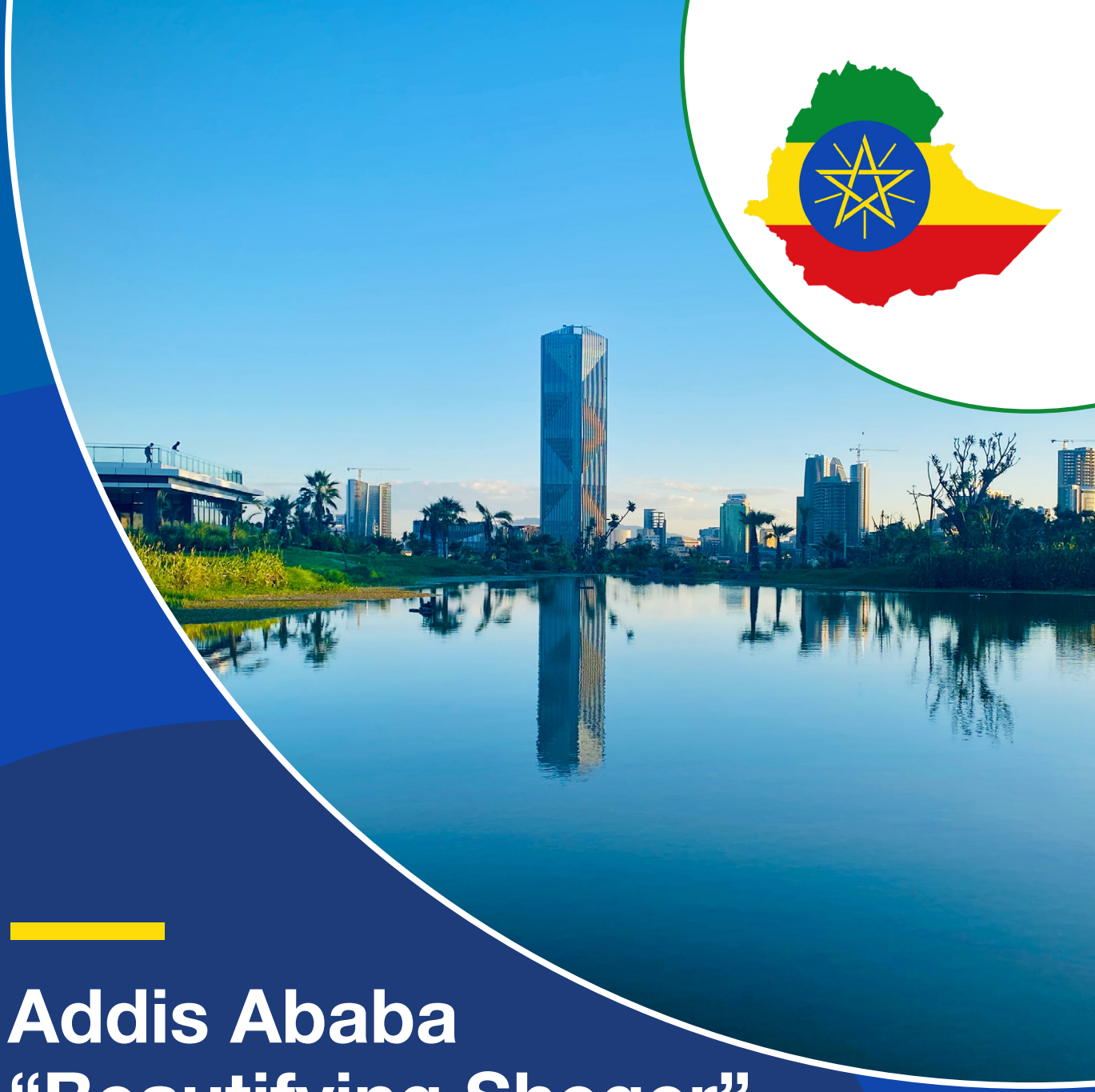


Addis Ababa “Beautifying Sheger” River Development Project

Investment Strategy and Infrastructure Plan

AFRICAN DEVELOPMENT BANK GROUP

Urban and Municipal Development Fund

Improving the quality of life in African cities

Disclaimer

Table of Contents

List of Figures

List of Tables

Acronyms

AACAORPO	Addis Ababa City Administration Organization and Restructuring Project Office
AABPCDAA	Addis Ababa Beautification, Parking and Cemetery Development Administration Agency
AACDWRRPO	Addis Ababa City Dry Waste Recycling and Removal Project Office
AACG	Addis Ababa City Government
AACICBPCA	Addis Ababa City infrastructure coordination, building permit and control Authority
AACMA	Addis Ababa Cleansing Management Agency
AACPDC	Addis Ababa City Plan and Development Commission
AACRA	Addis Ababa City Road Authority
AACTA	Addis Ababa City Transport Authority
AAEPA	Addis Ababa Environmental Protection Authority
AAEPGDC	Addis Ababa Environmental Protection and Green Development Commission
AAEU	Addis Ababa city Electric Utility office
AAHDPO	Addis Ababa Housing Development Project office (AAHDPO)
AALDURA	Addis Ababa Administration Land Development and Urban Renewal Agency
AALRT	Addis Ababa Light Railway Transit
AARA	Addis Ababa Roads Authority
AARBGDA	Addis Ababa River Basin and Green area Development Agency
AATMA	Addis Ababa traffic Management Agency
AAU	Addis Ababa University
AAWSA	Addis Ababa Water and Sewerage Authority
AAWSA	Addis Ababa Water and Sanitation Authority
AAWSA-PO	Ababa Water and Sewerage Authority Project Office
AfDB	African Development Bank
AMCOW	African Ministerial Council on Water
AnAOB	Anaerobic ammonium oxidizing bacteria
AOB	Ammonium Oxidizing Bacteria
APHA	American Public Health Association
ARBA	Awash River Basin Authority
ARDCAP	Ababa Rivers and Riversides Development and Climate Change Adaptation Project
ARDCAPO	Addis Ababa Rivers, Riversides Development and Climate Change Adaptation Project Office

ASPRS	American Society for Photogrammetry and Remote Sensing
ASS	Atomic Absorption Spectrophotometer
AU	African Union
BA	Big Akaki
BKK+K	Banteyiketu-Kechene- Kurtume and Kebena
BKKK	Banteyiketu, Kurtumi, Kechene and Kebena
BOD	Biological Oxygen Demand
BOFED	Addis Ababa City Government, Bureau of Finance and Economic Development
BPCDAA	Beautification, Parks and Cemetery Development and Administration Agency
BY	Banteyiketu
CBO	Civil Society Organization
CGAALDMB	City Government of Addis Ababa Land Development and Management Bureau
CMA	Cleanliness Management Agency
COD	Chemical Oxygen Demand
CRGE	Climate Resilient Green Economy Strategy
CSA	Central Statistics Agency
CSOs	Civil Society Organizations
DO	Dissolved Oxygen
EC	Electrical Conductivity
ECA	Economic Commission for Africa
EDRI	Ethiopian Development Research Institute
EEC	European Economic Commission
EEP	Ethiopian Electric Power
EEPCO	Ethiopian Electric Power Corporation
EET	Ethio-Telecom
EIA	Environmental Impact Assessment
EiABC	Ethiopian Institute of Architecture, Building Construction and City Development (EiABC)
EMA	Ethiopian Mapping Agency
EPA	Environmental Protection Authority
EPE	Environmental Policy of Ethiopia
EU	European Union
FC	Faecal Coliforms
FDRE	Federal Democratic Republic of Ethiopia

FEDB	Finance and Economic Development Bureau of Addis Ababa City
FEPA	Federal Environmental Protection Agency
FEPRA	Fire and Emergency Prevention and Rescue Authority
GA	Great Akaki
GCP	Ground Control Point
GGGI	Global Green Growth Institute
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IDH	The Sustainable Trade Initiative
IHP	International Hydrological Programme
INGOs	Intergovernmental Organisations
IREP	Inter-Regional Environmental Platform
IWRM	Integrated Water Resources Management
KA	Kebena
KC	Kechene
KU	Kurtume
LA	Little Akaki
LDCRA	Land Development and City Renewal Agency
LUP	Land Use Plan
m.a.s.l	meter above sea level
MAC	Maximum Allowable Concentration
MAL	Maximum Allowable Limit
MEA	Multilateral Environmental Agreement
MEFCC	Ministry of Environment Forest and Climate Change
MFPDA	Ministry of Federal and Pastoralist Development Affairs
MoA&NR	Ministry of Agriculture and Natural Resources
MoI	Ministry of Industry
MoT	Ministry of Transport
MoUDC	Ministry of Urban Development and Construction
MoUDH	Ministry of Urban Development and Housing
MoWIE	Ministry of Water Irrigation and Energy
MoWR	Ministry of Water Resources
MSE	Micro and Small Enterprises
MUDH	Ministry of Urban Development and Housing

NDRMC	National Disaster Risk Management Commission
NGO	Non-Governmental Organization
NMA	National Meteorological Agency
NOB	Nitrite Oxidizing Bacteria
NPS	Nitrogen, Phosphorus and Sulfur
NSSDA	National Standard for Spatial Data Accuracy
NTU	Nephelometric Turbidity Unit
ORAAMP	Office for the Revision of Addis Ababa Master Plan
ORECCF	Oromia Regional Bureau of Environment, Climate Change and Forests
PHE	Population Health and Environment
RAP	Resettlement Action Plan
RMG	River Management Group
SBPDA	Sanitation, Beautification &Parks Development Agency
SCBR	Suspended Carrier Biofilm Reactors
SDGs	Sustainable Development Goals
SEA	Strategic Environmental Assessment
SWRDPO	Solid Waste Recycling and Disposal Project Office
TC	Total Coliforms
TDS	Total Dissolved Solids
TSS	Total suspended solids
UDWW	Untreated Domestic Wastewater
UK GQA	United Kingdom General Quality Assessment
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPI	Urban Planning Institute
UPIN	Unique Personal Identification Number
USEPA	United States Environmental Protection Agency
USFEPA	United States Federal Environmental Protection Agency
M$	Millions of US dollars
UTM	Universal Transverse Mercator
UWWTD	Urban Waste Water Treatment Directive
WB	World Bank
WFD	Water Framework Directive
WHO	World Health Organization
WSSD	World Summit on Sustainable Development
WWTP	Wastewater Treatment Plant

1. Background

The Beautifying Sheger Project is an initiative launched on 27 February 2019 under Prime Minister Abiy Ahmed Ali. The project will run along the rivers of Addis Ababa, developing green spaces starting from Entoto to Akaki alongside the 69 km 1river streams until they reach Kality waste water treatment plant.

Beautifying Sheger aims to increase tourism and quality of life, reduce the effects of climate change and to create jobs in Ethiopia's capital city by developing green spaces. The project aims to convince citizens to assist in the cleaning efforts as well, as despite Ethiopia's recent economic development, there has been no environmental action to reduce industrious and urban waste.

The most comprehensive study of the Sheger basin, named "Urban Landscape Designing and Planning Study for Addis Ababa Rivers and Riversides Development Plan Project" was commissioned in 2017 by the Addis Ababa River Basin and Green area Development Agency, who is in charge for the implementation of the project, to the Centre for Environmental Science (CES), of Addis Ababa University.

The present "Beautifying Sheger- River Development Project Investment Strategy and Infrastructure Plan - Sheger Project" is implemented in the framework of the Municipal Development Fund (UMDF), a multi-donor Trust Fund of the African Development Bank (AfDB) launched on April 2019.

The UMDF key objectives can be summarized as: (a) improved urban planning, (b) improved project preparation (i.e., pre-investment phase), (c) improved municipal governance and finance, and (d) increased support towards integrated urban development.

The Joint Venture "BETA Studio – A.R.S. Progetti – Z&A" signed the AfDB contract N° PICU.2/2020/1 1101 on December 11th 2020 and the commencement date was established on January 4th 2021.

2. Approved Reports

The Consultant, according to the Work Plan, submitted 5 Reports: Inception Report, Month 2 Report - Data Collection and alignment with Sheger vision, Month 4 Report – Draft Background Plans, Draft Final Report and Investment Plan and the present Final Report.

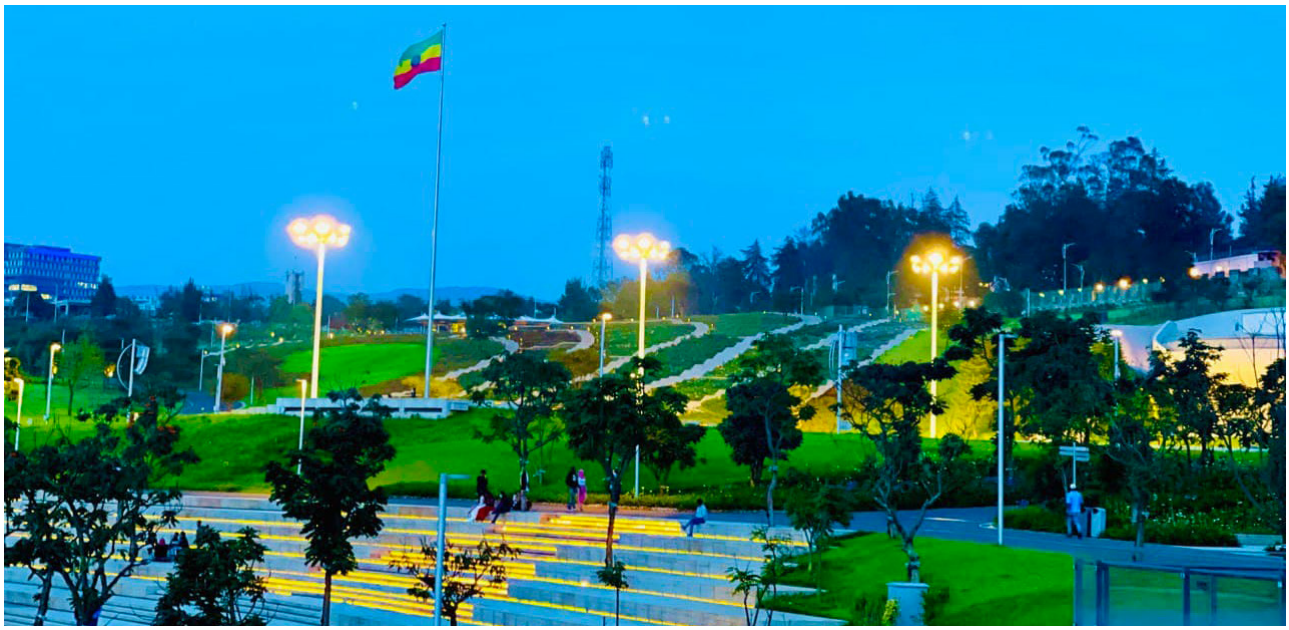
All the report were revised after receiving comments from the Stakeholder and from the Bank and finally approved.

The following table summarizes the Title of the revised and approved Shegher Reports and the date of submission.

	REPORT TITLE	DATE
1	INCEPTION REPORT REV	1 FEBRUARY 4 TH 2021
2	MONTH 2 REPORT REVISION 1 - DATA COLLECTION AND ALIGNEMENT WITH SHEGER VISION	MARCH 13 TH 2021
3	MONTH 4 REPORT – DRAFT BACKGROUND PLANS - REVISION 1 - and Maps in Annexes	JUNE 31 ST 2021
4	DRAFR FINAL REPORT AND INVESTMENT PLAN	JULY 29 TH 2021
5	FINAL REPORT (The present document)	SEPTEMBER 29 TH 2021

Table 2-1 Approved Sheger Reports

Not including the Inception Report, the following paragraphs summarize the contents of the above Reports



[1]The total length of the Sheger river streams is resulted, from the Consultant's GIS, 69 km instead of 56 km.

3. Month 2 Report – Revision 1 Data Collection and Alignment With Sheger Vision

This Report provides an overview of all the data collected in the vision of the Sheger project.

3.1 It Platform

The data collected and the project documents and GIS system are revised, organized, set up and timely implemented in a dedicated Google Drive IT Platform sheger.addisababa@gmail.com accessible to the Client and the Stakeholders. The Passwords is: Sheger_2021

3.2 Key Finding

3.2.1 GIS system setting up and Maps Implementation

As starting point the Consultant has set up a Geographic Information System (GIS) to integrate, store, edit, analyse, share, and display all types of geographical data of the Sheger project while they are being collected, processed, and produced. The maps have been processed using the geospatial processing software namely ArcMap (component of Esri's ArcGIS). The geographic and geospatial information implemented in the Maps includes the following:

Hydrographic network, Structural Plan – Land Use, Road Network, Catchment Area, World Imagery, Satellite maps, Bkkk+Kebena Digital Terrain Map, Information on utilities networks, water supply and sewer network.

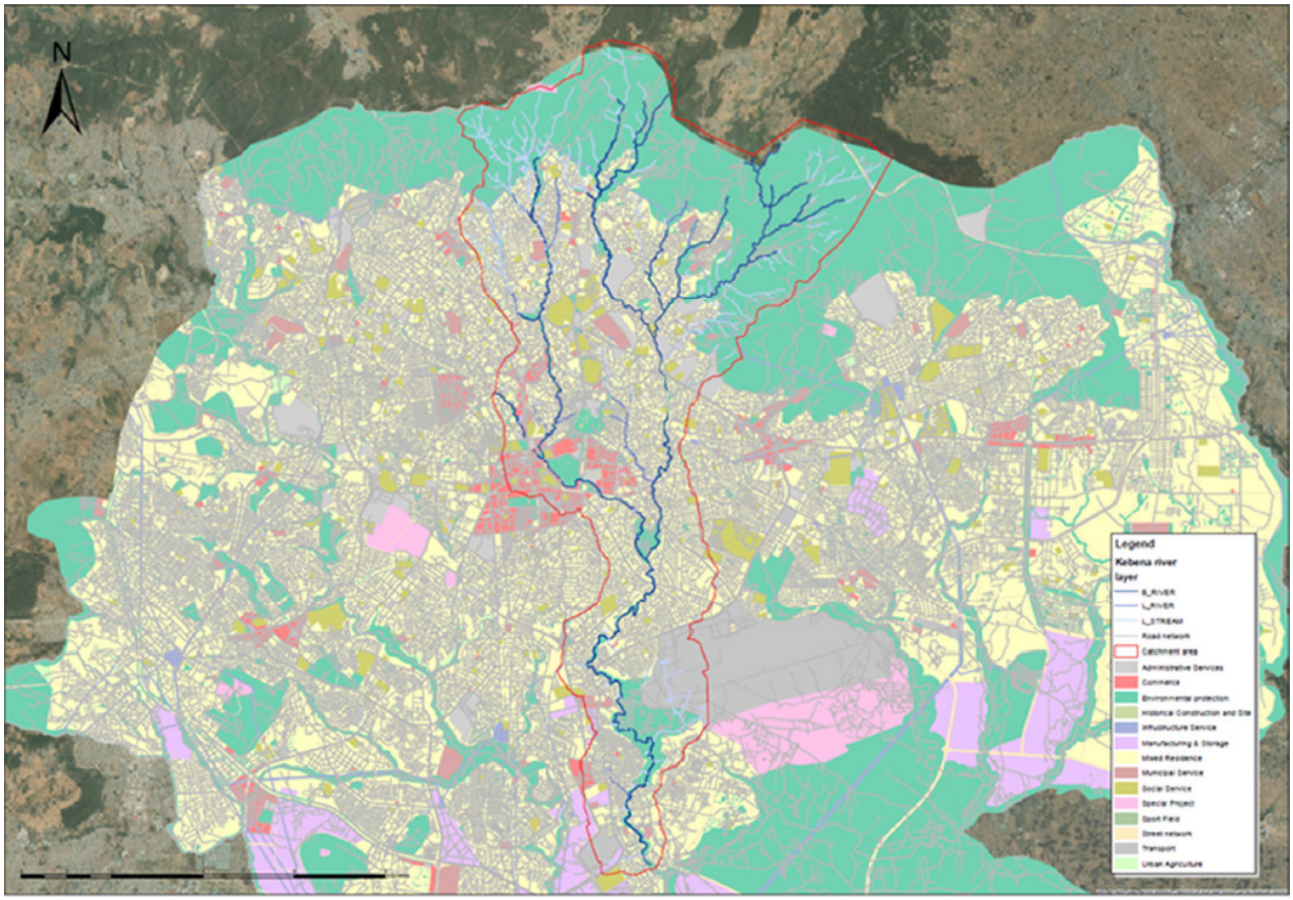


Figure 3-1. Sheger Map presenting: AAPDC Stuctural Plan (SP) Land Use with Industrial Zoned painted in violet and the contour on the Sheger catchment. Source: Consultant

3.2.2 Urban Landscape Designing and Planning Study for Addis Ababa Rivers and Riversides Development Plan – 2017"-

The Study was carried out by the "© Centre for Environmental Science, Addis Ababa University" (CES). CES has established five different multidisciplinary teams, i.e. catchment management, landscape and urban design, pollution and sanitation, socioeconomic and policy teams. The specific objectives of the study are to:

- Assess and analyse the existing condition of the rivers and riversides.
- Undertake ground/topographic survey to map the land use.
- Delineate the boundaries of Kechene Kurtumi (BKK) plus Kebena Rivers and Riversides.
- Produce the detailed land use plan and landscape design and pilot intervention project site, by selecting appropriate techniques.

