis of EMAPAG EP, regulatory agency, as the borrower, in charge of repaying the loan; and (c) financial analysis of Interagua, water and sewerage service provider, as entity in charge of operating and maintaining the works implemented under the project. The detailed report can be found in the project files and an executive summary of key issues and results is presented below.

Fiscal Analysis of the Municipality

2. The municipality's finances show sound results. During the period 2005–2013, current expenditures have been covered by current revenue, generating an average operating margin of about 30 percent. During this period, the municipality of Guayaquil, as the most important seaport and business hub of the country, has generated own revenues of US$150 million on average per year, representing 45 percent of total revenues and showing a growth rate of 7.5 percent per year. The GDP generated at the municipality of Guayaquil represents 80 percent of the Guayas Province's GDP and around 18 percent of Ecuador's.

3. In 2013, national transfers represented 59 percent of the municipality's total revenues. On average, transfers from the National Government were US$170 million per year during the 2005–2013 period (51 percent of total revenues), and have grown at 10.8 percent annually. The municipality of Guayaquil transfers from the National Government US$30 million per year to EMAPAG EP to contribute with investment required in the water and sanitation services.

4. The municipality has contracted loans to partially pay for capital expenditures in all sectors. Capital expenditure has been on average US$230 million per year. From 2005 to 2013, debt has increased 68 percent, yet this growth has been lower than revenue growth, which has doubled during the period. As a consequence, debt stock to revenues ratio has decreased from 39 percent in 2005 to 32 percent in 2013. Outstanding total debt in December 2013 was US$143 million, or 32 percent of revenues. Servicing the debt has not caused financial stress to the municipality. Financial expenses have decreased from seven percent of revenues in 2005 to just one percent in 2013. Debt service (interest and principal) has represented less than ten percent of total revenue or 24 percent of own revenue during the period. By 2013, debt service was just three percent of total revenue or eight percent of own revenue. Debt stock has been lower than one percent of GDP in the 2007–2010 period, where information of GDP was available.

5. All debt indicators show levels lower than the ceilings established in the Ecuadoran Legislation, defined in the 2010 *Codigo Organico de Planificacion y Finanzas Publicas*. This legislation establishes the following debt limits: (a) at the national level, public debt cannot be higher than 40 percent of GDP; and (b) at the municipal level, two indicators are set: *debt stock to total revenue* ratio has to be lower than 200 percent and *annual debt service to total revenues* has to be lower than 25 percent.

6. The results of the analysis show that the municipality would be able to take the additional new loans of US$205 million from the IBRD and the EIB. The projected debt stock and associated debt service would be far lower than the ceiling established under the law. The maximum point will be in 2017 when debt stock will be 66 percent of revenues, still lower that the 200 percent established, then it decreases gradually to reach 30 percent in 2022. Servicing the debt will require about 10 percent of total revenue, lower than the 25 percent established by law.

Table 5.1: Projection of Debt Ratios and Compliance with the Law (2014–2022)

Municipality of Guayaquil	2014	2015	2016	2017	2018	2019	2020	2021	2022
Debt-Revenue Ratios									
Debt stock/total revenue has to be lower than 200%.									
Expected values	42%	42%	58%	66%	59%	54%	45%	37%	30%
Compliance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Debt service to total revenue has to be lower than 25%.									
Expected values	10%	6%	7%	6%	5%	5%	7%	7%	6%
Compliance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Financial Analysis of EMAPAG EP

7. The financial analysis of EMAPAG EP is based on the municipality's commitment of keeping annual transfers of US$30 million to contribute with water and sanitation investments. The US$30 million is part of what is transferred by the National Government to the municipality, who is in charge of transferring them to EMAPAG EP. This transfer represents a small fraction of municipality's total revenues (8 percent) or of National Transfers (13 percent) and it does not risk municipality's operation. The municipality has transferred the funds on regular basis since 2002 and EMAPAG EP has applied them to water and sanitation investments complying with the concession contract agreements.

8. The US$30 million funds transferred by the municipality every year to EMAPAG EP would be enough to service current loans and the loans to be contracted with IBRD and the EIB. Currently EMAPAG EP is responsible for paying loans contracted by the municipality with the *Banco del Estado* (BdE), which by 2013 equaled US$22 million. It is expected that this loan will be fully paid by 2018, until then servicing it costs about US$4 million per year.