The Consultant made a review and a summary of the key contents of 5 thematic:.

- VOLUME 1a - THEMATIC 1a: Riverside determination of urban landscape
- VOLUME 1b - THEMATIC 1b: Rivers buffer: assessment of the river buffer
- VOLUME 2 - THEMATIC 2: Catchment Management Plan
- VOLUME 3 - THEMATIC 3: City Pollution and Sanitation
- VOLUME 4 - THEMATIC 4: Kebena Resettlement Action Plan
- VOLUME 5 - THEMATIC 5: Policy Legal VOLUME 1a

3.2.3 AAWSA Wastewater Infrastructures

The Consultant, who has a long working experience with AAWSA in sewers project, prepared an analysis, focusing on Sheger catchment, of: the current infrastructures asset in the three Kaliy, Akaky and Eastern Catchments, the status of the pollutants from Urban, Condom, Hotels, and Industries and collection by vacuum trucks and Wastewater Treatment Plant (Kality and Kotebe) state. The amount of wastewater generated in the City was estimated 479,200 m^3 per day

3.2.4 Solid Waste

According to Addis Ababa solid waste management system report (2010), the daily waste generation was estimated at 0.4 kg/capita/day with daily City waste production of 550 tons/day (200,000t/year) of which 65% is collected and disposed into a dump site. Another 5% of the waste is composted and 5% is recycled while the remaining 25% is dumped into open spaces, ditches, rivers and riverbanks. Studies also showed one quarter of the households in Addis use open defecation in free spaces. This situation is affecting the flow capacity of the rivers and increasing flood events. The Physical Composition of Solid Waste in BKKK is reported as well.

3.2.5 AAWSA Water Supply Network

The Consultant, who has a long working experience with AAWSA in water supply projects, prepared an analysis of the current infrastructure assets. The total water produced is estimated 590,000 m3 per day. Currently, the total demand of potable water for the City of Addis Ababa is estimated to be above 700,000 m3/d while the coverage of the water supply of the capital is estimated to be 85.6 %.

3.2.6 Stormwater

Addis Ababa is undergoing rapid urbanization with unprecedented high rate of road and building constructions, resulting in a sudden increase of impervious surfaces and generation of significant amounts of runoff volumes. The main challenge in this regard is the Addis Ababa's poorly developed drainage system. The drains were indeed planned and designed unsystematically through a segmental approach. Furthermore, stormwater management in Addis Ababa is purely traditional, meaning that it has no additional purpose other than collecting and conveying stormwater from source to rivers. No retaining, infiltration, and harvesting process are then pursued by these type of drainage systems.

3.2.7 AADPC Structural Plan (SP)

The Structure Plan is a technical, institutional, and legal framework for guiding the long-term social, economic, environmental, and spatial development of the city and its surroundings. The Plan is divided per themes: land use, centres. transportation and roads, social services, municipal services, houses, social development, local economic development, industry, environment, urban and peri-urban agriculture and tourism.

A strategic Plan for Immediate Actions to be implemented in a 5-year and 10-year perspective is provided at the end of the Plan. The Strategic Plan identifies a set of actions in the following categories: Roads and Public Transportation, Housing, Secondary centres development, and Environment.

4. Month 4 Report – Draft Background Plans – Revision 1

4.1 Study Area Classification

Preliminarily to the identification of the infrastructures needed for "Beautifing Sheger" the Consultant has Classified the areas of intervention according to the concepts and the terms of the AA Structure Plan and the study performed by CES, the Centre for Environmental Science, Addis Ababa University" in the Landscape Plan.

The SP and the CES Study, identified the River Buffer Zone which vary from 30 to 60 m and the Corridors which define a stretch of around 300-500m. Sheger River Corridors have been split in 6 macro-riparian-areas, these areas are divided, in 17 segments.

Macro Area	River Section
Little Kebena	Corridor sections 1-2-3-4-5
Kurtumi	Corridor sections 1-2-3-4-5
Kechene	Corridor sections 1-2
Ginfile	Corridor sections 1
Bantyiketu	Corridor sections 1-2-3
Big Kebena	Corridor sections 6

The names of the rivers inside the Sheger area vary in the different studies: in other studies, Kurtume is are also called Bayiketu, while Ginfile is also named Kechene, in most cases their acronym is BKKK or BKK+Kebena (, Kechene, Kurtume and Kebena).

4.2 Ongoing Initiatives

Many studies and projects have already been launched in the Sheger area. All these initiatives cover the largest part of the 69 km (initially 56km) stretches, and, apart the first phase of the Chinese Project, are still in the early stage of concept, pilot or feasibility study.

So the Consultant is undertaking the study along all the 69 km of the Sheger River, wisely considering what has already been planned.

Five studies have been identified, they are described in the report and summarised in the table below.

PROJECTS	RIVER CORRIDORS
AA River Basin And Greenery Agency-AA University – CES	Kurtumi 1 and Kebena 2.
China-Aided Ethiopian AA River Side Green Development Project	Kechene 1, Ginfile 1, 2, 3, Little Kebena 5.
AICS – Italian Agency For Development Cooperation	Little Kebena 3
Un Habitat Sheger Project	End of Little Kebena 5
UNDP Sheger Resilience Programme	All the Sheger area
Korean Cooperation	Little Kebena 3, 4, 5

Table 4-1 Sheger ongoing projects

4.3 Wastewater Infrastructures

4.3.1 Sewers Network

Our approach regarding the sewer network, that is needed for the Sheger corridor to be protected from pollution, is based on the existing network of AAWSA as well as the planned, already designed and the future network proposed in the Sewerage Master Plan. All these pipes, existing, planned and future are presented below.

It is understood that wherever there is existing, planned or future network by AAWSA there is no reason to propose sewerage network and also there is no need for diameters calculation since these calculations have already been performed by AAWSA.

It has to be noted that AAWSA is the only Authority responsible for sewerage design and construction in Addis Abeba and its planning cannot and should not be ignored.

These rivers run through the city centre and the most densely settled areas. The level of the river pollution is high causing severe problems both to the environment and the health and resilience of the local population.

A detailed work was done to map on the GIS System (see Month 2 Report) the existing and planned sewers system starting from the collection and the analysis of existing documentation.

As documented in the Report we understood that:

- along most of its length the river is served by an existing network
- in addition alongside the river parallel networks have been designed by AAWSA in different level of design (Master Plan or Detail Design)

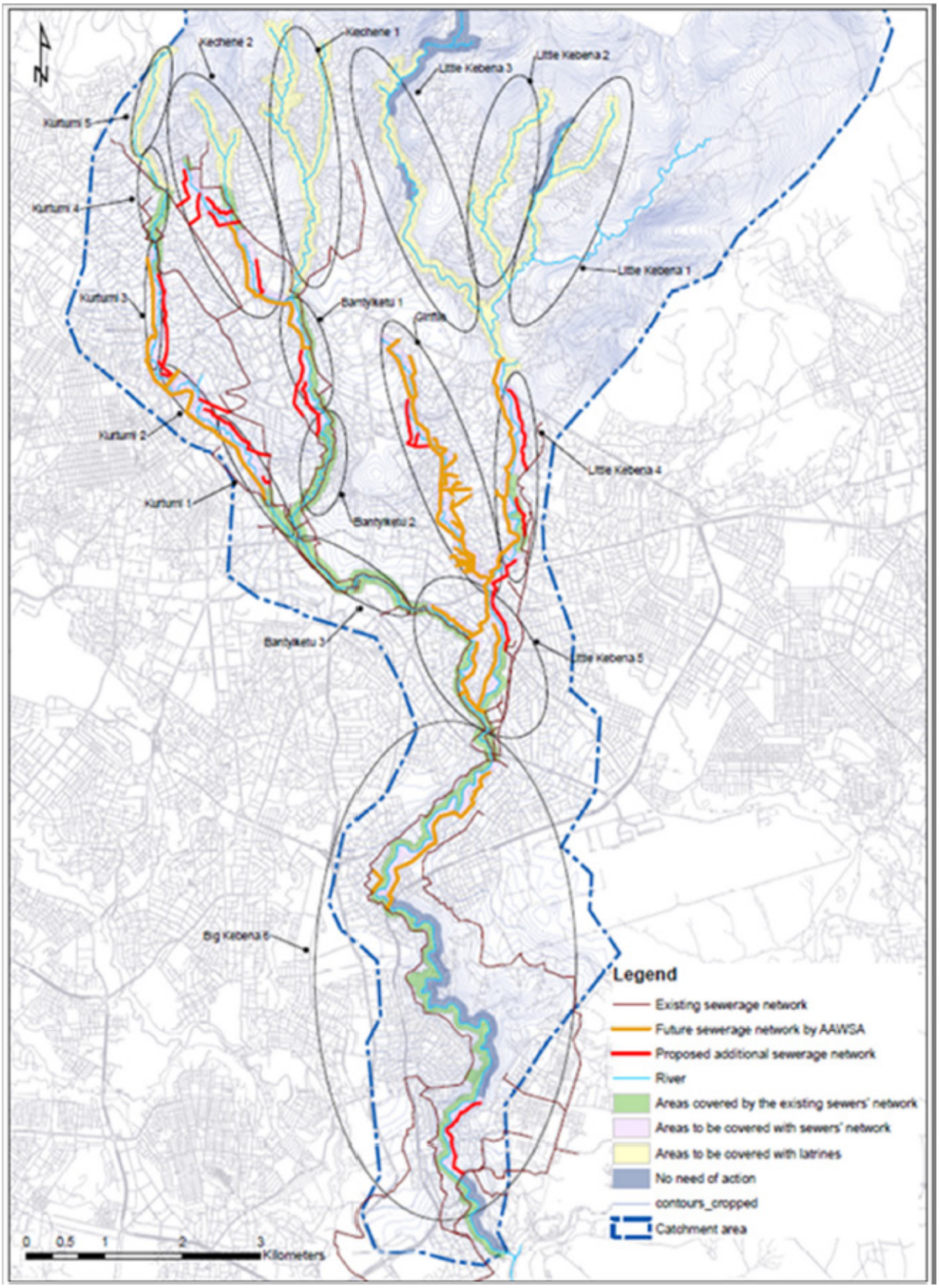


Figure 4-1 Proposed network connected to the existing.

The additional network proposed by the team, is depicted in red lines in the Figure 4.1; these conduits will collect the existing pipes in the areas to be covered with sewers lines (violet areas).

The proposal consists of laying an uPVC pipe, diameter of 315mm, along the river side to serve two main purposes:

1. All existing or future local networks that collect sewer from the nearby areas, not to be led to the river but to be connected to this pipe and conveyed safely to the existing sewer collectors and finally to the central WWTP.

2. Public toilets that are foreseen along the river following planning of the river rehabilitation and protection, to be connected to this pipe, avoiding the construction of septic tanks or pits.

3. Areas in the northern part of the City , not densely populated, and where no collection system is planned by AAWSA to be served by Public Toilets (VIP Latrines) with local wastewater treatment.

The Figure 4.1 synthetizes the situation of the areas already covered by the existing sewers networks (green) , the areas to be covered with new sewers networks (violet) and the areas to be covered with toilets/latrines (yellow).

As far as it concerns areas that no network exists, to be covered with sewers network according to AAWSA Master Plan, the report proposes the construction of main pipes with diameters of mainly 315mm. The pipes will be placed parallel to the river bed and their purpose will be to collect sewerage from future developments in these areas until the AAWSA planning constructs permanent sewerage networks.

In case the secondary network has to be implemented, according to AAWSA Plan the consultant has considered
pipes with 200/250 mm.

4.3.2 Public Toilets

The "yellow" river stretches without sewers are corresponding to the following 5 Corridors as classified by CES: Kebena 1, Kebena 2, Kebena 3, Kurtumi 5 and Kechene 1.

The main aim to improve the sanitation condition of the upper Sheger River during this period, until a sewerage system is implemented, is to improve the sanitation management in the level of containment, collection and transportation.

The public toilets, depending on the urban density of the specific area where they are located, are estimated to cover, as serviced population, approx. 1,000-2,000 people. Each public toilet will be divided into two gender wise parts and specific part for disabled people is also provided. Two types of Public Toilets will be installed:

- Type1: 4 seats and 2 showers.
- Type 2: 8 seats and 4 showers.

4.3.3 Wastewater Treatment Plants (WWTPs)

According to AAWSA Master Plan, all the existing, planned or future network that is presented in the report, including also the new network in areas where there is no planning by AAWSA today, is connected or will be connected with the Kaliti Waste water Sewerage plant.

It has to be noted that all the Sheger Corridor is inside the Kalliti WWTP catchment. This report does not propose the construction of any new WWTP since the effluent from all the catchment has been considered in the design of the Kaliti WWTP. For this reason the Consultant did not make an estimate of the volume to be treated, neither of the cost of capture, storage, transport and treatment facilitiesThe toilets will be (VIP) Ventilated Improved Pit latrines with septic tanks and soak away pit, with facilities for disabled.

4.4 Stormwater Infrastructures

4.4.1 Hydrological and Hydraulic Analysis

Addis Ababa has a number of relatively small, but very significant, rivers running through it, with the Kebena River and its tributaries being most important as they run through the centre of the city and the most densely settled areas (See figure below). These rivers are highly polluted and subject to flooding, causing severe environmental and health problems.

The city of Addis Ababa has flood prone riparian area especially Kechene, Bantyeketu, Kurtume rivers. These areas suffered from serious floods in the last decades causing damages to houses, various infrastructures; also, it led to loss of human lives and paralyze of socio-economic activities resulting serious social disturbance. The hydraulic issues affecting the project area generally consist in the over-use of river alluvial areas for residential settlements. In addition, many areas of the watercourse system are overgrown with spontaneous vegetation and litter, which reduces the flow capacity of the river cross section.

The aim of the study is to analyse the potential flood risk of the Sheger River network, which is developing through the metropolitan area of Addis Ababa, which represent a very sensitive structures and activities complex to be protected from hydro-geological risks.

Figure 4-2 Layout of the Sheger River Network

4. Month 4 Report – Draft Background Plans - Revision 1

The objective of the present study is to draw a map of the flooded areas in correspondence of flood events characterized by a particular intensity and verify that the location the buildings envisaged within the metropolitan area of Addis Ababa will not be affected by flooding phenomena.

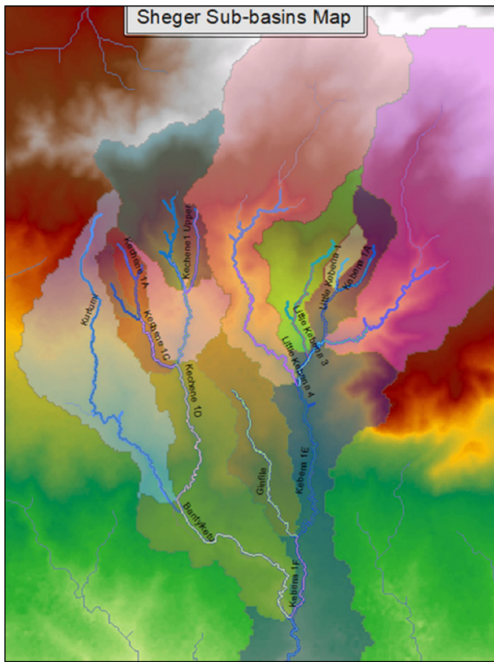
The study has been divided in three different phases:

- Phase 1 - Hydrological analysis - Starting from the collected basic data, which includes digital terrain model, land use, soil map and rainfall depth, the analysis of the Sheger network system has been carried out by extracting all the geo-morphological and hydrological features of the study area in order to define the Sheger River network system. The hydrologic analysis has been completed with the calculation of the design peak flows, for different return periods.
- Phase 2 - Hydraulic study - thanks to the knowledge of the topography and morphology of the area, it was possible to create a digital model of the river network by which it was possible, using GIS software tools, to produce several cross sections of the study area, and then with a dedicated hydraulic model (HEC-RAS) to study the inundated area in case of severe rainfalls, corresponding to the different return periods;
- Phase 3 - Stormwater intervention planning - The results gained from the hydraulic analysis has been used to define the required intervention in order to mitigate flood risk in the Sheger area.

The hydrologic and hydraulic study requires several sub-activities in order to completely define the analysis and to obtain the final results for evaluating the needed of protection works.

In summary, the procedure can be summarized as follows:

- Catchment and stream network definition;
- Rainfall analysis;
- Implementation of a rainfall-runoff model;
- Analysis of the results;
- Hydraulic river modelling using Hec-Ras software;
- Inundation mapping using ArcGis tool GeoRas.



The adopted method is based on the Ethiopian Road Authority Drainage Manual 2013 for the design of drainage works, and on the Manual for Urban Drainage Establishment and Management 2015 issued by the Urban Planning, Sanitation and Beautification Bureau of the Ministry of Urban Development Using and Construction, and Addis Ababa City Road Authority Design Manual.

The definition of the catchment area and of the hydrographic stream network of interest has been performed through the use of the ArcHydro tool. ArcHydro consists in a set of data models and tools that operates in GIS environment to support geospatial and temporal data analyses.

Input rainfall for the rainfall-runoff model was obtained analysing Intensity Duration Frequency Curves (IDFC) from "Ethiopian Road Authority Drainage Manual» (ERA DM2013), giving regional rainfall intensities as function of duration and return period through a regression method.

Moreover, the Consultant has carried out the calculations of peak flow rates foreseeing the application of a corrective coefficient equal to 1.15 (+15%) following ERA guidelines, which provide an indication of how to account for the effects of climate changes on precipitation heights and peak flow rates through the application of correction coefficients:

Regarding the return period, Since there is no regulation reference for the flood risk assessment, the Consultant has performed the hydrological analysis defining the peak flow rates for each sub-catchment considering different return period (5, 10, 25, 50 and 100 years). The inundation maps for 25, 50 and 100 years are presented in the Report and in the drawing in the Annexes.

The selection of the 25-year return period as the reference for carrying out the design of flood risk mitigation measures was made taking into account the cost/benefit balance as well as the availability of areas within the urban structural plan in which to allocate such infrastructures.

The calculation of runoff rates has been carried out using SCS Unit Hydrograph Method in accordance with ERA DM2013 guidelines, where the definition of the CN value was developed in a GIS environment using the Ethiopia Sentinel 2, Land Use-Land Cover map as basic information.

In order to implement the hydraulic analysis of the Sheger River network, the Consultant has collected a Digital Elevation Model of the river's corridor, 5mx5m resolution, obtained through a LIDAR remote sensing technique The hydraulic study was divided into three phases:

- Phase 1 - A digital model of the river has been created using geo-RAS tool of ArcGIS;
- Phase 2 - The digital model has been imported into Hec-Ras to run the simulation with the peak flow discharge with 25, 50 100 years return period and to generate water level along the different stretches of the Sheger River network;
- Phase 3 - The generated water surface allowed to draw the map of the inundated areas that has been used as reference in order to define the zones of the river network that require mitigation measures against the flooding risk.