9. Debt obligations of interest and principal will vary according to grace and maturity periods, which are not defined at this time but some estimates were done in coordination with the Bank team Financial Officer. Simulation was drawn assuming 5 years of grace period and results show that debt service will always be below US$30 million per year, which is the transferred amount. This is also true if there is no grace period. The breakeven point would be reached when the repayment period is 10 years, there is no grace period, and the annual interest rate is five percent. Under these conditions, debt service from both loans would equal US$30 million; yet the likelihood of this happening is very low, if any, as both Banks offer softer financial conditions.

Financial Analysis of Interagua

10. The analysis examined audited financial statements for Interagua for the period 2009–2013. The results of the analysis show a healthy financial operation. Operating costs have been fully covered by revenues along the years. The operating margin has been about 20 percent, which has allowed Interagua to pay for its financial obligation and taxes. Net income generated has been about ten percent of revenues. The Operating Ratio, measured as operating costs to revenues, has been 0.83 on average in the period. In 2013, this ratio increased to 0.86.

11. The concession contract between EMAPAG EP and Interagua establishes one financial indicator: equity to liabilities ratio, which has to be at least 35 percent. Actual value of equity-debt level has been on average 85 percent during the period, which is far higher than the value established by the covenant.

12. A financial projection was built to understand the impact that the upcoming operation will generate on Interagua's finances and define the actions needed to mitigate the impact. The projected operating and maintenance costs of the works to be implemented under the project will be about US$8 million per year, increasing total operating costs by six percent. If revenues are not increased, the operating ratio would deteriorate and the operating surplus would not be enough to cover financial obligations, risking Interagua's financial sustainability.

13. A tariff review for the concession is due in the short term as the current regulatory period of 5 years will end in 2015.[64] The new tariff levels will be applied for the period 2016–2020 taking into consideration the investment plan, associated targets, and corresponding operating and maintenance costs. Results of the analysis show that in order to maintain the operating ratio below 0.85 levels and to be able to pay financial obligations and maintain a net income at similar levels than historical figures, the sewerage tariff should increase to 95 percent of water charges, from current charge of 80 percent of water charges. Current water tariff is US$0.58 per m^3 on average and for sewerage it is US$0.42 per m^3.[65] If the connection has both services, the average domestic monthly bill is about US$14 per connection. The increase on sewerage tariff will increase the monthly bill for water and sewerage to about US$15 per month.

14. Under this scenario, results show that Interagua will be financially able to operate and maintain the works constructed under the proposed project, showing an operating margin of around 15 percent. The operating ratio would gradually decrease from 0.86 in 2013 to 0.84 in 2020. Net income would be about 5 percent of revenues. The operating ratio was selected as one of the key performance indicators for sustainability and included in the project Results Framework as this indicator shows the cost coverage level and it also allows monitoring financial sustainability of the operation of the works implemented under the project. A maximum value of 0.90 has been set during the project's implementation period.

[64] The concession contract establishes regulatory periods of five years each, after which tariffs are reviewed based on investments and fixed for the following period.

[65] Average sewerage tariff is not exactly 80 percent of water tariff as sewerage coverage is lower than 100 percent.

ANNEX 6: ECONOMIC AND FINANCIAL ANALYSIS

ECUADOR
GUAYAQUIL WASTEWATER MANAGEMENT PROJECT

1. The economic analysis was carried out in qualitative terms. The positive externalities of improved environment and reduced health risks are largely due to (a) sewerage expansion and rehabilitation, which will improve the quality of life of poor residents in the area and also will contribute to reduce the pollution of the Estero Salado (an important environmental asset); and (b) treatment of all wastewater collected in the whole southern area of Guayaquil, which will have an important ecological improvement in the Guayas River. However, these benefits are difficult to quantify. Thus, instead of a cost-benefit approach, a cost-effectiveness approach has been taken for the economic analysis.