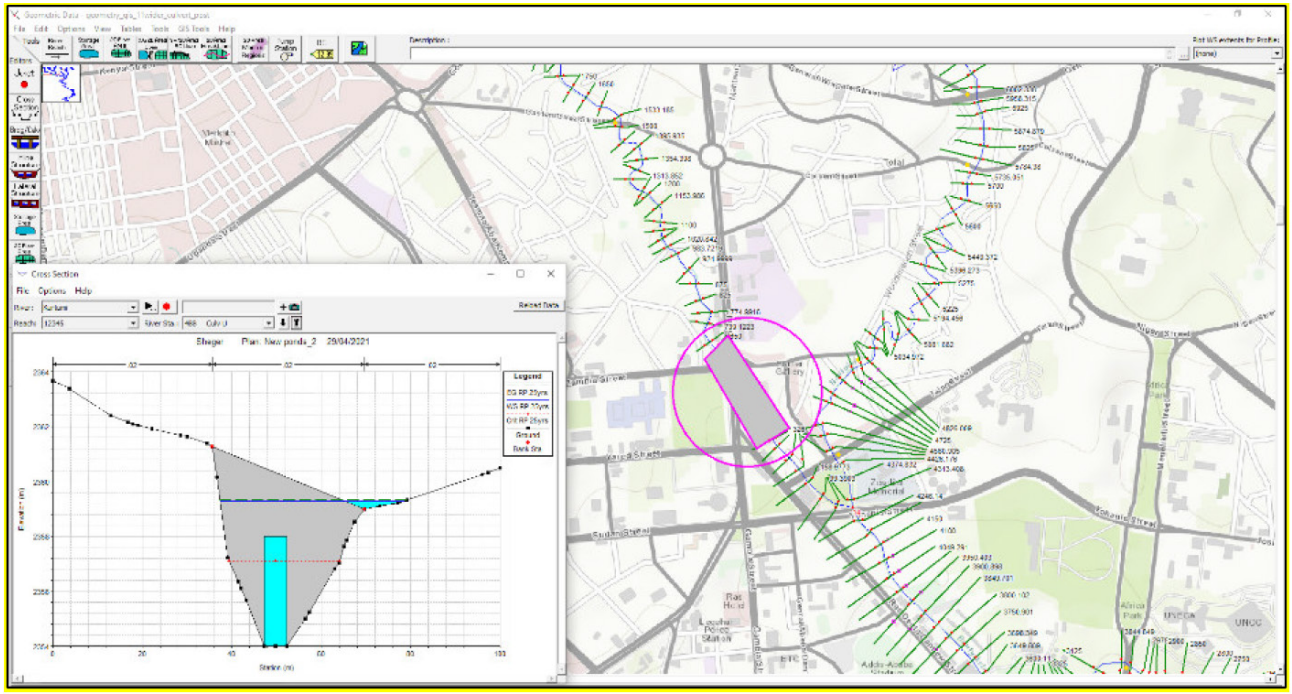


Figure 4-4 Hydraulic model of Sheger River

4.4.2 Inundation Mapping

The results of the HEC-RAS unsteady flow analysis have been imported into GIS environment in order to draw a map of the flooded areas. In developing the hydrological assessment study, the Consultant found different types of hydraulic criticalities related to morphological and urbanisation-related factors.

Inundation maps corresponding to 25 years, 50 years and 100 years return period are provided in the Report and in the drawing in the Annexes, which compare the extension of flooded areas "Ante Operam" and "Post Operam" (see Inundation Maps below).

The maps clearly show the effects on the planned mitigation measures As said before the mitigation measures are designed for a 25 years Return Time, however, it must be noticed, that also for a return period of 50 years and 100 years the planned works contribute effectively to reduce the extension of floods.

More in detail the upper zones of the Kurtumi and Kechene rivers don't show any particular issue related to the risk of flooding at events recurrence interval. There are in fact only a few isolated flooding problems in correspondence of a road crossing on the Kurtumi River that can be addressed by improving the river's conveyance capacity through cleaning and maintenance of the riverbed.

The most critical situations were found in lower Banntyieku, (see Figures below) the downstream area of the Kurtumi and Kechene watercourses, where the confluence of the two rivers is marked by flooding affecting vast areas of the neighbouring town. The flooding phenomenon continues to have the same intensity in the course of the Bantyiketu River, where large areas of the zones bordering the watercourse fall within the perimeter of the flooded areas. Finally, in the last section of the Sheger River, the Kebena watercourse's lower section, doesn't present any noteworthy criticalities, as the cross-section of the watercourse has a more pronounced conformation that allows to confine the perimeter of the flooded areas to the floodplain zone of the river which is sparsely urbanized.

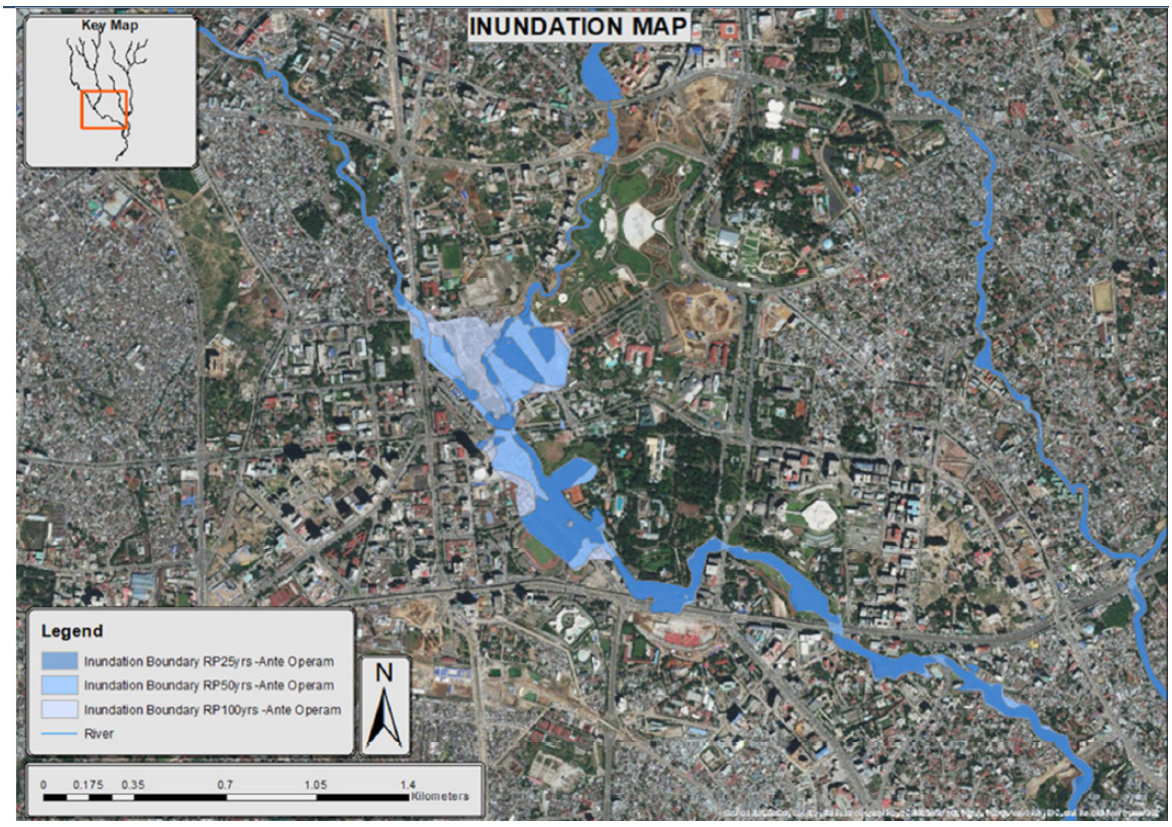


Figure 4-5 Inundation boundary "Ante Operam" of lower Bantyiketu River for 25, 50 and 100 Return Period

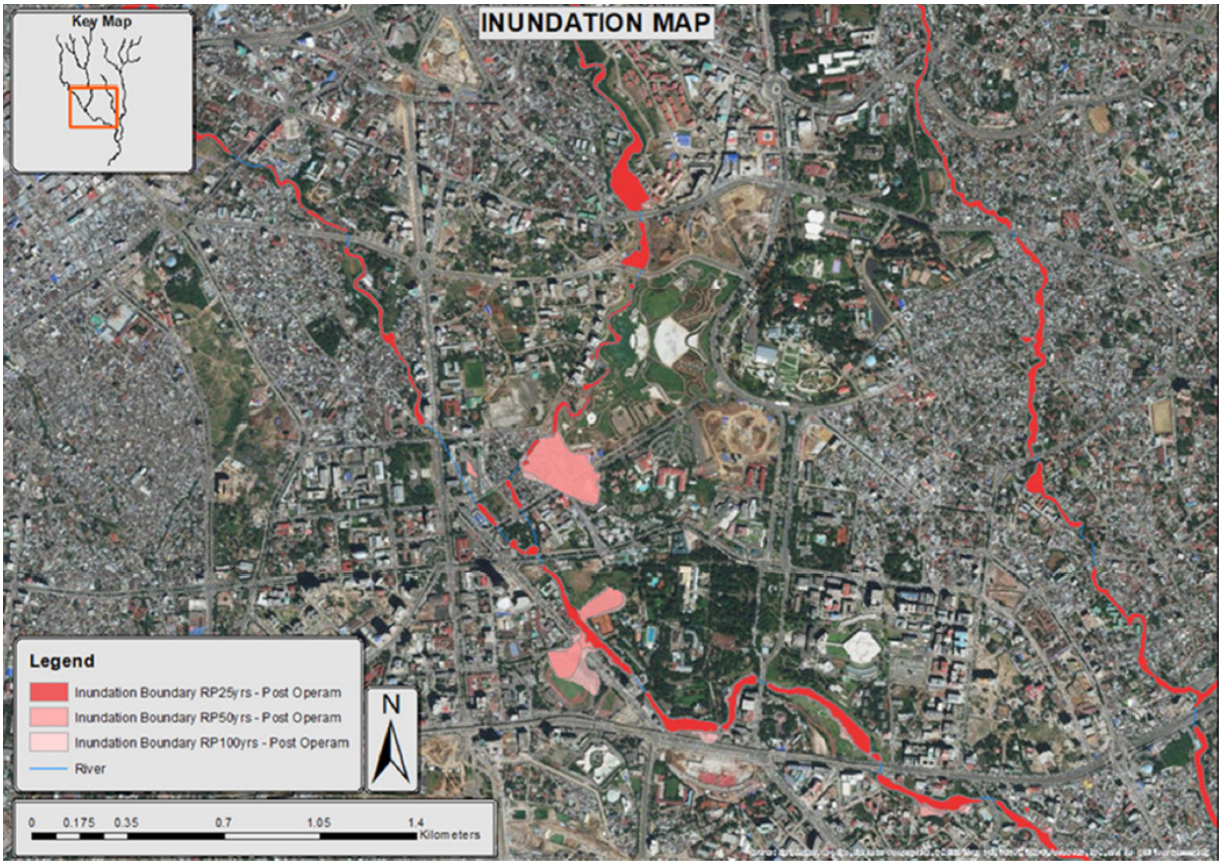


Figure 4-6 Inundation Boundary "Post Operam" of lower Bantyiketu River for 25, 50 and 100 Return Period

4.4.3 Proposed flood mitigation measures

In order to design a system of flood risk mitigation measures for the area under study, the Consultant carried out an analysis of the design alternatives normally applied for this type of actions, taking due account of the context in which this type of intervention must necessarily be integrated. The mitigation measures must therefore fulfil the dual function of reducing the risk of flooding during particularly intense rainfall events and contributing to the general improvement of the environment of the River Sheger, which is the subject of this assignment, without compromising the delicate balance of social and economic connections in the city through which it flows. Given the above considerations, the proposed flooding risk mitigation measures consist in re-shaping of the river cross-section (river training) and the implementation of detention ponds.

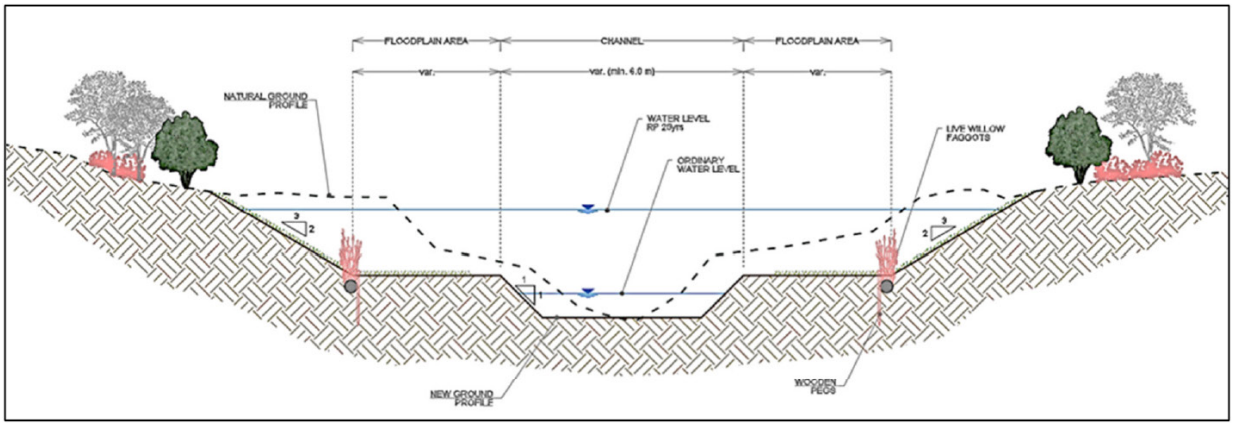


Figure 4-7 Typical river cross section reshaping

Reshaping of the cross-section consists of general cleaning, through the removal of debris and litter, and mainly earthworks by which to ensure an adequate regular drainage section for the river flow. The intervention is carried out by creating a trapezoidal cross-section to accommodate ordinary discharges and floodplain areas, free from obstacles that could interfere with the flowing of water, capable of receiving discharges corresponding to extreme flood events.

Detention ponds are surface storage basins or facilities that provide flow control through attenuation of stormwater runoff. They also facilitate some settling of particulate pollutants. Detention basins are normally dry and in certain situations the land may also function as a recreational facility. However, basins can also be mixed, including both a permanently wet area for wildlife, leisure or treatment of the runoff and an area that is usually dry to cater for flood attenuation. In order to carry out the design of the detention basins, the Consultant identified a some of areas in which detention basins could be allocated in order to mitigate the effects of the peak flow rate characterized by a recurrence interval equal to 25 years. The Consultant carried out a simulation of the proposed interventions in order to quantify the effects of the mitigation measures on the extent of the boundary of the inundated areas. In order to produce the new inundation maps that provide for the implementation of the mitigation measures described above, the consultant run the modelling with the HEC-RAS software using the flow values attenuated by the presence of the detention basins. The combined effects due to the implementation of hydraulic risk mitigation measures show significant benefits also with respect to the hydraulic structures existing within the hydrographic network of the Sheger River.

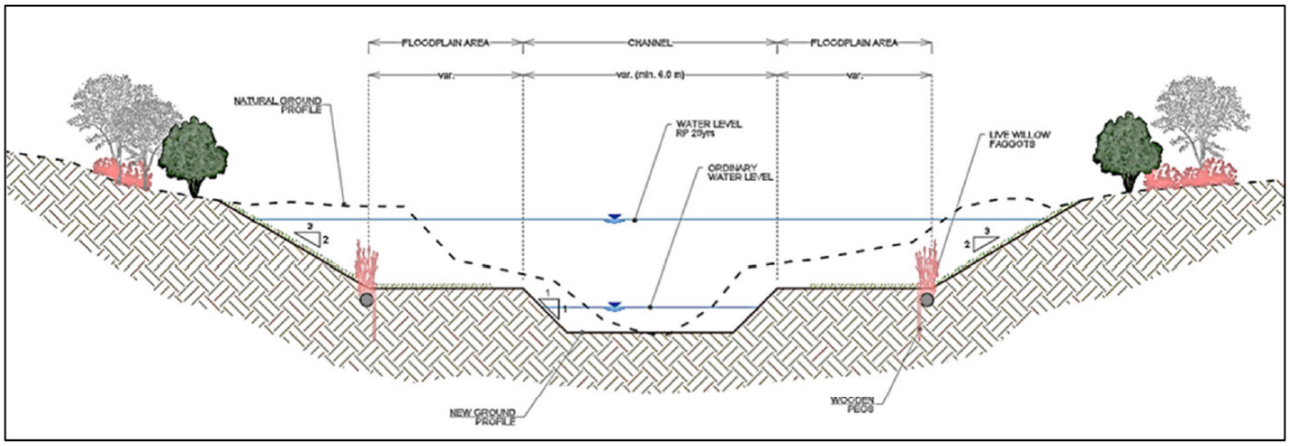


Figure 4-8 Effect of mitigation measures on culverts

4.5 Urban and Zone Based Infrastructures

PLANNING PRINCIPLES

As precondition to the development of the zone based infrastructural plans, the Consultant has engaged in the identification of planning guiding principles.

The principles are aligned with the vision and aspirations of the main stakeholders and relevant authorities (as delineated in the AA Structure Plan, the AA University Riverside Landscape Plan and the BKK+K Strategic Plan) and based on the Consultants previous experiences:

- Principle 1_Ensuring that development considers and integrates with its context
- Principle 2_Enhancing connectivity, accessibility and promoting sustainable means of transport
- Principle 3_Applying human-centred quality criteria in the planning process
- Principle 4_Enhancing river ecosystem to build resilience and protect communities.
- Principle 5_Providing multi-use open spaces that are accessible, comfortable and sociable
- Principle 6_Ensuring minimum resettlement impacts on developing riverside upgrading

4.5.1 Standards and Binding Elements

To achieve the mentioned principles a set of standards have been defined in coherency with the national policies and legal frameworks and in some cases variated to be realistically applicable to the Sheger project. In parallel have been identified a set of elements so called "fixed or bindings" for the elaboration of the investment packages. Those elements include:

a) the land use requirements as per Structure Plan along the river buffer

b) projects in process to be designed or implemented by other actors along the riverbanks,

c) the buffer boundaries as per the University Landscape Plan Study and the Structure Plan

As a matter of facts, the fixed elements listed under paragraph (a) and (c) have been studied to be integrated and to inform and influence the development of the investment packages. While binding elements listed as paragraph (b) have been considered as "grey zones" which will be excluded from the estimation of the investment packages.

4.5.2 Classification of buffer stretches: existing

The riverside area included within the buffer boundaries as indicated by the AA University Study have been classified into stretches based on the following qualitative criteria that will provide important indications for the type of investments to be proposed.

As a matter of fact the subdivision in stretches aims at proposing integrated investment packages by zone which will not be sectoral but could be applicable for any stretch classified under the same class. The criteria are:

- CRITERIA 1_ morphology of river banks
- CRITERIA 2_ typology of green vegetation cove
- CRITERIA 3_ built up adjacent areas typology and density

Following the identification of the criteria the Consultant has engaged in appraising the rivers segments, crosschecking observations during site surveys with the analysis included in the AA Landscape Study Document. The qualitative-based analysis of the above mentioned criteria has resulted into the identification of invariant characters and similarities and in the final classification of the rivers into the following typological stretches:

- Category A_Natural/rural context
- Category B_Peri-urban areas
- Category C_Dense Urban areas
- Category D_Central districts
- Category E_Transformation plots and open spaces in dense urban areas
- Category F_Urban gardens

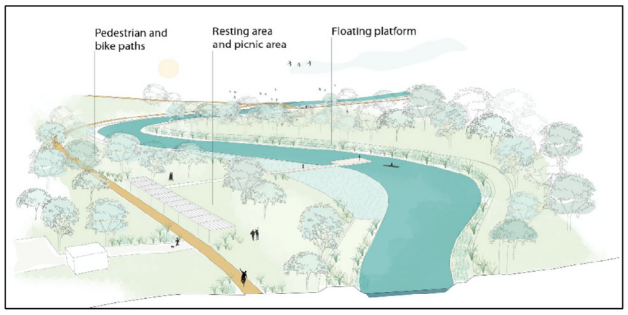
4.5.3 Typical sections for the development

Typical solutions to guide the development of the six identified stretches above described have been then elaborated. For each stretch the Consultant has identified a set of infrastructural interventions to be implemented in order to create a linear green corridor/park along the Sheger River, to facilitate the diffusion of its enjoyment within the whole community and to raise urban quality as a whole.