2. There are requirements at municipal level for on-site sewage disposal solutions, as well as for standards at the national level, that the effluents have to meet. The environmental and municipal authorities have established that only sewerage connections are allowed in the Project area, as other on-site solutions are increasing pollution due to poor maintenance and high water table in the area. For the effluent quality, the law has established limits for the BOD_5 and TSS before discharge. The cost-effectiveness analysis took into consideration the regulations and selected among different alternative the most cost-effective. For sewerage expansion, the solution was simple as the network already exists; however, to make the connections feasible, the households have to adjust the in-house connection and some pipes need rehabilitation. The alternative for sewerage consisted of the adjustment and rehabilitation. Three alternatives for wastewater treatment that complied with the regulation of effluent were studied: (a) CEPT, (b) DAF, and (c) High Rate Clarification. Associated investment and operating costs were estimated through a life-cycle analysis for the alternatives for a 30-year period. Results show that the CEPT solution is not only the most cost-effective alternative but also allows adding units of biological and anaerobic treatment for secondary treatment when limits for effluent are stricter. The chosen alternative has an expected unit cost similar to the ones obtained in other countries that have applied the same type of treatment. Sensitivity analysis shows that only when DAF's investment cost is reduced by 67 percent or High Rate Clarification by 38 percent, these alternatives become the lowest option. The likelihood that this happens is very low, if any.

3. In addition to the economic analysis, the project was evaluated from a financial perspective. Costs were expressed at 2014 prices. Lifetime of the project is expected to be 30 years.

4. The financial evaluation of the project differs from the financial evaluation of the entities in charge of the project (EMAPAG EP and Interagua).Interagua The first evaluation examines if the project will have sufficient funds to meet all its resources and financial obligations, whether these funds come from user charges or budget sources. The second evaluation measures the ability of both entities (EMAPAG EP and Interagua) to service their entire obligation, not only those generated by the Project but also those previously acquired and those planned to acquire in the near future. The financial evaluation of the Project is presented in this annex while the financial evaluation of the entities is presented in detail in Annex 5 of this document.

5. The financial evaluation of the Project includes costs and benefits expressed at market prices as they will be paid or received by the entities in charge (EMAPAG EP and Interagua).Interagua The evaluation was conducted taking into account the preliminary arrangements for the Project, in which, Interagua will be in charge of operating the works with its own revenues, while the municipality of Guayaquil, through EMAPAG EP, will implement the investments and will pay for it. Based on this arrangement, the financial evaluation included operating costs and subsidies on investment.

6. The results of the economic analysis show that the **Project will have a positive impact on the development of Guayaquil** as it affects the quality of life of the neediest population and will reduce the pollution in the Estero Salado and the Guayas River at the lowest cost.

7. Results of the financial evaluation show that current tariffs will be enough to cover only operating cost of the expanded sewerage component; yet, tariffs will be insufficient to cover the operation of the wastewater treatment system. Increase in tariffs is needed to make the Project financially sustainable. Results suggest that sewerage tariff should increase from the current 80 percent to 95 percent of water charges. This increase will allow Interagua to comply with one of the monitoring indicators of the Project, which is operating ratio (operating costs/total revenues billed) has to be <0.9 all the time.

8. *Justification for public sector provision*. The government of Guayaquil has designed a comprehensive wastewater management investment program to universalize wastewater collection, transportation, treatment, and disposal services coverage to improve environmental conditions in Guayaquil's water bodies (the Guayas River and the Salado Estuary) and bring better livelihood conditions for its residents. The project will implement the first phase of the works in the southern area of the city. Intervention on sewerage service expansion will focus on one of the most vulnerable and poverty-stricken regions of Guayaquil. This intervention along with those for treating wastewater of the southern area will improve their living conditions, boosting the capacity of the city and safeguard the population against the waterborne diseases associated with lack of sewerage and high contamination on water bodies. Public financing and public subsidies are needed as households alone cannot afford to pay for all those improvements.

9. *Bank value added*. The significant investment requirements to gain universal access to WSS services in the city of Guayaquil amount to over US$493 million in the next 5 years. In this context, this IBRD-financed operation will help to satisfy these investment requirements while bringing relevant knowledge in the field of pro-poor service provision. The Bank also has recent sector experience in the country, working with the municipal governments of Ecuador, with the approval of the Manta project in August 2013, and is supporting the national sector authority—SENAGUA—in the definition of the National Drinking Water and Sanitation Development Plan through a technical assistance program financed by the WSP.

10. The investment cost of the total project is estimated at US$227.9 million.[66] Twenty percent goes to sewerage expansion, 73 percent to sewage treatment, and the remaining seven percent to social, environmental, and management activities (table 6.1).