Stretches has been designed with a specific attention to its position in the urban context and the correlated diversity of users they might attract. A varied set of infrastructure elements for passive recreation (trails, playgrounds, and service blocks), measures for flooding risks mitigation and public health hazards reduction have been proposed. Here below are reported examples of each category.

4.5.3.1 .....Category A_ Nature oriented River Park

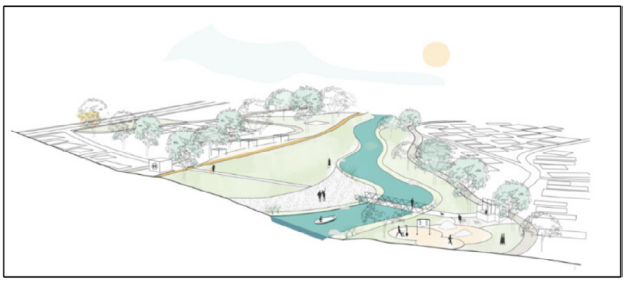
To become a nature oriented River Park attracting visitor at city and regional levels.



Main function of the area will be the preservation of the eco-systemic role of the river, its wild fauna and flora.

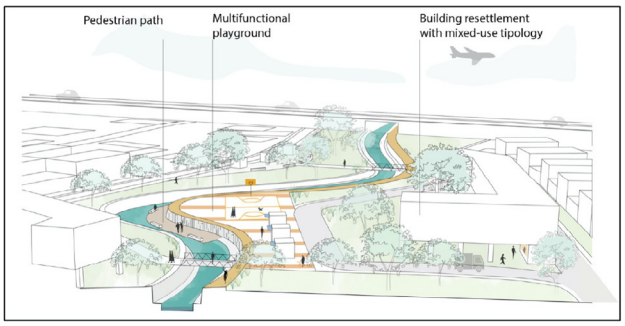
4.5.3.2 .....Category B_ City level Recreational River Park

To become a City-level Recreational River Parks, offering low impacting passive recreation activities in a natural preserved environment.



4.5.3.3 .....Category C_ Neighbourhood level Linear Open Space

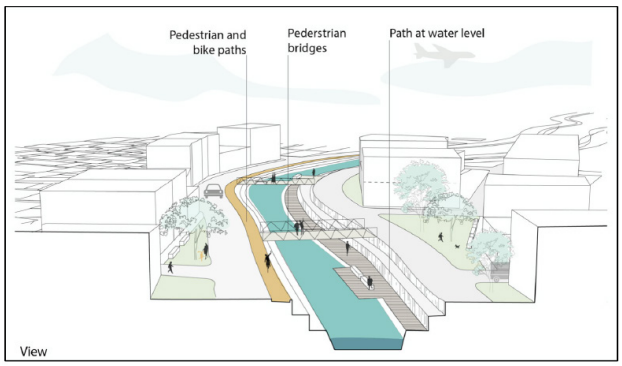
To become a linear open space attracting Addis Abeba residents living in the mix residential areas neighboring those stretches.



4.5.3.4 .....Category D_ Central districts Riverfront

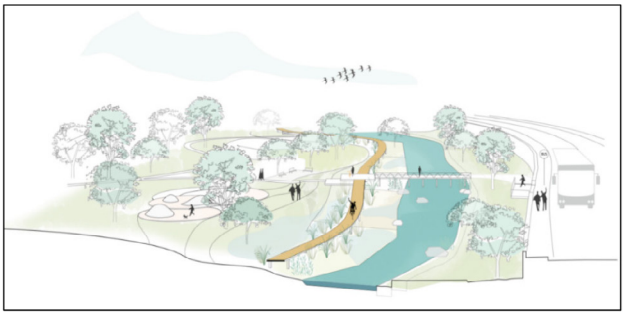
The Central District Riverfronts shall change from being an obsolete infrastructure into quality linear public spaces.

The upgrading project shall promote the creation of a vibrant space for socialization and detoxing from the high intensity life and polluted environment of the city center.



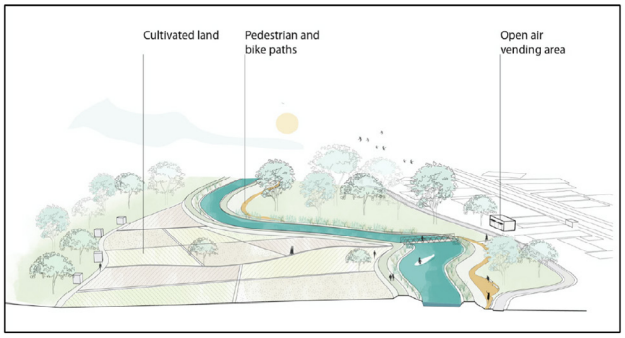
4.5.3.5 .....Category E_ City level Flooding Park and Wetland

To become a city level flooding park, characterized by the presence of retention ponds and wetlands witnessing seasonal flooding.



4.5.3.6 .....Category F_ Urban gardens

Urban gardens and orchards developed on large plots located along the riverbanks will keep their original productive function.



4.6 INFRASTRUCTURES PLAN

The following tables summarise the infrastructures cost.

4.6.1 Wastewater Infrastructures

NEW SEWERS PIPES		
River Segment Length	Main pipes D= (300mm)/(km)	Secondary AAWSA Pipes D= (200/250mm)/(km)
Kechene 2	2,4	2,5
Kurtuni 1	1,56	2
Kurtuni 2	0,84	3
Bentyiketu 1	1,56	2
Bentyiketu 2	1,32	0,5
Ginfile	0,96	12
Little Kebena 4	2,2	8
Little Kebena 5	1,08	12
Little Kebena 6	1,08	11
TOTAL	13	53

TOILETS				
River Segment	Population	Types 1 Toilets	Types 2 Toilets	Total Toilets
Kebena 1	8534,4	6	3	9
Kebena 2	7602	5	3	8
Kebena 3	7591,5	5	3	8
Kurtumi 5	7414,68	5	3	8
Kechene 1	9774,24	7	4	11
TOTAL	40916,82	29	16	45

4.6.2 Stormwater Infrastructures

DETENTION PONDS				
N°	River Segment	Ponds Type	Area [m^2]	Volume [m^3]
1	Kurtumi	In-line	4,500	13,500
2	Kurtumi	Out-line	3,000	9,100
3	Kechene	In-line	13,000	38,000
4	Kechene	In-line	4,000	12,000
5	Kebena	Out-line	7,000	21,000
6	Bentyiketu	Out-line	9,700	38,800

Cat	RIVER RESHAPING	Stretch Length [km]
A	Trapezoidal shapping of river's channel, banks stabilization with hydroseeding and live willow faggots	5.9
B	Trapezoidal shapping of river's channel, banks stabilization with hydroseeding and live willow faggots. Pedestrian facilities.	21.4
C	Cleaning and widening of river's channel, banks stabilization with rockfilled gabions where necessary.	18.5
D	Cleaning and widening of river's channel, banks stabilization with rockfilled gabions where necessary.	6.5
E	Trapezoidal shapping of river's channel, banks stabilization with hydroseeding and live willow faggots or gabions where necessary	15.1
F	Trapezoidal shapping of river's channel, banks stabilization agricultural terraces	2.0

4.6.3 Urban and zone based infrastructures

Cat.	Stretch Urban Role	Stretch extension
A	Trapezoidal shapping of river's channel, banks stabilization with hydroseeding and live willow faggots	5.9 km
B	Trapezoidal shapping of river's channel, banks stabilization with hydroseeding and live willow faggots. Pedestrian facilities.	21.4 km
C	Cleaning and widening of river's channel, banks stabilization with rockfilled gabions where necessary.	18.5 km
D	Cleaning and widening of river's channel, banks stabilization with rockfilled gabions where necessary.	6.5 km
E	Trapezoidal shapping of river's channel, banks stabilization with hydroseeding and live willow faggots or gabions where necessary	15.1 km
F	Trapezoidal shapping of river's channel, banks stabilization agricultural terraces	2 km

TYPOLOGY OF INTERVENTION FOR CATEGORY		
Group of interventions	Type of intervention	Stretches
Pedestrian and cycling paths	Park trails	All Categories
	Elevated trails and floating platforms	A,B
	Access/Emergency streets	All Categories
	Bridges	All Categories
Facilities for passive recreation activities and sanitation	Children Playground	B,C,E
	Multi-sport fields	B,C
	Outdoor fitness areas	B,C
	Skating parks	C
	Public toilets	All Categories
Landscaping and greening	Green Retention Infrastructures	All Categories
	Vegetated areas with ornamental purpose	A,B,C,D,E
Sanitary facilities	Public toilet	

4.7 Overall Costs

The Consultant quantified all the works needed for wastewater, stormwater and urban infrastructures as described in the previous paragraphs.

After analysing the data we worked out a set of parametric unit cost for the main categories of works.

The unit cost have been multiplied for the quantities of works identified in the Infrastructures Plan providing the cost of works, the cost has finally been increased by 60% (K=1,6) to take into consideration the following additional overheads:

- land acquisition,
- rights of way,
- design and supervision costs,
- administrative costs,
- contingencies,
- financing costs
- taxation.

On this foundation the Consultant has prepared the approximate cost estimate of the planned infrastructures, the table summarising all the infrastructures and the related cost is reported below.

SHEGER OVERALL PARAMERTIC COST		WORKS US $	TOTAL COST US $
WASTEWATER			
ABCDEF	Main Pipes D= 30mm	928,500.00	1,485,600.00
	Secondary Pipes D= 200/250 mm	3,312,250.00	5,299,600.00
	VIP latrines	960,000.00	1,536,000.00
	TOTAL	5,200,750.00	8,321,200.00
STORMWATER			
ABCDEF	Detention Ponds	5,270,000.00	8,432,000.00

	River Reshaping		
A	Trapazoidal shaping of river's channel, banks stabilization with hydroseeding and live wilow faggots	7,909,687.00	12,655,500.00
B	Trapazoidal shaping of river's channel, banks stabilization with hydroseeding and live wilow faggots. Pedestrian facilities	28,153,125.00	45,045,000.00
C	Cleaning and widening of river's channel, banks stabilization with rockfiled gabbins where necessary.	38,185,156.25	
D	Cleaning and widening of river's channel, banks stabilization with reinforced concrete retaining wal where necessary.	13,416,406.25	21,466,250.00
E	Trapazoidal shaping of river's channel, banks stabilization with hydroseeding and live wilow faggots or gabions where necessary.	31,167,343.75	49,867,750.00
F	Trapazoidal shaping of river's channel, banks stabilization with hydroseeding and live wilow faggots	2,681,250.00	4,290,000.00
	TOTAL	126,782,968.75	202,852,750.00
	URBAN INFRASTRUCTURES		
A	Natural/rural context	2,786,608.33	4,458,573.33
B	Peri-urban areas	20,968,491.00	33,359,585.60
C	Danse Urban areas	18,897,750.00	30,236,400.00
D	Central districts	10,731,925.00	17,171,080.00
E	Transformation pilots	11,781,775.00	18,850,840.00
F	Urban gardens	2,465,680.00	3,345,088.00
	TOTAL	67,632,229.33	108,211,566.93
	OVERCALL COST	199,615,948.08	319,385,516.93

Table 4-2 Sheger overall parametric cost

4.8 Preliminary Investment Packages (Ip) Options

Using the Preliminary cost estimate (Chapter 8) the Consultant has drawn up a preliminary proposal of 10 Investment Packages (IP) in order to facilitate the Bank and the Stakeholders to assess the priority of interventions. The Figure below present in a comprehensive way:

- The location of the ongoing cooperation projects: UN Habitat, CES, China Aided, Korean Cooperation and Italian Cooperation (UNDP project is spread all over Sheger)
- The location of the 6 categories A, B, C, D, E, F marked with different colours
- The boundaries of each intervention Package.

Inside each IP the Consultant has identified (see table below) the sub stretches pertaining to each category and sub category, and for each sub stretch the Investment cos and the number of people who will benefit of the intervention.

IP	SUB-STRETCH	LENGTH (KM)	COST OF INVESTMENT (MILLION USD)	BENEFICIARY POPULATION (PEOPLE)
IP01	B1	1.3	$ 6	20,475
	C1	0.7	$ 3	18,375
	E1	0.3	$ 1	4,725
	C2	1	$ 5	26,250
	E2a	0.6	$ 3	9,450
	C3	2.7	$ 13	70,875
Sub total IP01		6.6	$ 31	150,150
IP02	B2	2.5	$ 12	39,375
	C4	2.3	$ 11	60,375
	E3	0.6	$ 3	9,450
Sub total IP02		5.4	$ 25	109,200
IP03	B3	3.5	$ 16	55,125
	B4	2.2	$ 10	34,650
	E2	0.8	$ 4	12,600
	C5	1.2	$ 6	31,500
Sub total IP03		7.7	$ 36	133,875
IP04	C6	2.2	$ 10	57,750
	E4	1.1	$ 5	17,325
	D1	0.3	$ 1	7,875
	E5	3.4	$ 16	53,550
	D4	0.5	$ 2	13,125
Sub total IP04		7.5	$ 35	149,625
IP05	D2	1.4	$ 6	36,750
	E6	0.3	$ 1	4,725
	D3	2.6	$ 12	68,250
	D5	0.3	$ 1	7,875
	F1	2.3	$ 11	60,375
Sub total IP05		6.9	$ 32	177,975
IP06	A1	1.4	$ 6	11,025
	B5	2.2	$ 10	34,650
	E7	1.7	$ 8	26,775
Sub total IP06		5.3	$ 25	72,450
IP07	B6	8.2	$ 38	129,150
Sub total IP07		8.2	$ 38	129,150
IP07a	A2	3.9	$ 18	30,713
Sub total IP07a		3.9	$ 18	30,713
IP08	E8	0.9	$ 4	14,175
	C8	3.4	$ 16	89,250
	C7	2.1	$ 10	55,125
Sub total IP08		6.4	$ 30	158,550
IP09	E9	2.1	$ 10	33,075
	C9	1	$ 5	26,250
	E10	1	$ 5	15,750
	C10	1.7	$ 8	44,625
Sub total IP09		5.8	$ 27	119,700
IP10	E11	3.1	$ 14	48,825
	C11	2.2	$ 10	57,750
SUB TOTAL IP010		5.3	$ 25	106,575
TOTAL		69	$ 319	1,337,963

Table 4-3 Investment cost and beneficiary population for each sub package

5 Economic and Financial Analysis

The economic and financial analysis is the main content of the Draft Final Report. The aim of the economic and financial analysis of the Beautifying Sheger Project is to assess the impact of foreseen investments on local social and economic conditions. As put by TORs, despite the strong economic growth trends, Addis Ababa faces significant economic challenges, which include not only unemployment and poverty levels, but substantial difficulties in providing housing and urban services and in creating a 'liveable' city where its citizens and enterprises can thrive.

The assumption is that an environment with well managed open spaces and a river system as close as possible to its natural condition is a prerequisite condition for a 'liveable' city, which in turn would trigger its economic and social development. The project indeed aims to convince citizens to assist in the cleaning efforts, as there has been no environmental action to reduce industrious and urban waste so far.

The analysis is therefore driven by specific TORs' objectives - increasing tourism and quality of life, reducing the effects of climate change and creating jobs in Ethiopia's capital city by developing green spaces – which are assumed as a basis for the choice of the methodology too.

The methodological approach is built around a 5-steps approach:

1. Application of Multi-Criteria Decision Analysis (MCDA), in order to prioritize Investment Packages (IPs) according to broad socio-economic costs and benefits
2. Focus on specific IPs in order to test the robustness of the model
3. Economic appraisal of such IPs according to a Cost-Benefit Analysis approach
4. Calculation of Economic Internal Rate of Return (EIRR) to prove the sustainability of related investments at designed IPs
5. Analysis and identification of most suited value capture methods with specific regard to Real EstateValorization

MCDA was adopted as the financial effort is spread through 10 investment packages (IP), ranging from natural/rural context and peri-urban areas (categories "A", "B") to more densed areas ("C", "D", "E") till urban gardens ("F"), with each category corresponding to different set of interventions and involved population.

As the implementation of a unique financial analysis for such extensive and composite investment would not allow to deepen specific circumstances according to the features of each IP, the Consultant and AfDB agreed to focus on smaller and distinctive areas, coinciding with specific IPs. This would allow to test reference cases which would later drive the evaluation for the broader Sheger Project.

MCDA exercise considered different arrays of costs and benefits - tangible and intangible – and pushed the Consultant to choice IP01 and IP08 areas, as they respectively reflected a high score in the MCDA results (IP01) and an lack of other international organizations' intervention (IP08).

For such IPs a Cost-Benefit Analysis (CBA) was conducted. Both methodologies – the MCDA and CBA – were conducted according to international models and practices and allowed for sensitivity analysis, which proved the robustness of the models.

The CBA provided the Economic Internal Rate of Return (EIRR) for each of the two pilot projects, which in turn showed the economic viability of foreseen investments. While cost analysis concentrated on cost of investment, integrated by ordinary and periodic maintenance, and coupled with periodical renovation of infrastructure, benefits included an also broader set of indicators, including improvement of residents' health, savings to public sector, safety and security of personal belongings and increase of residents' wealth.

Finally, a deepening was made about real estate valorisation which might benefit from urban upgrading and betterment of local environmental conditions. Such valorisation would be a pre-condition for further economic actions.

The analysis tested the possibility, for the public sector – whose relevance includes nearly half of the properties interested by the intervention - to direct capture the value increase by the real estate value of public properties, while the introduction of betterment levies or, more difficultly, property tax – was tested as a potential fiscal too to capture increase in the value of private properties too.

THE ANALYSIS IS BASED ON THE OUTCOME OF PREVIOUS PARAGRAPH SHEGER MONTH 4 REPORT - DRAFT BACKGROUND PLAN REVISION 1

The Beautifying Sheger Project is an initiative that runs along the rivers of Addis Ababa, developing green spaces starting from Entoto to Akaki alongside the 56 km river streams until they reach Kality waste water treatment plant. It aims to increase tourism and quality of life, reducing the effects of climate change and creating jobs in Ethiopia's capital city by developing green spaces. The project aims to convince citizens to assist in the cleaning efforts as well, as despite Ethiopia's recent economic development, there has been no environmental action to reduce industrious and urban waste.

The foreseen investment is very relevant and amounts to around 318.8 USM$, including around 1/3 (33.9%, 108.3 USM$) for Urban Upgrading and the rest for Storm Water Reshaping (60.8%, 194.2 USM$), with the exception for Storm Water Retention Ponds (2.6%, 8.4USM$) e Waste Water (2.5%, 8.0 USM$). See also a copy of Table 4-1 below.

	SHEGER OVERALL PARAMERTIC COST	WORKS US $	TOTAL COST US $
	WASTEWATER		
ABCDEF	Main Pipes D= 30mm	928,500.00	1,485,600.00
	Secondary Pipes D= 200/250 mm	3,312,250.00	5,299,600.00
	VIP latrines	960,000.00	1,536,000.00
	TOTAL	5,200,750.00	8,321,200.00
	STORMWATER		
ABCDEF	Detention Ponds	5,270,000.00	8,432,000.00
	River Reshaping		
A	Trapazoidal shaping of river's channel, banks stabilization with hydroseeding and live wilow faggots	7,909,687.00	12,655,500.00
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	TOTAL	126,782,968.75	202,852,750.00
	URBAN INFRASTRUCTURES		
A	Natural/rural context	2,786,608.33	4,458,573.33
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F	Urban gardens	2,465,680.00	3,345,088.00
	TOTAL	67,632,229.33	108,211,566.93
	OVERCALL COST	199,615,948.08	319,385,516.93

Copy of table 4-1

Such investment is spread through 10 Investment Packages (IP), which impact the whole 69 km of river stretches, for each one different categories of interventions were foreseen in the previous reports, ranging from natural/rural context and peri-urban areas (categories "A", "B") to more dense areas ("C", "D", "E") till urban gardens ("F"), with each category corresponding to different set of interventions and involved population. **See a Table 4-2 and Figure 5-1.**

Implementation of financial analysis for such extensive investment is a challenge as broad social and economic benefits do overstep mere financial considerations. Investments do indeed address dramatic issues such as drainages and sewerage, whose absence jeopardize entire growing communities, along with other apparently less urgent aspects such as the provision of open spaces and facilities, which nevertheless substantially contribute to the "livability" of the interested areas. A broader approach does also bring to consideration related to the satisfaction of upper-level human needs ranging from beauty and cultural expression, to a sense of belonging to the place.