Table 6.1: Investment Cost (US$, thousands)[67]

Sewerage Component	
In-house connections	18,000
Sewerage rehabilitation	37,000
Total Sewerage Component	55,000
Wastewater Treatment Component	
Land	6,500
WWTP Las Esclusas	95,300
Pumping stations	29,910
Conveyance	35,790
Total Wastewater Component	167,500
Social and Environmental Components	3,200
Management	2,200
TOTAL	227,900

11. Rehabilitation of sewer pipes is necessary to expand the sewerage system and to improve the service in areas where the rehabilitation is needed. The resulting cost of sewerage rehabilitation and cost of adjusting in-house connection is estimated at US$846 per household or about US$200 per person, which is a reasonable cost compared with average connection costs in Ecuador and other countries. The cost of the chosen technology (CEPT) for sewage treatment is US$86 per person.

Table 6.2: Cost per Beneficiary (US$)

	Beneficiaries	Unit Cost
Sewerage Component:		
In-house connections and sewerage rehabilitation	65,000	US$846 per household
Wastewater treatment		
WWTP Las Esclusas	1,100,000	US$86 per person

Sewerage Component

12. The works in this component consist of (a) investment to adjust the in-house connections of about 30,000 households to make them feasible for sewerage connection and (b) rehabilitation of sewerage network in areas where pipes are in poor condition. About 35,000 households are already connected to the sewerage network in these areas and affected with frequent breakage and clogging of pipelines.

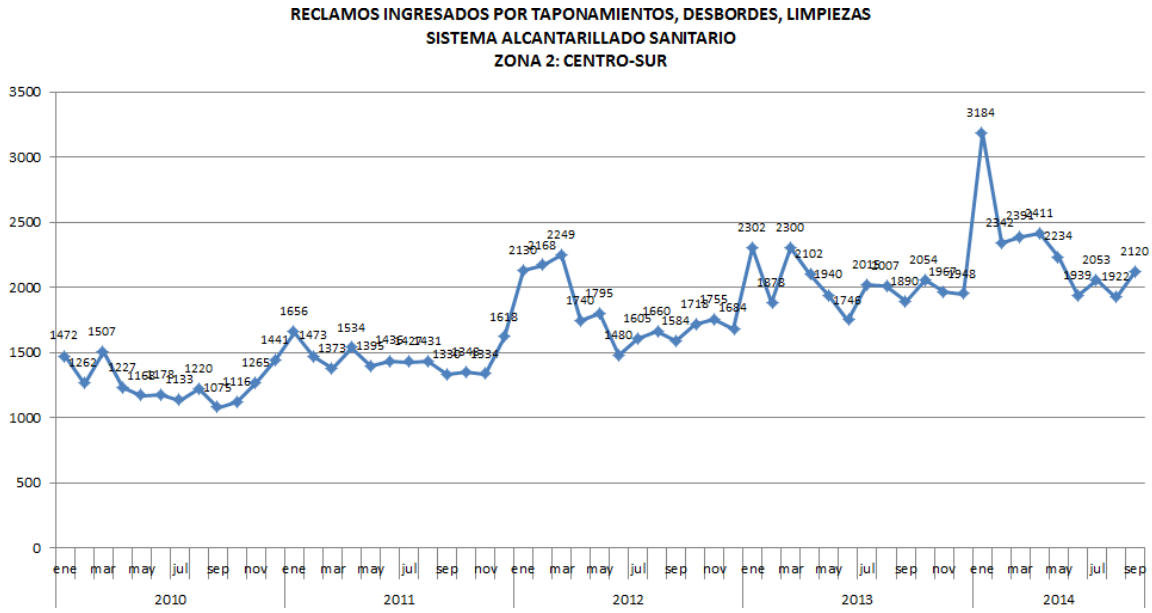
[66] Excluding VAT.
[67] Excluding VAT.

13. Works to be carried out for sewerage component and household connections will benefit 30,000 households that are not connected to the network, plus the 35,000 already connected facing problems related to the poor state of sewer pipes. Benefits were identified as those related to (a) complete universal coverage in the southern area of Guayaquil; (b) improved sewerage service in areas already served; (c) reduction in maintenance cost on sewerage network, and (d) health improvement and better quality of life. The benefits referred to in (d) were not estimated, and so the results are on the conservative side.