In such a situation two different evaluation options were available to the Consultant. The first referred to a broad analysis of the whole Sheger Project, while the second one was to focus such analysis on a smaller area, so that to test a reference case which would later drive the evaluation for the broader Sheger Project. After discussion and agreement with the African Development Bank Group, the Consultant chose to follow the second option, which brought the advantage to allow for the elaboration of a more grounded and sophisticated approach avoiding the risk to be generic and superficial as a larger scale method might have carried with.

Following such approach, a two-steps methodology was implemented. The first step referred to the priorization of the 10 IPs, so that to come to a rational and shared choice about two pilot-projets to focus on. Such action was conducted resorting to a multi-criteria approach, where different arrays of costs and benefit, tangible and intangible, were considered.

Once a set of eligible IPs were identified, a collective decision was taken to focus on specific IPs which broadly satisfied the whole technical and institutional conditions. For such IPs a Cost-Benefit Analysis (CBA) was conducted. Both methodologies – the MCDA and CBA – were conducted according to international models and practices and allowed for sensitivity analysis, which allowed to prove the robustness of the models.

After the CBA exercise, which allowed to calculate the Economic Internal Rate of Return (EIRR) of the two pilot projects, a deepening was made about real estate valorisation which might benefit from urban upgrading and betterment of local environmental conditions. A scenario of technical solutions were appraised in order to suggest a viable option – directly capture the increase in real estate value of public property, couple with betterment levies or property tax – which might be extended to the whole Sheger Project.

5.1 The Area of Intervention

5.1.1 Problems and priorities

The 69 km Sheger Project river stretches refer to a River Buffer Scale which, as illustrated in the Landscape Plan, sets max 60 meters as the longest possible distance to the river bank, with site-specific adjustments proposed where the limits set were considered unfitable. particularly in the densely developed central area of the city. The Study identifies 6 macro-riparian-areas, the so-called Rivers Corridors, with these areas divided in 16 River Sections.

5.1.2 Projects to be implemented

The riverside area included within the buffer boundaries as indicated by CES-AA University Study were classified into stretches based on qualitative criteria that provided distinctive indications for the type of investments to be proposed.

The subdivision in stretches aimed at proposing integrated investment packages by zone so that to overcome sectorial distinction but apply to any stretch classified under the same category.

The following typological stretches were considered:

- CATEGORY «A» - Natural/rural context
- CATEGORY «B» - Peri-urban areas
- CATEGORY «C» - Dense Urban areas
- CATEGORY «D» - Central districts
- CATEGORY «E» - Transformation plots and open spaces in dense urban areas
- CATEGORY «F» - Urban gardens

Category A and B stretches are mainly located in the northern fringes of Kurtumi, Kechene and Kebena rivers. Here settled area is sparse and in general the environmental conditions of the river are good to fair.

Category C and D are located in densely urbanized areas. Both are characterized by the presence of informal settlements that have been developing on the river banks. They are located in the very city center in a dense mixeduse pattern. They are found along the Kurtumi, Kechene, Kebena and Ginfile rivers.

Categories E stretches are scattered from north to south of the city along the four rivers. They include those stretches that are edged at least on one side by an existing open space or a planned transformation area as per Structure Plan indications. This typology of stretches is particularly interesting due to the possibility of proposing the creation of retention ponds on the wide-open spaces and unbuilt areas. Such integrated system of retention ponds along the rivers is intended to mitigate and reduce the flooding risks assessed in several tracts.

Category F consists in a single stretch located in the junction between Kebena e Banteyketu Rivers where a wide area dedicated to agricultural activities is present. Urban agriculture has been considered a worth use to be kept as source of livelihood and best sustainability practice in the urban environment.

The Sheger investment is spread through 10 investment packages (IP), which impact the whole 56 km of river stretches, and include the different categories of interventions.

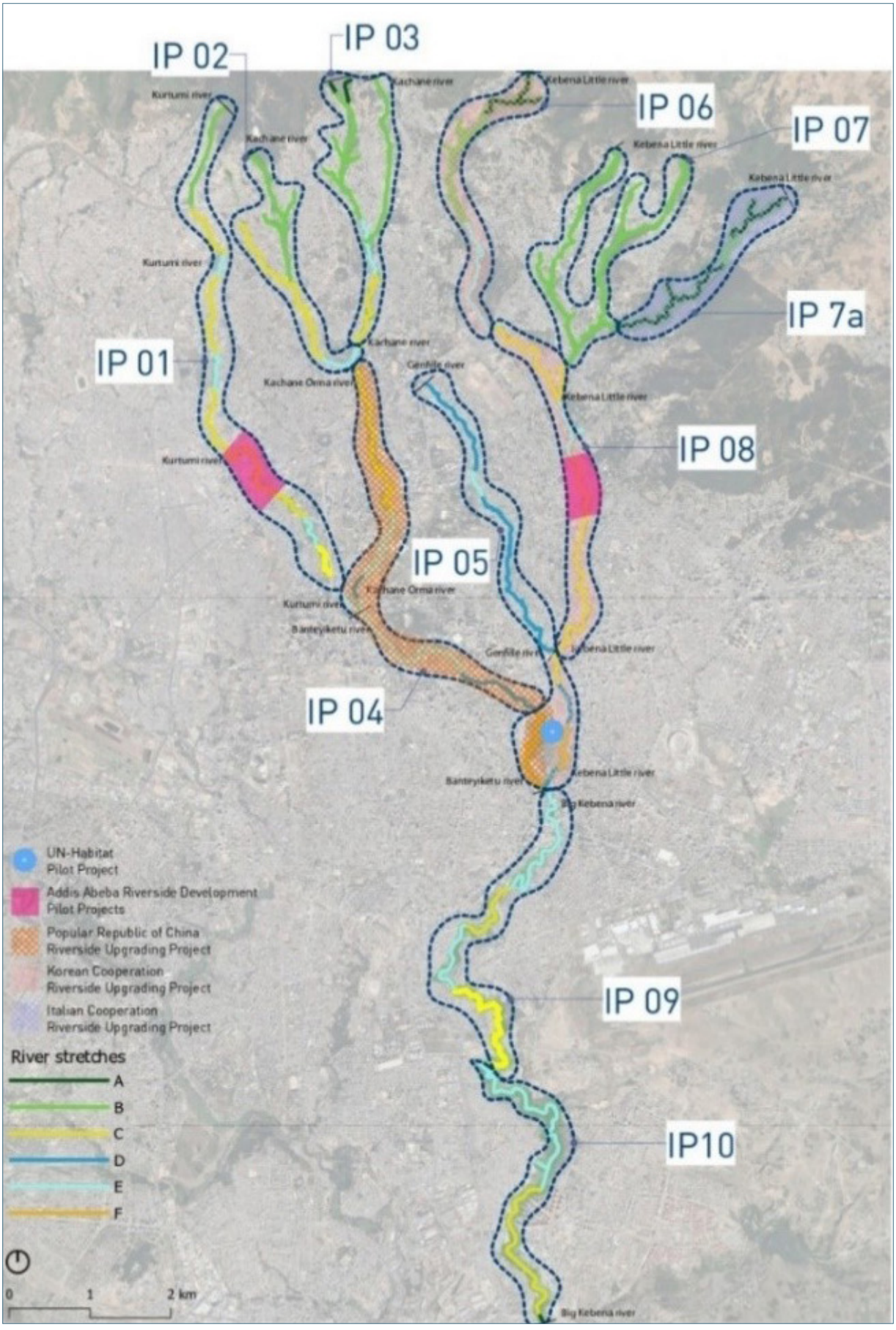

Figure 5-1 The Beautify Sheger area of intervention organized into 10 investment packages (IP)

5.2 Key Input Indicators

The following table sums sup key input indicators, including:

- Substretch;
- Length;
- Cost of investment;
- Beneficiary population.

IP	Substretch	Length (km)	Cost of investment (Million M$)				Total	Beneficiary population ()
			Urban Upgrading	Stormwater reshaping	Stormwater ponds	Waste Water		
IP01	B1	1.3	2.19	2.94	20,475			
	C1	0.7	1.03	2.09	18,375			
	E1	0.3	3.56	0.94	4,725			
	C2	1	1.48	2.98	26,250			
	E2a	0.6	7.11	1.88	9,450			
	C3	2.7	3.98	8.05	70,875			
Sub total IP01		6.6	M$ 9.75	M$ 18.88	M$ 2.33	M$ 0.78	M$31.7	150,150
IP02	B2	2.5	4.21	5.66	11.575	39,375		
	C4	2.3	3.39	6.85	10.649	60,375		
	E3	0.6	0.71	1.88	2.778	9,450		
Sub total IP02		5.4	M$8,82	M$ 14.36	M$ 0.60	M$ 0.53	M$ 23.84	109,200
IP03	B3	3.5	5.90	7.92	16.205	55,125		
	B4	2.2	3.71	4.98	10.186	34,650		
	E2	0.8	0.95	2.51	3.704	12,600		
	C5	1.2	1.77	3.58	5.556	31,500		
Sub total IP03		7.7	M$ 12.32	M$ 19.0	M$ 0.80	M$ 0.38	M$ 35.6	133,875
IP04	C6	2.2	3.24	6.56	10.186	57,750		
	E4	1.1	1.30	3.45	5.093	17,325		
	D1	0.3	1.01	1.26	1.389	7,875		
	E5	3.4	4.03	10.66	15.742	53,550		
	D4	0.5	1.68	2.10	2.315	13,125		
Sub total IP04		7.5	M$ 13.27	M$ 24.03	M$ 2.58	M$ 0.58	M$ 34.7	149,625
IP05	D2	1.4	4.71	5.89	6.482	36,750		
	E6	0.3	3.56	0.94	1.389	4,725		
	D3	2.6	8.75	10.94	12.038	68,250		
	D5	0.3	4.03	1.26	1.389	7,875		
	F1	2.3	1.68	4.29	10.649	60,375		
Sub total IP05		6.9	M$ 18.78	M$ 23.33	M$ 0.00	M$ 1.13	M$ 31.9	177,975
IP06	A1	1.4	1.18	3.34	6.482	11,025		
	B5	2.2	3.71	4.98	10.186	34,650		
	E7	1.7	2.02	5.06	7.871	26,775		
Sub total IP06		5.3	M$ 6.90	M$ 12.39	M$ 2.12	M$ 0.28	M$ 24.5	72,450
IP07	B6	8.2	13.83	18.56	37.966	129,150		
Sub total IP07		8.2	M$ 13.83	M$ 18.56	M$ 0.00	M$ 0.31	M$ 37.9	129,150
IP07a	A2	3.9	3.28	9.31	18.057	30,713		

Sub total IP07a		3.9	M$ 3.28	M$ 9.31	M$ 0.00	M$ 0.28	M$ 18.0	30,713
IP08	E8	0.9	1.07	2.82	4.167	14,175		
	C8	3.4	5.01	10.13	15.742	89,250		
	C7	2.1	3.10	6.26	9.723	55,125		
Sub total IP08		6.4	M$ 9.10	M$ 19.21	M$ 0.00	M$ 2.36	M$ 29.6	158,550
IP09	E9	2.1	2.49	6.58	9.723	33,075		
	C9	1 1.48	2.98	4.63	26,250			
	E10	1 1.19	3.14	4.63	15,750			
	C10	1.7	2.51	5.07	7.871	44,625		
Sub total IP09		5.8	M$ 7.66	M$ 17.77	M$ 0.00	M$ 1.10	M$ 26.8	119,700
IP10	E11	3.1	3.67	9,72	14.353	48,825		
	C11	2.2	3.25	6,56	10.186	57,750		
Sub total IP010		5.3	M$ 6.92	M$ 16.28	M$ 0.00	M$ 0.12	M$ 24.5	106,575
TOTAL		69	M$ 108.2	M$ 194.15	M$ 8.43	M$ 8.04	USD M 318.84	1,337,963

Table 5-1 -Key input indicators of Beatifying Shegen

5.3 Types of Costs

The considered Costs include two typologies of costs:

6. the cost of investment
7. the resettlement costs.

5.3.1 Cost of investment

The cost of investment for each IP and sub-stretch was reported in the previous table. It includes the following items:

- Planning studies.
- Sanitation facilities along the riverside, including on-site sanitation management, public toilet and washing
- blocks, sewers and any riverside-specific treatment.
- Storm water facilities along the riverside, including channels, retention facilities, pipelines or larger scale conduits.
- Other services which can use the riverside as a servitude, including electricity cables, water pipelines and telecommunications cabling.
- River bank protection.
- Greening of river within buffer one, including necessary earthworks.
- Cycle ways, pathways and park facilities.
- Roadways and parking areas, where these will be part of the riverside development.
- Public buildings, other than toilet and washing blocks, which may include special community facilities.
- Housing and resettlement costs for people currently living in buffer zone.
- Commercial property development (land only with building costs excluded).

5.3.2 Resettlement costs

Costs were estimated in the previous parts of the study. A benchmark of 50 housing units/ hectare of surface was considered.

Results are showed in the table. Total cost of resettlement is 396*15.000 U$ = 5.940.000 USD

Sub-Stretches	Resettlement area (ha)	Units to be resettled (units)
D2+D3+D5	3.19	160
D5	1.77	89
D4	2.39	147
TOTAL	7.89	396

Table 5-2- Input data for resettlemen

5.4 The Decision Process

5.4.1 The objectives

The decision process aims to select the area where to focus the financial and economic analysis, according to contribution to the five main themes (benefits) and related costs.

5.4.2 The alternatives

Alternatives include the 10 IPs reported in the previous table nr. 2.
It is relevant to notice that the TORs require for the project to include recommendations on project packaging with a view to achieving efficiency of delivery, maximum socio-economic benefit and optimal financial arrangements.

IPs therefore include:

- Stretches of riverside (river zones) with associated local infrastructure, public facilities, public spaces and private property which can be included under individual riverside zone packages.
- Larger scale infrastructure which is best done at a scale separate from riverside zone packages.

The Consultant Approach foresees that project priorization is made through applying a multicriteria approach based on comparison of Benefits and Costs. Such approach will allow prioritize IPs which, in turn, might be packaged according to available money for investments.

5.4.3 The consequences

Consequences are measured and evaluated according to contribution to the five main themes (benefits) and related costs.

Benefits include contribution to:

- Environment
- Public Health
- Public realm
- Culture and institutions
- Economic development

Costs include contribution to:

- Investment
- Resettlement

5.5 Scoring and Weighting

Scoring and weighting was made through implementation of the Equity model by Catalyze[2]. Such model helped to normalize benefits and cost scores according to a 0-100 ranking scale, while allowing for weighting also weights[3].

The following table reports the results of the MCDA.

IP	Benefits/Costs Ratio	Investment (USM)
IP05	122.03	43.4
IP01	69.80	31.7
IP04	32.10	38.5
IP09	21.01	26.5
IP03	19.49	32.5
IP02	14.82	23.8
IP08	13.35	30.7
IP06	10.68	22.7
IP10	5.87	23.3
IP07	1.44	32.7

Table 5-3–Results of the MCDA

[2]Report of the Equity model implementation is enclosed in Annex 2
[3]We considered the following weights: Economic development: 100; Displacement: 100; Public health: 80; Environment: 70; Public Realm: 60; Culture and Institutions: 40

5.6 Trade Off

The below figure shows best choices according to B/C ratio and investments.

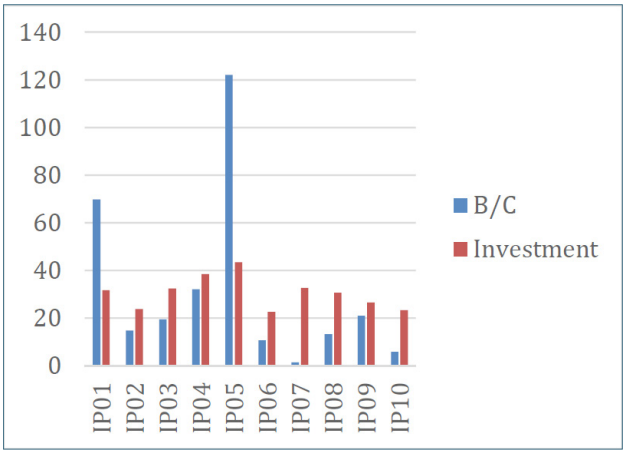

Figure 5-2- Results of MCDA

The figure helps us to understand that stretches included in the IP01, IP04 and IP05 have the best B/C ratio.

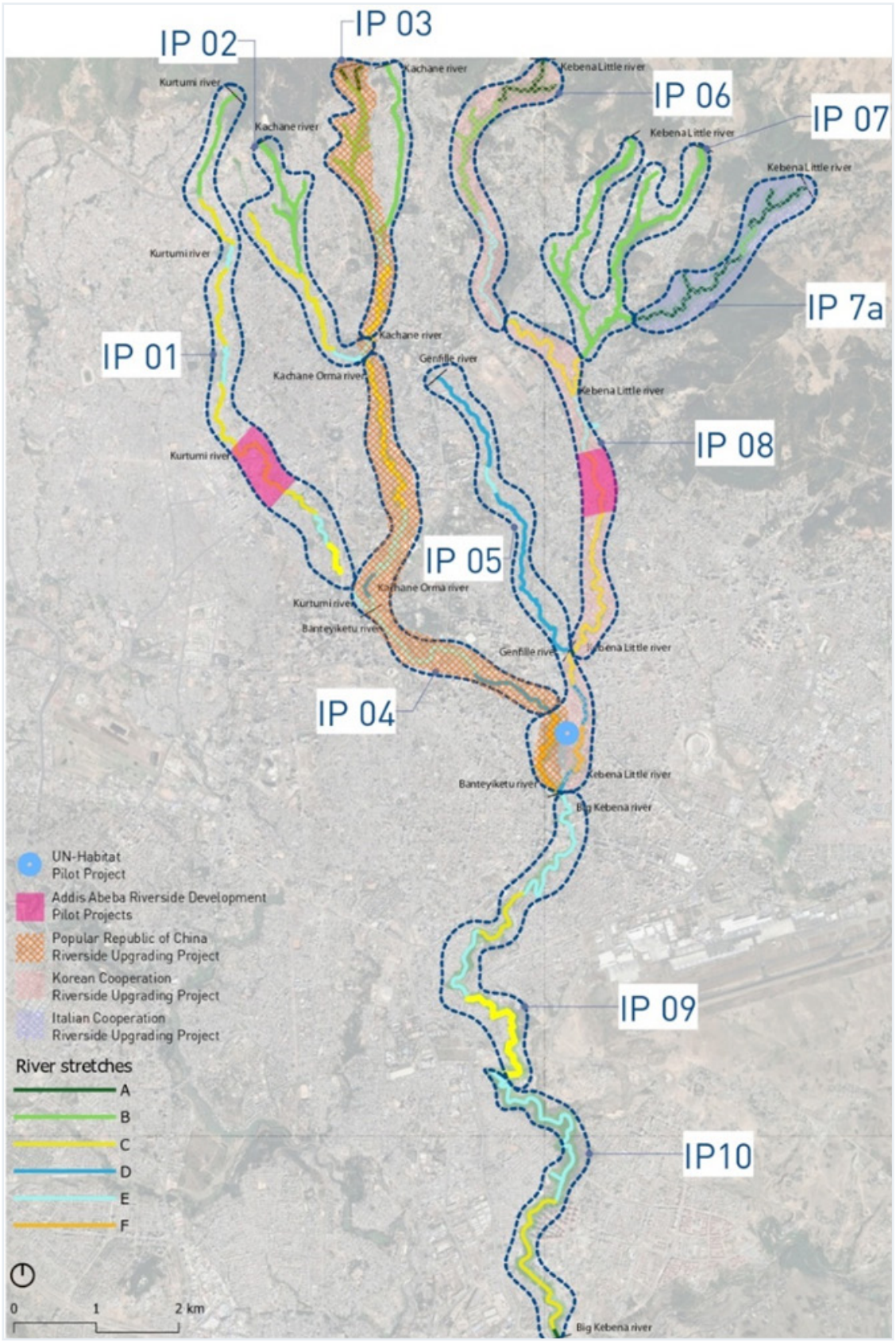

Figure 5-3- The identified IPs

The choice for the pilot areas included:

- IP01 for being included through the best options (the second best);
- IP08 for being an area where less studies have been so far focused on.

5.7 The Study Area: Problems And Priorities

5.7.1 The IP01 area

The IP01 includes the following sub-stretches:

- B1
- C1
- E1
- C2
- E2a
- C3

Key indicators are reported in the following table.

Substretch	Length (km)	Costs					Beneficiary population
		Urban Upgrading	Stormwater (reshaping)	Stormwater (retention ponds)	Waste water	Total	
B1	1.3	$2,191,682	$2,942,638				20,475
C1	0.7	$1,032,462	$2,086,213				18,375
E1	0.3	$355,676	$$940,901				4,725
C2	1.0	$1,474,946	$2,980,305				26,250
E2a	1.0	$711,352	$1,881,801				9,450
C3	2.7	$3,982,355	$8,046,823				70,875
TOTAL	7.0	$9,748,474	$18,878,682	$2,335,000	$778.000	$31,740,157	177,975

Table 5-4 Key indicators of IP01

In order to conduct our analysis, we need to distinguish categories of interventions for each sub-stretch.

We considered the following Urban Upgrading input data for sub-stretch "B".

5. Economic and Financial Analysis

TYPE OF INTERVENTION	UNIT OF MEASURE	UNIT COST FOR INVESTMENT	QUANTITY	APPROXIMATE ESTIMATE US $
Park trails average width 2.5	m^2	USD 40	53,500	USD 2,140,000
Elevated trails width 2 m width	m^2	USD 320	3,567	USD 1,141,333
Floating platform 10m^2	m^2	USD 320	71	USD 22,827
Access/Emergency streets	m^2	USD 320	85,600	USD 27,392,000
Bridges	m^2	USD 352	803	USD 282,480
Children Playground (module 50m^2)	m^2	USD 64	550	USD 35,200
Multi-sport fields (min pitch 150m^2)	m^2	USD 48	1,650	USD 79,200
Outdoor fitness areas (min 25m^2)	m^2	USD 280	275	USD 77,000
Vegetated areas with ornamental purpose	m^2	USD 35.2	525	USD 18,480
Riparian vegetation 2 meters average width	m^2	USD 35.2	42,800	USD 1,506,560
Service blocks (equipped shelter module 30m^2)	nr	USD 6,240	21	USD 133,536
Kiosks (1 kiosk module 10m^2)	nr	USD 1,680	64	USD 107,856
Sitting and resting areas including bins and signages (modules 3 tables + benches 9 seats + shading shelter + accessories - 25m^2)	nr	USD 1.600	21	USD 34,240
Public toilets (block 4 units and lavatory - 24m^2)	nr	USD 6,720	21	USD 143,808
Birdwatching towers (10m^2 platform)	m^2	USD 192	7	USD 1,370
Parking areas (single plot 500m^2)	nr	USD 20,000	21	USD 420,000
Public lighting	nr	USD 160	86	USD 13,696
TOTAL				USD 33,549,585.6
Average cost upgrading and regeneration per m^2				USD 15.68
Average cost upgrading per m/buffer				USD 1,567.74

Table 5-5 -Key indicators for sub-stretch "B"

We considered the following Urban Upgrading input data for sub-stretch "C".

TYPE OF INTERVENTION	UNIT OF MEASURE	UNIT COST FOR INVESTMENT	QUANTITY	APPROXIMATE ESTIMATE US $
Park trails average width 2.5	m^2	USD 40	46,250	USD 1,850,000
Access/Emergency streets	m^2	USD 128	74,000	USD 9,472,000
Bridges	m^2	USD 352	694	USD 244,200
Children Playground (module 50m^2)	m^2	USD 64	1,850	USD 118,400
Multi-sport fields (min pitch 150m^2)	m^2	USD 48	5,550	USD 266,400
Outdoor fitness areas (min 25m^2)	m^2	USD 280	925	USD 259,000
Skating parks (min 200m^2)	m^2	USD 88	1,850	USD 162,800
Riparian vegetation 2 meters average width	m^2	USD 35.2	37,000	USD 1,302,400
Vegetated areas with ornamental purpose	m^2	USD 35.2	185,000	USD 6,512,000
Service blocks (equipped shelter module 30m^2)	nr	USD 6,240	37	USD 230,880
Kiosks (1 kiosk module 10m^2)	nr	USD 1,680	111	USD 186,480
Sitting and resting areas including bins and signages (modules 3 tables + benches 9 seats + shading shelter + accessories - 25m^2)	nr	USD 1.600	37	USD 59,200
Public toilets (block 4 units and lavatory - 24m^2)	nr	USD 6,720	37	USD 248,640
Parking areas (single plot 500m^2)	nr	USD 20,000	19	USD 370,000
Public lighting	nr	USD 160	463	USD 74,000
Incremental housing (50m^2 min unit)	nr	USD 24,000	370	USD 8,880,000
TOTAL				USD 30,236,400
Average cost upgrading and regeneration per m^2				USD 16.34
Average cost upgrading per m/buffer				USD 1,634.40

Table 5-6-Key indicators for sub-stretch "C"

5. Economic and Financial Analysis

We considered the following Urban Upgrading input data for sub-stretch "E".

TYPE OF INTERVENTION	UNIT OF MEASURE	UNIT COST FOR INVESTMENT	QUANTITY	APPROXIMATE ESTIMATE US $
Park trails average width 2.5	m^2	USD 40.00	37750	USD 1,510,000.00
Access/Emergency streets	m^2	USD 128.00	60400	USD 7,731,200.00
Elevated trails width 2 m width	m^2	USD 320.00	2517	USD 805,333.33
Floating platform 10m^2	m^2	USD 320.00	50	USD 16,106.67
Bridges	m^2	USD 352.00	1133	USD 398,640.00
Children Playground (module 50m^2)	m^2	USD 64.00	1510	USD 96,640.00
Multi-sport fields (min pitch 150m^2)	m^2	USD 48.00	4530	USD 217,440.00
Outdoor fitness areas (min 25m^2)	m^2	USD 280.00	755	USD 211,400.00
Skating parks (min 200m^2)	m^2	USD 88.00	6040	USD 531,520.00
Riparian vegetation 2 meters average width	m^2	USD 35.20	30200	USD 1,063,040.00
Vegetated areas with ornamental purpose	m^2	USD 35.20	151000	USD 5,315,200.00
Service blocks (equipped shelter module 30m^2)	nr	USD 6,240.00	30	USD 188,448.00
Kiosks (1 kiosk module 10m^2)	nr	USD 1,680.00	91	USD 152,208.00
Sitting & resting areas incl. bins & signages (modules 3 tables + benches 9 seats + shading shelter + accessories - 25m^2)	nr	USD 1,600.00	30	USD 48,320.00
Public toilets (block 4 units and lavatory - 24m^2)	nr	USD 6,720.00	30	USD 202,944.00
Parking areas (single plot 500m^2)	nr	USD 20,000.00	15	USD 302,000.00
Public lighting	nr	USD 160.00	378	USD 60,400.00
TOTAL				USD 18,850,840.00
Average cost upgrading and regeneration per m^2				USD 15.61
Average cost upgrading per m/buffer				USD 1,248.40

Table 5-7-Key indicators for sub-stretch "E

Previous inputs refer to the whole B, C and E category.
By considering their relative length by simply applying a linear proportion, we obtain data for the selected stretches.

We considered the following total categories' length:

CATEGORY	TOTAL LENGTH (KM)	IP01 LENGTH (KM)	IP01 SHARE (%)
A	5.3	0	0.0%
B	19.9	1.3	6.53%
C	20.5	4.4	21.46%
D	5.1	0	0.00%
E	15.9	1.3	8.18%
F	2.3	0	0.00%
TOTAL	69.0	7.0	10.14%

Table 5-8- Relevance of specific categories in IP01

The area of study is therefore featured by a prevalence of "C" category ("Dense Urban Areas"), with minor "B" ("Peri Urban Areas") and "E" ("Transformation plots and open spaces in dense urban areas") interventions.

We remind hereafter specific features and recommended interventions for such categories

FEATURES	RECOMMENDED INTERVENTIONS
Mix or rural and urban characters. Morphology of riverbanks varies according to the level of development of plots adjacent to the riverbank. Moderate steepness between 10 to 25%. The riverbed has a variable width ranging between 10 to 20 meters. The buffer is rarely marked by retaining wall. The river is in general accessible. The vegetation is rich and generally continuous along the riparian strip forming a natural protective buffer of tall spontaneous trees Low level of water pollution. Sparse settled areas characterized by low rising single family detached houses and few multistory residential buildings. Building construction typology and materials suggest up to good/ fair quality standards. The buffer could be extended up to 30 to 50 meters each side No or minor resettlement is required. Suitable for development of light infrastructure to promote passive recreation activities. Accessibility from surrounding settlements to be ensured to improve intermodal connectivity with central urban areas.	• Pedestrian and bike paths along riverside. • Multifunctional playgrounds (skating parks, children multi activities areas, open areas for yoga and meditation, open air fitness. • Bike renting spots. • Small retail kiosks. • Sitting and resting areas. • Waste bins. • Public toilet blocks to be provided in those tracts. • Natural landscaping along riparian strip.

Table 5-9- Recommended interventions for category "B"

FEATURES	RECOMMENDED INTERVENTIONS
Steep slopes (>25%) that prevent or limit accessibility and visibility. Vegetation cover generally of low rising spontaneous plants with sparse tall trees non continuous. Riverbed is quite narrow ranging between 5 to 10 mt. Generally located in urban compact areas characterized by low density residential use of single detached houses Riverbanks are sparsely settled. Water in those tracts is highly polluted. Solid waste is visible along riverbanks. It is recommended to enforce an area of respect along the riverbanks and to relocate the substandard houses proposing schemes of replotting and densification on the nearby areas/ plots proceeding to a regularization process of the informal settlements. Suitable as well for development of light infrastructure to promote passive recreation activities. Accessibility from surrounding settlements to be ensured to improve intermodal connectivity with central urban areas.	• Pedestrian and bike paths • Access to riverside with more "artificial" solution such as gabions, cement etc. • Multifunctional playgrounds (skating parks, children multi activities areas, open areas for yoga and meditation, open air fitness, basketballs, footballs. • Bike renting spots. • Small retail kiosks and cafes. • Public toilet blocks to be provided in those tracts. • Pedestrian crossing. • Waste bins. • Lighting. • Designed landscaping with lawn, flowers to enhance recreation areas. • Riverbank is kept natural or using reno mattresses and gabions limiting the complete imperviousness. • Connections to be created with high density residential area that will be developed on neighboring plots.

Table 5-10- Recommended interventions for category "C"

FEATURES	RECOMMENDED INTERVENTIONS
Riverbanks are low rising and characterized by gentle slopes. The riverbed is wide visible and easily visible by adjacent areas. The proximity to open green spaces and roads makes those stretches accessible. Vegetation cover is of tall trees along the riparian strip and dense low rising vegetation in the adjacent buffer. Buildings are almost absent. Located within the dense urban areas in proximity to city center and CBD. Resettlement of buildings very close to riverbank (within 10 meters buffer) is recommended. Suitable to be become main accesses to the riparian urban park, where there will be the possibility to locate services to promote passive recreation activities. It would be recommended to ensure direct connection with main infrastructure and provide intermodal exchanges. Due to large spaces available modification of the riverbanks would be advisable to provide direct access to the river. If needed, location of infrastructure for stormwater retention (wetlands and retention basins) to create floodable seasonal parks.	• Floodable parks to be created. • Pedestrian and bike paths integrated with the park and the pond. • Multifunctional playgrounds (skating parks, children multi activities areas, open areas for yoga and meditation, open air fitness. • Bike renting spots. • Small retail kiosks. • Sitting and resting areas. • Waste bin. • Public toilet blocks to be provided in those tracts. • Create connection with city infrastructure (bust stops, pedestrian crossing). • Vegetation to be designed and studied to be integrated with flooding events…could change with season and floods level.

Table 5-11- Recommended interventions for category "E"

5.7.2 The IP08 area

The IP08 includes the following sub-stretches:

- E8
- C7
- C8

Key indicators are reported in the following table.

SUB-STRETCH	LENGTH (KM)	COSTS					BENEFICIARY POPULATION
		URBAN UPGRADING	STORMWATER (RESHAPING)	STORMWATER (RETENTION PONDS)	WASTE WATER	TOTAL	
E8	0.9	$1,067,029	$ 2,822,702				14,175
C8	3.4	$5,014,818	$10,133,037				89,250
C7	2.1	$3,097,387	$ 6,258,640				55,125
TOTAL	7.0	$9,179,234	$19,214,380	$0	$2,357,680	$30,751,293	158,550

Table 5-12-Key indicators of IP08

Previous inputs refer to the whole C and E category.

By considering their relative length by simply applying a linear proportion, we obtain data for the selected stretches.

We considered the following total categories' length:

CATEGORY	TOTAL LENGTH (KM)	IP08 LENGTH (KM)	IP08 SHARE (%)
A	5.3	0	0.00%
B	19.9	0	0.00%
C	20.5	5.5	26.83%
D	5.1	0	0.00%
E	15.9	0.9	5.66%
F	2.3	0	0.00%
TOTAL	69.0	6.4	9.28%

Table 5-13- Relevance of specific categories in IP08

The area of study is therefore featured by a prevalence of "C" category ("Dense Urban Areas"), with minor "B" ("Peri Urban Areas") and "E" ("Transformation plots and open spaces in dense urban areas") interventions.

We remind hereafter specific features and recommended interventions for such categories.

FEATURES	RECOMMENDED INTERVENTIONS
Steep slopes (>25%) that prevent or limit accessibility and visibility. Vegetation cover generally of low rising spontaneous plants with sparse tall trees non continuous. Riverbed is quite narrow ranging between 5 to 10 mt. Generally located in urban compact areas characterized by low density residential use of single detached houses Riverbanks are sparsely settled. Water in those tracts is highly polluted. Solid waste is visible along riverbanks. It is recommended to enforce an area of respect along the riverbanks and to relocate the substandard houses proposing schemes of replotting and densification on the nearby areas/ plots proceeding to a regularization process of the informal settlements. Suitable as well for development of light infrastructure to promote passive recreation activities. Accessibility from surrounding settlements to be ensured to improve intermodal connectivity with central urban areas.	• Pedestrian and bike paths • Access to riverside with more "artificial" solution such as gabions, cement etc. • Multifunctional playgrounds (skating parks, children multi activities areas, open areas for yoga and meditation, open air fitness, basketballs, footballs. • Bike renting spots. • Small retail kiosks and cafes. • Public toilet blocks to be provided in those tracts. • Pedestrian crossing. • Waste bins. • Lighting. • Designed landscaping with lawn, flowers to enhance recreation areas. • Riverbank is kept natural or using reno mattresses and gabions limiting the complete imperviousness. • Connections to be created with high density residential area that will be developed on neighboring plots.

Table 5-14- Recommended interventions for category "C"

FEATURES	RECOMMENDED INTERVENTIONS
Riverbanks are low rising and characterized by gentle slopes. The riverbed is wide visible and easily visible by adjacent areas. The proximity to open green spaces and roads makes those stretches accessible. Vegetation cover is of tall trees along the riparian strip and dense low rising vegetation in the adjacent buffer. Buildings are almost absent. Located within the dense urban areas in proximity to city center and CBD. Resettlement of buildings very close to riverbank (within 10 meters buffer) is recommended. Suitable to be become main accesses to the riparian urban park, where there will be the possibility to locate services to promote passive recreation activities. It would be recommended to ensure direct connection with main infrastructure and provide intermodal exchanges. Due to large spaces available modification of the riverbanks would be advisable to provide direct access to the river. If needed, location of infrastructure for stormwater retention (wetlands and retention basins) to create floodable seasonal parks.	• Floodable parks to be created. • Pedestrian and bike paths integrated with the park and the pond. • Multifunctional playgrounds (skating parks, children multi activities areas, open areas for yoga and meditation, open air fitness. • Bike renting spots. • Small retail kiosks. • Sitting and resting areas. • Waste bin. • Public toilet blocks to be provided in those tracts. • Create connection with city infrastructure (bust stops, pedestrian crossing). • Vegetation to be designed and studied to be integrated with flooding events…could change with season and floods level.

Table 5-15- Recommended interventions for category "E"

5.8 Specific Interventions Priorities

5.8.1 Category "C"

The following table sums interventions planned in the area for category "C".

TYPE OF INTERVENTION	UNIT OF MEASURE	UNIT COST FOR INVESTMENT	QUANTITY	APPROXIMATE ESTIMATE US $
Park trails average width 2.5	m^2	USD 40	9,925	USD 397,010.00
Access/Emergency streets	m^2	USD 128	15,880	USD 2,032,691.20
Bridges	m^2	USD 352	149	USD 52,405.32
Children Playground (module 50m^2)	m^2	USD 64	397	USD 25,408.64
Multi-sport fields (min pitch 150m^2)	m^2	USD 48	1,191	USD 57,169.44
Outdoor fitness areas (min 25m^2)	m^2	USD 280	199	USD 55,581.40
Skating parks (min 200m^2)	m^2	USD 88	397	USD 34,936.88
Riparian vegetation 2 meters average width	m^2	USD 35.2	7,940	USD 279,495.04
Vegetated areas with ornamental purpose	m^2	USD 35.2	39,701	USD 1,397,475.20
Service blocks (equipped shelter module 30m^2)	nr	USD 6,240	8	USD 49,546.85
Kiosks (1 kiosk module 10m^2)	nr	USD 1,680	24	USD 40,018.61
Sitting and resting areas including bins and signages (modules 3 tables + benches 9 seats + shading shelter + accessories - 25m^2)	nr	USD 1.600	8	USD 12,704.32
Public toilets (block 4 units and lavatory - 24m^2)	nr	USD 6,720	8	USD 53,358.14
Parking areas (single plot 500m^2)	nr	USD 20,000	4	USD 79,402.00
Public lighting	nr	USD 160	99	USD 15,880.40
Incremental housing (50m^2 min unit)	nr	USD 24,000	79	USD 1,905,648.00
TOTAL				**USD 6,488,731.44**
Average cost upgrading and regeneration per m^2				USD 16.34
Average cost upgrading per m/buffer				USD 1,634.40

Table 5-16-Key indicators for sub-stretch "C"

5.8.2 Category "E"

The following table sums interventions planned in the area for category "E".

TYPE OF INTERVENTION	UNIT OF MEASURE	UNIT COST FOR INVESTMENT	QUANTITY	APPROXIMATE ESTIMATE US $
Park trails average width 2.5	m^2	USD 40.00	3,088	123,518.00
Access/Emergency streets	m^2	USD 128.00	4,941	632,412.16
Elevated trails width 2 m width	m^2	USD 320.00	206	65,884.99
Floating platform 10m^2	m^2	USD 320.00	4	1,308.80
Bridges	m^2	USD 352.00	93	32,623.15
Children Playground (module 50m^2)	m^2	USD 64.00	124	7,905.15
Multi-sport fields (min pitch 150m^2)	m^2	USD 48.00	371	17,786.59
Outdoor fitness areas (min 25m^2)	m^2	USD 280.00	62	17,292.52
Skating parks (min 200m^2)	m^2	USD 88.00	494	43,478.34
Riparian vegetation 2 meters average width	m^2	USD 35.20	2,470	86,956.67
Vegetated areas with ornamental purpose	m^2	USD 35.20	12,352	434,783.36
Service blocks (equipped shelter module 30m^2)	nr	USD 6,240.00	2	15,312.96
Kiosks (1 kiosk module 10m^2)	nr	USD 1,680.00	7	12,505.58
Sitting & resting areas incl. bins & signages (modules 3 tables + benches 9 seats + shading shelter + accessories - 25m^2)	nr	USD 1,600.00	2	3,926.40
Public toilets (block 4 units and lavatory - 24m^2)	nr	USD 6,720.00	2	16,490.88
Parking areas (single plot 500m^2)	nr	USD 20,000.00	1	24,540.00
Public lighting	nr	USD 160.00	31	4,947.26
TOTAL				**USD 1,541,672.82**
Average cost upgrading and regeneration per m^2				USD 15.61
Average cost upgrading per m/buffer				USD 1,248.40

Table 5-17-Key indicators for sub-stretch "E

5.9 Economic Appraisal

5.9.1 Methodology

5.9.1.1 The rational for economic appraisal

The TORs did not mention any specific tool for financial or economic analysis. It only foresaw to engage in capital costing, project packaging, operating costs, operating revenues and financial analysis. Particularly, the last asked for a model to be prepared in order to demonstrate the financial viability of the overall river development, including measures required to ensure financial viability.