14. At present, 30,000 households that are not connected to the sewer are equipped with toilets that either discharge directly to the estuary or to reportedly poorly constructed and maintained pits or septic tanks, which contributes to the degradation of the Estero Salado. Additionally, some main sewer pipes have been identified to require urgent rehabilitation as they generate wastewater losses, get clogged frequently, and need permanent repairs. There about 35,000 households living in the area who complain of sewage overflow, bad odor, and pipe breakages.

15. The problem with the pipelines has increased in recent years and so, the number of complaints. Figure 6.1 shows the number of complaints in the Centro-Sur area.

Figure 6.1: Number of Complaints Due to Clogged Sewerage Pipes and Sewage Overflow



Source: Interagua

16. The environmental authorities and the municipality have established that only sewerage connections are allowed in the Project area as other on-site solutions are increasing pollution due to poor maintenance and high water table in the area. To complete universal coverage, some in-house adjustments are needed to make the connection feasible as well as rehabilitation of some sewer pipes. The project will fund the cost of adjusting in-house connections and the municipality will provide almost full subsidy to the households.

17. The technical solution included under the Project is the only acceptable solution by the MAE and the municipality; besides, it is cost-effective as only minor investments are needed for universal coverage in the southern part of the Guayaquil's city. The main benefits will be on health and environment, which are difficult to quantify.

18. *Financial benefits were quantified to test the sustainability of the works.* The financial benefits were measured as (a) reduction of maintenance costs when sewerage network improves; and (b) higher revenue when sewerage coverage increases. Revenues will increase as a consequence of higher sewerage coverage. The base case scenario includes 30,000 new connections. To measure the likelihood of a connection rate that is lower than 100 percent, sensitivity analysis was conducted and showed that the connection rate would need to be at least 80 percent. Revenues were estimated as the volume of water billed to sewerage connections multiplied by average sewerage tariff, which was US$0.41 per m^3 in November 2014.

19. *Financial results* show that current sewerage tariffs cover all operating costs that will be generated with the sewerage component. However, when the operating costs of wastewater treatment are included, tariffs fell short to cover all operating costs generated with the Project. The present value of operational deficit will be about US$33 million (table 6.4). A tariff increase is necessary to make the Project financially sustainable.

20. EMAPAG EP, the regulatory agency, is in charge of setting the tariffs. EMAPAG EP establishes the tariffs for a five-year period and defines the price index for quarterly adjustment during the period. The current regulatory period of five years will end by 2015, and so, EMAPAG EP is examining the required tariff for the upcoming period 2016–2020. The tariff revision will take into consideration the investment plan for these five years, associated targets, and corresponding operating and maintenance costs. During preparation of the Project, a detailed analysis was conducted with EMAPAG EP's personnel, and results show that to maintain financial viability of Interagua and financial sustainability of the project, sewerage tariffs should increase from current 80 percent of water charges to 95 percent.[68] With this increase, revenues will be enough to cover operating costs, generating an operational income of about US$0.6 million and eleven percent return (table 6.4).

Table 6.4: Results of Financial Evaluation

	Present Value of Flows (US$, million)			
	Costs	**Benefits**	**Net benefit**	**IRR**
Sewerage and wastewater treatment component:				
Financial results without tariff increase	61.7	28.3	(33.3)	n.a.
Financial results with tariff increase	61.7	62.3	0.6	11%

Cost-Effectiveness Analysis of Wastewater Treatment Component

[68] More detail is presented in the section containing the financial analysis of Interagua.

21. **Cost-effectiveness analysis**. This technique evaluates what alternative creates the wanted result at a lower cost. The cost-effectiveness analysis is a technique used in weighing the effectiveness of a project against its cost. In this approach, the benefits deriving from the project or the alternatives considered are not monetized. This approach was used to compare various alternatives that deliver roughly similar outcomes and benefits.

22. Four alternatives were studied for treating and discharging wastewater produced in the southern area of the city of Guayaquil. They correspond to the following technologies: (a) Option 1: Advanced Preliminary Treatment (APT); (b) Option 2: CEPT; (c) Option 3: DAF; and (d) Option 4: High Rate Clarification. Option 1 does not comply with the standards of the effluent in a consistent manner and so, the cost effectiveness was applied only to the other three solutions.

23. The economic evaluation, undertaken as part of the feasibility study by EMAPAG EP, conducted a microeconomic lifecycle cost analysis. In this approach, only specific equipment and operating costs that differ among alternatives were included. Table 6.5 presents the costs that vary among alternatives estimated in the feasibility study.