Results of previous reports as well as expected outputs of the study do however privilege the implementation of a broader economic analysis rather than a more focused and only financial appraisal. Benefits expected from the project do indeed across a large spectrum, including the establishment of new green spaces, the improvement of river water quality, the upgrading of infrastructure and housing, and the creation of new economic opportunities along the riverside. Such benefits, which would descend out of the progressive resolution of problems related to high pollution of the rivers, which are also subject to flooding, which cause severe environmental and health problems, cannot be grasped and assessed on a mere financial ground. For their very nature they require the implementation of an approach inclusive of financial analysis but capable to contain broader social and economic impacts.

To such extent, the Cost Benefit Analysis (CBA) is widely used for large investment projects where it is necessary to prove with solid financial tools that the investment project is feasible and the public money is not spent in vain. The usefulness of CBA in the public sector relates to the fact that such instrument takes into account monetized social benefits. CBA therefore presents a series of calculations which conducts to the final assessment. These calculations are focused around the financial analysis and the economic analysis. Financial analysis is based on financial indicators (mainly revenues and costs), while economic analysis incorporates also the social benefits obtained by implementing an investment project.

Benefits are those who make difference between financial and economic analysis: while financial revenues are taken into account in financial analysis, any kind of benefit are considered in economic analysis. The most challenging part of CBA is therefore to monetize benefits because these are not easy to be identified, involve difficulties to be quantified and require numerous calculations and presumptions in order to associate a monetized value to each piece of benefit. They are defined as increases in human wellbeing or utility[4].

The benefits of a project should therefore include all the advantages generated to the society, including the benefits to all implied in the project (or targeted by the project) and for the society seen as a whole. Thus, the benefits include direct and indirect positive effects.

Direct revenues of public investments are mainly charges asked for the public services offered to those who explicitly demand such services. These charges can be cashed as the value of entrance tickets, tariffs for certain services (for example medical services, water supply), price for goods (meal, for example), rents. All direct revenues are established in accordance with the market because similar goods and services are offered by other entities (private or public) in the same area or in the neighbourhood.

In opposition with direct revenues, social benefits usually affect, in a positive way, not only the direct beneficiaries of the investment project, but the whole society. This is why these are indirect benefits which are not subject to a commercial transaction, being rather externalities. CBA imposes that also these benefits to be evaluated in monetary

[4]OECD (2006). Cost - Benefit Analysis and the Environment Recent Developments, Paris: OECD Publishing

expression, in order to compare them with costs (in constant prices). Indirect benefit valuation therefore requires an inventory of positive effects that could be obtained by implementing the investment project.

Identification is done by comparing the presumed benefits with "business as usual" scenario. Due the difficulty of valuating social benefits, the analysis will emphasize only the relevant indirect benefits which can be estimated using available data. The rest of benefits will be discussed qualitatively, but will not influence the CBA results. It is also vital to reveal possible couples of benefits which are interrelated and which would conduct to a double counting of the benefits, which is a typical mistake that would bring to an overestimation of benefits.

5.9.1.2 Methods used to estimate social benefits

The social benefits resulted by implementing public investments in drainage and urban upgrading will be related to the improvement of the peoples' life conditions: some of these are dramatic, such as the safe of live of people suffering from bad diseases due to hygienic conditions; at least they will however include reduction of periods with illness or discomfort, improvement of life quality, assurance of better access to water, etc.
All benefits should be valued in a monetary form, in order to fulfil the CBA. To reach such objective two stages are needed:

a) establishing quantitative positive effects of the investment;
b) estimating the monetary value of the benefit determined in the previous stage.
c)

Benefits will be estimated in comparison with a basic scenario with no supplementary investment. This should be dome using as a basic methodology the "willingness-to-pay", but as market values will be mostly not available in the Ethiopian case (e. g. value of life), other techniques have been used. Particularly, we will refer to "revealed preferences" based on the use of proxies and case studies carried out in similar contexts, especially if provided by scientific articles.

As evidenced before, our project foresees interventions in several fields, namely road infrastructure, lighting, drainage, water supply, sewerage network, waste management, open spaces, facilities. As follows, we will stress on the calculation proposals for some of benefits: reducing the number of sick days from environmental pollution, improving healthy life expectancy, reduce potential damage from flooding, reduce displacement, increase the market value of houses, etc.

As the project targets the improvement of life quality, particularly by better health conditions, our benefits will focus, from the public sector side, on reducing the number of hospital days which should be devoted to those persons which have deteriorated health conditions. Such hospital day reductions will be valued using average costs of medical care. On the resident side, we will instead highlight the reduction of certain disease, which will make adults capable of working, thus supplemented the gains resulting from their work instead of staying inactively. These benefits will be estimated using average value of labour and the average number of sick days as provided by the socio-economic survey and field research.

General improvement of life quality is strongly associated to healthy life expectancy, with healthy life years (HLY) being the number of years spent free of activity limitation, being equivalent to disability free life expectancy. The value of statistical life is the amount that people is willing to pay for fatal risk reduction in the expectation of saving one life and can be assumed from international statistics such as the European Union Statistics on Income and

Living Conditions (EU-SILC) survey[5], taking into account variations of value of statistical life in different countries[6], as usually

5.9.1.3 Key assumptions

The Cost Benefit Analysis (CBA)[7] is deployed according to the following assumptions:

- Opportunity cost. Input and outputs (including intangible ones) and external effects of the investment project are valued at their social opportunity costs, instead of prices observed in the market, which may be distorted for the following reasons:
  - non-efficient markets where the public sector and/or operators exercise their power;
  - administered tariffs for utilities may fail to reflect the opportunity cost of inputs due to affordability and equity reasons;
  - some prices include fiscal requirements (e. g. duties on import, excises, VAT and other indirect taxes, income taxation on wages, etc.);
  - for some effects no market (and prices) is available (e. g. reduction of air pollution, time savings)
- Long-term perspective. A long-term outlook is adopted, considering a time horizon of forecast future costs and benefits of 30 years, adopting a 5% discount rates to calculate the present value of future costs and benefits;
- Calculation of economic performance indicators expressed in monetary terms. CBA is based giving a monetary value to all the positive (benefits) and negative (costs) welfare effects of the intervention. These values are discounted and then totalled in order to calculate a net total benefit. The project overall performance is measured by key indicators, namely the Economic Net Present Value (ENPV), expressed in monetary values, and the Economic Rate of Return (ERR);
- Microeconomic approach. While direct employment or external environmental effects got by the project are reflected in the ENPV, indirect (e. g. on secondary markets) and wider effects (e. g. on public funds, employment, regional growth, etc.) are excluded. There are two main reasons: for such exclusion:
  - to limit the potential for benefits double-counting, as most indirect and/or wider effects are usually transformed, redistributed and capitalized forms of direct effects;
  - to overcome the difficulty to translate them into robust techniques for project appraisal, as analysis would rely on assumptions whose reliability is difficult to check.

5.10 Financial & Economic Analysis

5.10.1 Financial analysis

We assume some basic financial information, namely the estimated project cost in USD. Such project costs are detailed, distinguishing among the following cost items: direct investment costs, routine & periodic O&M costs, resettlement costs[8].

[5]OECD (2012), op. cit.
[6]Miller, T. R. (2000). "Variations between Countries in Values of Statistical Life", Journal of Transport Economics and Policy, Vol. 34 (2), 169-188
[7]The economic analysis was undertaken in accordance with the standard application of the Cost Benefit Analysis (CBA) approach utilizing the WB's Guidelines for the Economic Analysis of Investment Operations (1997) and the European Commission Guide to Cost-Benefit Analysis of Investment Projects (2014).

[8]As explained above, resettlement has been foreseen for sub-stretches D2, D3, D4 and D5, which are not included in IP01. Therefore, no resettlement cost is considered in our analysis.

The following table sets routine O&M, periodic maintenance and depreciation period for each class of investment[9].

CATEGORY	ROUTINE O&M (% PER YEAR)	PERIODIC MAINTENANCE (EVERY 5 YEARS)	DEPRECIATION TIME (YEARS)
Urban Upgrading	3%	15%	10
Stormwater reshaping and retention ponds	5%	20%	15
Wastewater	5%	20%	15

Table 5-18- Routine O&M, Periodic Maintenance and Depreciation Time for each class of intervention

Consequently, renovation is set at the 11th and 21th year for urban upgrading and at the 15th year for stormwater reshaping and retention ponds and wastewater.

The following table reports investment and O&M costs for each category of investment.

CATEGORY	INVESTMENT (USD)	O&M COSTS	
		ROUTINE (USD PER YEAR)	O&M (USD EVERY 5 YEARS)
Urban Upgrading	USD 9,748,473	USD 292,454	USD 1,462,271
Stormwater reshaping and retention ponds	USD 21,213,681	USD 1,060,684	USD 3,182,052
Wastewater	USD 778,000	USD 38,900	USD 155,600
TOTAL	USD 31,776,154	USD 1,392,038	USD 4,799,923

Table 5-19 Investment and O&M costs for each category of investment in IP01

CATEGORY	INVESTMENT (USD)	O&M COSTS	
		ROUTINE (USD PER YEAR)	O&M (USD EVERY 5 YEARS)
Urban Upgrading	USD 9,179,234	USD 734,339	USD 1,376,885
Stormwater reshaping and retention ponds	USD 19,214,380	USD 2,305,726	USD 4,323,235
Wastewater	USD 2,357,680	USD 282,922	USD 530,478
TOTAL	USD 30,751,293	USD 3,322,987	USD 6,230,598

Table 5-20 Investment and O&M costs for each category of investment in IP08

[9]Benchmarks are set based on international practice, with specific regard to Africa. See, for instance, Ernst & Young (2018). Worldwide Capital and Fixed Assets Guide. 2018

5.10.2 From financial to economic analysis

In order to move from financial to economic analysis, the following adjustments have been made:

- fiscal corrections[10];
- conversion from market to shadow prices[11];
- evaluation of non-market impacts and correction for externalities[12];
- discounting, as costs and benefits occur at different times, through the application of a Social Discount Rate (SDR), that reflects the social view on how future benefits and costs should be valued against present ones;
- calculation of the project economic performance, measured by the following indicators: Economic Net Present Value (ENPV), Economic Rate of Return (ERR) and Benefit/Cost ratio (B/C ratio).

5.10.3 Benefits considered

5.10.3.1 Key indicators and baseline data

As detailed further on in the present study, broader externalities are included. These include the betterment of general living conditions, which sustain the growth of health life expectancy in the long term, while indirectly endorsing the increase of market value of nearby houses.

We assume as baseline data that:

8.life expectancy was 66.597 in Ethiopia in 201913 ;
9.healthy life expectancy was 58.3 in Ethiopia in 201914;
10.the economic value of a statistical life in Ethiopia is USD 204,99815;
11.the economic value of a statistical life year in Ethiopia is therefore US $ 3,078 (c/a), while the economic value of a healthy statistical life year is USD 3,516 (c/b);
12.the market value of houses is very different according to private market (USD 632.1) and public market (80.5 USD) per square meter16. This means a range from 4,025 USD to 31,605 USD. For our study we will consider a simple average value of USD 17,815.

Benefits however differ according to each typology of investment and area hereafter considered.

5.10.3.2 Urban upgrading

Urban upgrading is the expected outcome of different interventions, including those directly benefiting residents - pedestrian and bike paths, multifunctional playgrounds (skating parks, children multi activities areas, open areas for yoga and meditation, open air fitness, basketballs, footballs), bike renting spots, small retail kiosks and cafes, public toilets blocks to be provided in those tracts – along with instrumental interventions which allow the previous to perform well (access to riverside with more "artificial" solution such as gabions & cement, pedestrian crossing. waste bins, lighting, designed landscaping with lawn, flowers to enhance recreation areas, reno mattresses and gabions).

[10]Taxes and subsidies are transfer payments that do not represent real economic costs or benefits for society as they involve merely a transfer of control over certain resources from one group in society to another. Such distortions are corrected using the following rules:
[11].When market prices do not reflect the opportunity cost of inputs and outputs, these are converted into shadow prices to be applied to the items of the mere financial analysis. In practice, the following (simplified) operational is be applied to inputs (there are no tradable outputs in the project) to convert financial items into shadow prices. For tradable goods border (international) prices are used. For non-tradable goods, the Standard Conversion Factor (SCF), which measures the average difference between world and domestic prices of the Ethiopian economy. Considering similar projects, carried out by the World Bank and other international institutions, inputs or niche products and services are internationally traded commodities and all goods and services are treated as non-traded, for which economic prices are based on financial prices adjusted by the SCF. The adjustments are made using SCF of 0.9 to all inputs and outputs, except for unskilled labor, for which a factor of 0.75 is applied.
[12].Impacts generated on project users due to the use of the new infrastructure, which are relevant for the community, but for which a market value is not available, are externalities, which include any cost or benefit that spills over from the project towards other parties without monetary compensation. Due to their nature, externalities are not captured with the evaluation of the project direct benefits and they are evaluated separately. As valuing externalities was difficult even though they may be easily identified, impacts were identified for a qualitative appraisal in order to provide more elements about the economic feasibility of the project.
[13]Source: World Bank, h https://data.worldbank.org/indicator/SP.DYN.LE00.IN?locations=ET
[14].Source: Global Health Observatory Deposit: https://apps.who.int/gho/data/node.main.688
[15].Source: World Health Organization and World Bank
[16].Source: Yohannes S. and Dinky A. (2018). "Housing provision and affordability in private residential real estates in Addis Ababa". Journal of EEA, Vol. 36, July

Beneficial effects are broad and include environmental aspects such as urban atmosphere improvement (physical and chemical); urban noise reduction; aesthetic improvement; recreational, cultural and social improvement. Final benefits therefore range from environmental ones (carbon sequestration, reduction of air-conditioning costs) to citizens health improvement, citizens psychophysical wellbeing improvement, educational and social benefits, increase of the natural feature of the city.

A further benefit relates to the positive impact on property value abutting or fronting passive park areas which, according to international benchmarks can be set at around 20% of the value over the prospected horizon time[17] . Such value, in the case of a community park, tends to extend out to 450-600 m although after 150-180 m the premium price becomes smaller[18] . Prudentially, we will assume an average lower rate, at 10%.

Specific benefits indicators will include:

- Improvement of residents' health, which is measurable through improvement of healthy statistical life years and saving to prevention costs;
- Savings to public sector, related to less health costs;
- Increase of residents' wealth related to increase of market value of houses.

Beneficiary	Category of benefit	Relevance	Description	Unit economic value (USD)	N. of beneficiaries	Impact of the project
Residents	Market value of houses	High	Increase in property value19;	17,815	177,975	From 5 to 30%
Health sector	Savings to health costs	High	Savings of hospitalization	31.4		+20%
Patients	Savings onprevention costs	High	Savings on medicine and medical treatment; value of time off work to care for the sick	10.8	177,975	+10%

Table 5-21– Benefits related to Urban Upgrading

5.10.3.3 Stormwater reshaping and retention ponds

Stormwater reshaping and retention ponds are aimed at preventing flooding, with related benefits including savings from:

- damages to buildings;
- damages to equipment and furniture;
- clean-up costs of the buildings;
- increase in the cost of electricity and water;
- clean-up costs of roads;
- prevention costs (mosquito coil, spray and rackets; lime; pumps and pipes);
- health costs (medicine and medical treatment; hospitalization; time off work to care for the sick);
- a broader improvement of health life expectancy.

In order to set their economic value, we referred to international benchmarks[20] .

[17]Tempesta T. "2014). "Benefits and costs of urban parks". Sustainable Landscapes and Economy. Council of Europe - European Landscape convention Fifteenth Council of Europe meeting of the workshop for the implementation of the European landscape convention. Urgup, Nevsheir, Turkey - 1-2 October

[18]Crompton J.L. (2005), The impact of parks on property values: empirical evidences from the past two decades in the United States, Managing Leisure, 10: 201-2018

[19]. This might be a double-counting against increase of property value

[20]Khai H.V., Dahn V,T. and Duon V.T. (2017), op. cit.

Specific benefits do include:

- Improvement residents' health, which is measurable through improvement of healthy statistical life years and saving to prevention costs;
- Savings to public sector, related to less health costs;
- Security of properties;
- Increase of residents' wealth related to increase of market value of houses;
- Savings on displacement costs to flooding.

Beneficiaries	Category of benefit	Relevance	Description	Economic Value (USD)	N. of beneficiaries	Impact of the project
Health sector	Savings to health costs	High	Savings on hospitalization	31.42	177,975	+30.0%
Residents	Improvement of HALE	High	Improvement of healthy statistical life year by 2.0%	9,340	177,975	+0.5%
	Savings to damages to buildings	High	Damage of the households due to flooding including the damage of road, buildings, equipment and furniture, the clean-up cost, an increase in utility cost, and paths, walkways and parking.	341.72		+100.0%
	Savings to damages to equipment and furniture			21.95		
	Savings to cleanup costs of the buildings			0.86		
	Savings to increase in the cost of electricity and water			2.58		
	Savings to cleanup costs of roads			122.23		
Patients	Savings to prevention costs		Savings on medicine and medical treatment; value of time off work to care for the sick	10.76		+5.0%

Table 5-22- Benefits related to Stormwater reshaping and retention ponds

5.10.3.4 Wastewater management

Wastewater management has a direct impact on different aspects:

- Improvement residents' health, which is measurable through saving to prevention costs;
- Savings to public sector, related to less health costs;
- Increase of residents' wealth related to increase of market value of houses.

Benefits do include[21]:

- public revenues from application of charges;
- increase of market value of houses;
- health benefits.

According to international benchmarks, population are willing to pay 0.38 US per month for sanitation [22] .

[21]Asian Development Bank (2002). Handbook for the Economic Analysis of Water Supply Projects. Guidelines, Handbooks and Manuals
[22]Quah E., Toh R. (2012). Cost Benefit Analysis: Cases and Materials. London: Routledge.

Beneficiary	Category of benefit	Relevance	Description	Economic Value (USD)	Impact of the project
Service provider	Revenues	Medium	Application of charges to users for the services rendered based on WTP of residents	10.03 per year per person served[23]	New revenue
Residents	Market value of houses	Medium	Increase in property value[24];	-	3%
Health sector	Savings to health costs	High	Savings of hospitalization	31.4	+20%
Patients	Savings on prevention costs	High	Savings on medicine and medical treatment; value of time off work to care for the sick	10.8	+10%

Table 5-23- Benefits related to Wastewater

As a joint effect with urban upgrading, we also consider an accrued value of 1% per year to the stock value of market houses, which equals to 30% over the time horizon of the project.

5.11 Results of the Economic Analysis

As stated above, the CBA was conducted applying a common methodology, based on an international recognized approach, such as that provided by the WB's *Guidelines for the Economic Analysis of Investment Operations* (1997) and the *European Commission Guide* to Cost-Benefit *Analysis of Investment Projects* (2014).

A long-term perspective was put in place, by considering a time horizon of forecast future costs and benefits of 30 years, while adopting a 5% discount rates to calculate the present value of future costs and benefits

In order to move from financial to economic analysis, the following adjustments were made:

- fiscal corrections;
- conversion from market to shadow prices;
- evaluation of non-market impacts and correction for externalities;
- discounting, as costs and benefits occur at different times, through the application of a Social Discount Rate (SDR), that reflects the social view on how future benefits and costs should be valued against present ones;
- calculation of the project economic performance, measured by the following indicators: Economic Net Present Value (ENPV), Economic Rate of Return (ERR) and Benefit/Cost ratio (B/C ratio).

The following typology of investments costs were considered in each of the three project areas:

a. Urban Upgrading;
b. Stormwater reshaping and retention ponds;
c. Wastewater.

Based on international practice, for each investment we assumed a specific ratio of unskilled work vs. other expenses, assigning to both of them a specific conversion factor (respectively 0.75 and 0.90). Each investment was also integrated by an estimation of routine and periodic O&M costs, to which we applied the same conversion method.