Table 6.5: Costs that Differ among Alternatives 2 to 4

(US$, thousands)	CEPT	DAF	High Rate Clarification
Construction costs	12,266	13,100	7,580
O&M Costs from Year 1 to 15			
Chemicals	1,829	1,829	3,322
Energy	39	538	70
Labor	61	292	292
Total O&M	1,929	2,659	3,684
O&M Cost from Year 16 to 30	100	1,166	3,684

24. The NPV for a lifetime of 30 years was estimated to compare the total difference in costs. Results vary according to discount rate, the lower the rate the higher the difference between CEPT and DAF. The contrary occurs with the alternative of High Rate Clarification. Yet, in all cases, the CEPT is the lowest cost option. Using 10 percent discount rate, the CEPT cost is US$8 million lower than the DAF's and US$15 million lower than High Rate Clarification. These differences correspond to 30 percent and 55 percent, respectively, of the CEPT cost.

Table 6.6: Net Present Value of Options

	Net Present Value for 30 Years (US$, million)			Cost Difference %	
Discount Rates	CEPT	DAF	High Rate Clarification	DAF/CEPT	HRC/CEPT
6%	31	43	58	38%	84%
10%	27	35	42	30%	55%
15%	24	29	32	25%	34%

Note: Including only the costs that differ among alternatives (micro lifecycle cost).

25. When the analysis is conducted, including the entire project costs even those that do not change among alternatives (macro life-cycle cost effectiveness technique), results show the same difference among alternatives (US$8 million and US$15 million). The cost difference corresponds to 4 percent and 10 percent, respectively, of the CEPT total cost.

Table 6.7: Difference in Total Costs among Alternatives

	Option 2 CEPT	**Option 3 DAF**	**Option 4 High Rate Clarification**
Investment (US$, thousands)			
Land	6,500	6,500	6,500
WWTP			
Chemical Process	12,266	13,100	7,580
Others	83,034	83,034	83,034
Total WWTP	95,300	96,134	90,614
Pumping station and conveyance (including subaquatic outfall)	65,700	65,700	65,700
Total Investment Cost	167,500	168,334	162,814
O&M (US$, thousands)			
O&M (year 1 to 15)	7,009	7,739	8,764
O&M (year 16 to 30)	5,180	6,246	8,764
Lifetime of investment	30	30	30
Present value of total costs[a]	230,513	238,896	245,888
Annual equivalent	24,453	25,342	26,084
Cost of each option/Cost CEPT	100%	104%	107%

Note: a. The present value was estimated with a discount rate of 10 percent.

Table 6:8: Cost Differences among Alternatives with Different Discount Rates

	Net Present Value 30-year Period (US$, millions)			**Difference %**	
Discount Rates	**CEPT**	**DAF**	**High Rate Clarification**	**DAF/CEPT**	**HRC/ CEPT**
6%	257	270	285	5	11
10%	231	239	246	4	7
15%	212	218	220	3	4
Cost difference compared to CEPT with 10% discount rate					
US$, million		8	15		

26. Option 2 (CEPT) besides being the lowest cost option, allows addition of units of biological and anaerobic treatment when limits for effluent are stricter, which it is expected to add in about 15 years. By then, the addition of chemicals can be eliminated decreasing the operating costs.

27. **Unit costs**. The chosen technology (CEPT) for wastewater treatment has a cost of US$86 per person, which is reasonable according to international standards for this type of treatment. Two examples are used for comparing costs of similar treatment implemented in Colombia: *Canaveralejo y Salitre,* whose costs were about US$84 and US$110 per person at 2015 prices.

Table 6.9: Cost per Beneficiary (US$/pp)

	2000 prices	2015 prices
Wastewater Primary treatment		
Canaveralejo-Colombia	64	84
Salitre Colombia	84	110
Las Esclusas-Guayaquil		86

Sensitivity Analyses

28. *Sensitivity analysis.* Results show that (a) when investment cost of High Rate Clarification reduces by 38 percent or DAF cost reduces by 70 percent, CEPT would not be the lowest cost option and (b) increase in operating costs widens the difference among the alternatives favoring even more CEPT. The main reason is because after Year 16, CEPT will add units of biological and anaerobic treatment, reducing the operating costs significantly.