[23]We considered the cost of partial treatment of wastewater as provided by international studies - See, for instance, Hutton G. and Haller L. (2004). Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global Level. World Health Organization. Geneva, Switzerland

[24]This might be a double-counting against increase of property value

5. Economic and Financial Analysis

Benefits included

1. improvement of residents' health;
2. savings to public sector (from savings to health costs and charges for service provision);
3. safety and security monetization;
4. increase of residents' wealth.

In order to test the robustness of the economic model, the approach was prudential, as we applied, for instance, moderate rate of increase to the market values of houses, while considering frequent investments for periodic maintenance (normally every five years).

Area	Investment costs (USD)	Whole of life costs (USD)	Present value of benefits (USD)	Present value of costs (USD)	Benefit Cost Ratio	Economic NPV (USD)	EIRR
IP01	28,248,737	60,457,638	501,738,564	89,814,506	5.59	1,324,698,688	111.84%
IP08	27,368,907	115,076,957	358,860,999	145,100,917	2.47	832,975,019	87.89%

Table 5-24-CBA Summary of results

Major benefits are associated to residents' safety and security, followed by improvement of the improvement of residents' health, increase of residents' wealth, particularly related to the increase of market value of houses, and savings to the public sector (mostly due to health cost savings), for both IP01 and IP08, although with different rates.

Area	Improvement of residents' health	Savings to public sector[25]	Safety and security	Increase of residents' wealth	Total
IP01	26.3	18.5	32.0	23.2	100.0
IP08	32.8	10.8	39.9	16.6	100.0

Table 5-25-Synthesis of benefits (%)

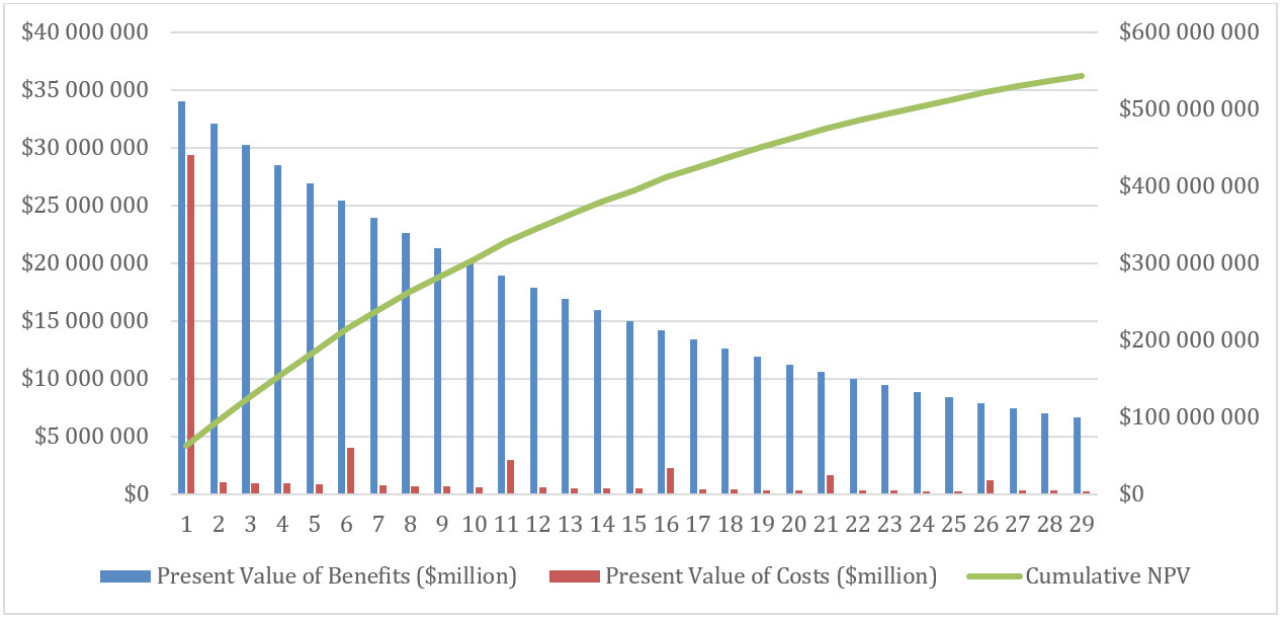

Figure 5 4- Economic projection, IP01

[25]. It includes costs of displacement due to flooding

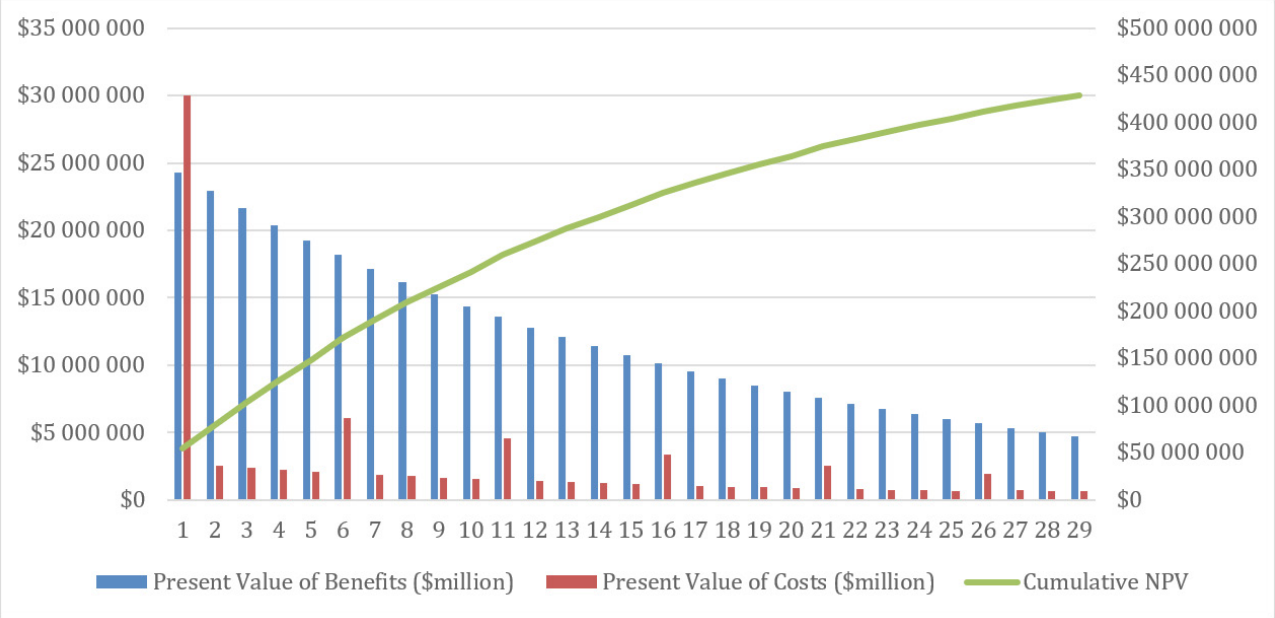

Figure 5-5–Economic projection, IP08

5.12 Real Estate Valorization

5.12.1 Financial needs and sources of revenue

In general financing sources for the project could mainly be the following:

- Public budget allocations for urban regeneration from Addis Ababa City and its public entities, either from un-guaranteed loans, accumulated reserves (equity), land lease income, development charges or other sources;
- Development financing from an international agency, either through grants or loans;
- Contributions from households and businesses from property developers or other PPP arrangements;
- Private funding mobilized by investors or by buildings owners developing income generating activities or in any case earning a profit.

As investments aim at solving key environmental issues, such as storm reshaping and retention ponds, as well as water, public investments are doomed to cover the larger part of the financial need. Any way a further source of financing, which could be introduced for Sheger River, is appropriation of part of the real estate plus-value generated by a public investment in upgrading an urban area, in particular streets and open areas. Numerous empirical studies do indeed show that the value generated by improvements in access to infrastructure and urban services is indeed capitalized into real estate prices[26].

The last item would be party a novelty in Addis Ababa and need further details about ways to implement it, as developed in the next section. It is however necessary to say that capacity building in finance is a prerequisite for the implementation of such investment projects, as the mechanisms for land value capture require managerial, financial and appropriate regulatory framework, which in the Ethiopian context cannot be taken for granted and might require the starting of a capacity building program in order to grow competences in this field.

5.12.2 Real estate value capture

With regard to real estate value generated by the foreseen public investments, the instruments for capturing the value generated by investments and other public sector interventions can be classified into the following types: (i) taxes, (ii) fees, and (iii) regulations[27]. Four types of value capture instruments are commonly used to finance urban projects:

- Betterment levies;
- Selling of development rights and exactions;
- Tax Increment Financing (TIF);
- Land readjustment.

As we will see through a simulation exercise, betterment levies are probably the best tool to use in the case of Addis Ababa.

Further options for appropriation of real estate plus-value might also include:

- for buildings directly owned by the Government, the latter shall directly earn the plus-value;
- public expropriation or acquisition of areas/ buildings to be resold or exploited after the intervention.

Each one of the above-mentioned methods has advantages and disadvantages, with their efficiency and feasibility depending on multiple variables, which are internal and external to the project.

When deciding which capture instrument is most suitable to finance a specific project, several factors are decisive:

- Type of project (rehabilitation of deteriorated areas or greenfield development);
- Its origin (public or private sector's interest);
- Scope of the value capture (recovery of just project cost or the full land value increment);
- Time of collection (ex-ante or ex-post);
- Degree of sophistication the instrument required.

Each instrument's features are briefly discussed here after.

[26] See, for instance, Peterson G.E. (2009). Unlocking Land Values to Finance Urban Infrastructure. World Bank. The International Bank for Reconstruction and Development. Trends and Policy Options n. 7 or Andrés G. Blanco B. / Nancy Moreno M. / David M. Vetter / Marcia F. Vetter (2016). The Potential of Land Value Capture for financing urban projects: methodological considerations and case studies. Inter-American Development Bank

[27] Smolka M., Amborski, D. (2000). Value capture for urban development: An Inter-American comparison. Working Paper WP00MS1. Cambridge, MA: Lincoln Institute of Land Policy

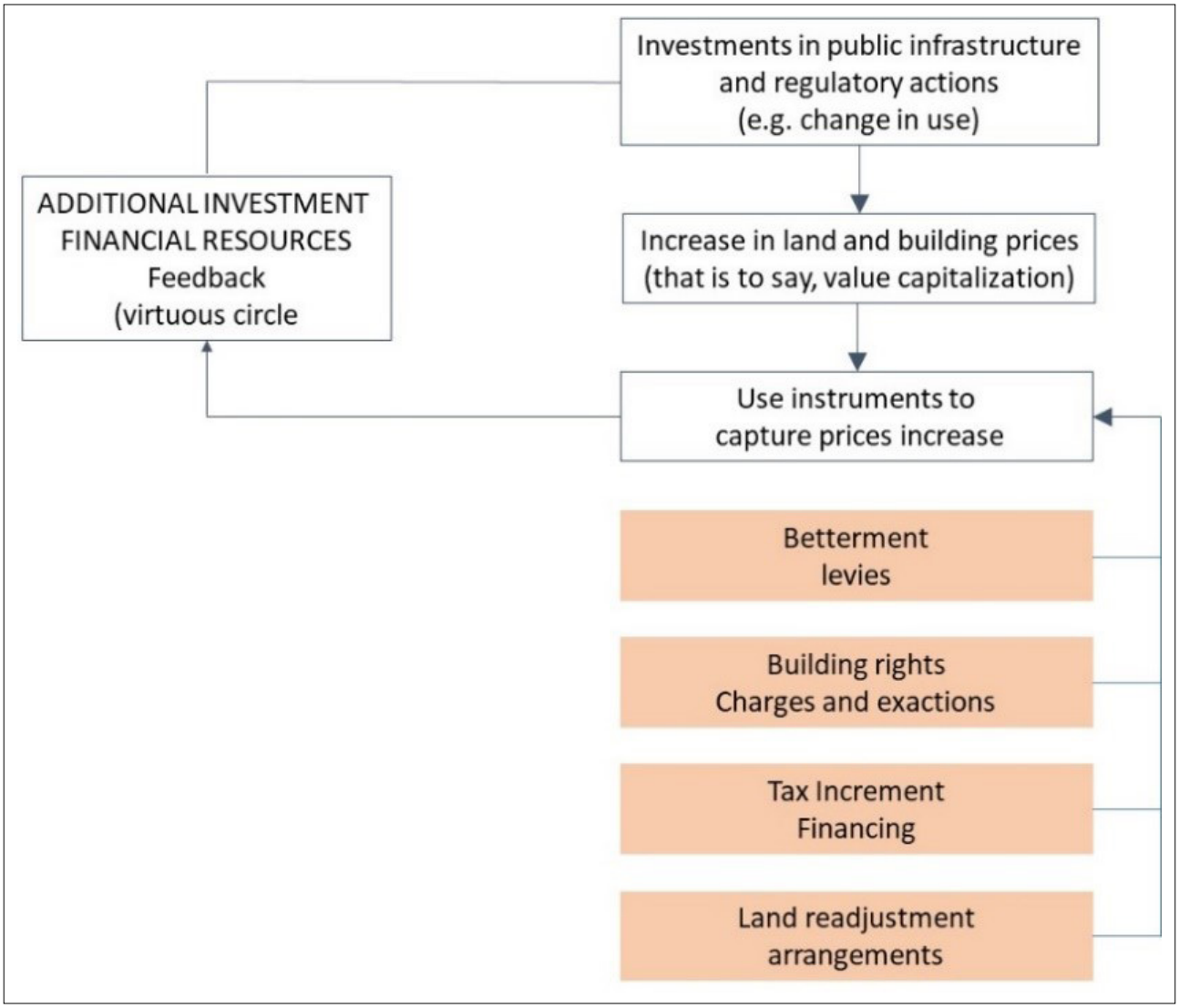

Figure 5-6- Methods for estate value capture[28]

5.12.3 Betterment levies

They are charges on real estate property owners who benefit from infrastructure improvements. This instrument is classified as a fee because the beneficiaries of the infrastructure project are responsible for its payment. There are different ways to structure this instrument. For example, its collection can be ex-ante (i.e., before the work's construction) or ex-post (after). Moreover, the amount charged can be defined based on the cost of the project being financed or on the full increase valorization that the project will produce.

Finally, the impact can be defined as general (when the project benefits the whole city) or local (when it impacts only a specific area), the most common case.

The effectiveness of this instrument depends on its structure. Structuring involves the definition of (i) the impact area of the public investment, (ii) the amount to be collected, and (iii) the criteria used to determine the distribution of these payments. In theory, the impact area should correspond to the spatial scope of the project's benefits. The amount to be collected can be defined as the project's cost or as a percentage of the expected benefits regarding

[28]Source: Andrés G. Blanco B. / Nancy Moreno M. / David M. Vetter / Marcia F. Vetter, op.cit.

valorization, or a combination of these two. The distribution criteria can include several aspects, such as the relative level of benefits received for specific areas, the area or cadastral value of the property, or the payment capacity of the families.

Usually the betterment taxes or levies are a one-time, upfront charge on the land value gain; but a variant, which is levied as an annual charge, is often used.
In practice, only a part of the gain in land value is captured by the betterment levies as the rate ranges between 30 and 60 per cent of the value increase[29] .

International experience also proves that betterment levies or a temporary increase in the property tax rate are legally sound, as well as transparent and straightforward for use at the municipal level, while the use of other instruments (e.g. exactions or building rights charges) could require more complex institutional structures as well as a stronger private side.

With comparison to betterment levies an additional reported advantage[30] is that revenue collected is used to finance the interventions (or improvements) that generate the valorization.

Moreover, the stronger the link that the beneficiaries perceive between the payment for and the benefits derived from the interventions (e.g. improved infrastructure and services and increase in the value of their properties), the greater is usually their willingness to pay.

5.12.4 Building rights charges and exactions

Instruments of this group stipulate or negotiate payment in exchange for the permission to develop a property in the form of money, infrastructure or land. Exactions and building rights charges are different, as the former often involves the provision of land for public use, and the latter requires payment for the right to build at heights over an established baseline or in different locations. Both are based on the idea that a new development involves public costs for the provision of urban infrastructure and services, and on the precept that the government has the right to regulate building.

These instruments differ from betterment levies in that they are collected at the time of approval of a new development and, therefore, are the builder's responsibility. These instruments are very common, as they typically involve requiring developers to provide a percentage of the area to be constructed for public purposes, generally between 15% and 35%. Such range is defined according to international benchmarks.

They can be set starting from the cost of the infrastructure necessary to enable the proposed development or on the increment in land value that the regulatory changes will generate. They usually involve negotiated or predefined charges for approval of requests to increase the limits on building heights. In this case, the municipality calculates the value of the newly-built space that will be generated and defines the payment in civil works or money.

The methods used in calculation and definition of the amounts charged vary according to the specifics of the instrument, but they generally involve appraisals by third parties or calculation of the value of the approved increase in the area at market prices.

5.12.5 Tax Increment Financing

This instrument consists in using the future flow of property tax increases generated by a public intervention to finance its costs. The process begins with the preparation of a master plan that establishes the boundaries of the area subject to intervention and defines the characteristics planned for each type of land

[29]UNHabitat (2015). The Challenge of Local Government Financing in Developing Countries. Nairobi
[30]Such advantage however does not apply in the case of a temporary increase in property tax rate

use, as well as municipal infrastructure required to develop the area according to the plan. The development agency also prepares a real estate market study that assesses the feasibility of implementing the plan and projects its impact on property values.

This projection of the project's impact on real estate prices is used to estimate the increase in property tax revenue. This increase in revenue is utilized to secure municipal debt (called TIF Tax Increment Financing bonds), which are issued to finance the public expenditures required for plan implementation. For this financial structure to work, the municipality must turn the renewal area into a TIF District. With this, the increases in property tax revenue generated by the project are earmarked to cover the payments on the TIF bonds, and, therefore, will not go into the municipality's general budget during the tenure of the bonds (usually more than 20 years).

Thus, the city continues collecting taxes based on the initial property tax base value (i.e., the total cadastral value before the creation of the TIF District), whereas the increase in tax revenues due to the rise in property prices generated by the project goes to cover the payments on the debt incurred to pay for the public infrastructure. The tax rate itself does not rise; what increases is revenue collection due to the value created by the intervention.

Since the tax rate by itself does not rise and beneficiaries do not pay for the project until after the value is created, political acceptance of TIFs can be reasonably high. The use of municipal debt also helps to resolve the cash flow problem posed by having to pay for the project before it generates value by using future revenues from the investments to secure the bonds. Nevertheless, TIFs have been criticized, because they allow recovery of only a small portion of the value created when property tax rates are relatively low. Furthermore, the proliferation of TIF Districts reduces municipal resources available for other expenditures, which can reduce the capacity of the city to address its overall priorities for all areas.

5.12.6 Land readjustment

This group of instruments allows the merging of individual lots within a defined area and to reconfigure them in accord with a plan that increases their value and provides the land necessary for public uses. The process begins with the development of a plan to urbanize a medium-size area that includes multiple lots and different owners. This approach is unique in that plan implementation is not lot by lot, but rather for the development of the adjustment area as a whole. In this, each owner accepts that his plot is reconfigured according to the plan, in terms of location, as well as in size. The costs of the infrastructure and public facilities of the project are allocated proportionally among the lots in the adjustment area.

Thus, an owner of a not-regular lot transfers it to the project and receives a smaller one in return, but one with higher potential for profitable development within the parameters and locations defined by the plan. The reason why land readjustment can be attractive for the owner is clear: although he receives a smaller plot, the price of the square meter of land will appreciate due to the implementation of the project and the installation of its infrastructure and public facilities. In other words, its total asset value will increase.

Land adjustment is a value capture instrument because the infrastructure and public facilities costs are partially or fully covered by the project development. The valorisation generated by plan implementation profits the owners, and also covers the cost of infrastructure and public facilities.

Land readjustment is more frequently used in new developments in the urban periphery that involve the transition from rural to urban land use. However, it has also been used in urban renewal projects. Several countries have used the land adjustment in varying ways, but the most well-known at the international level are Germany, Japan, and South Korea.

There are more sophisticated versions of the instrument, such as the trusts involving owners and sometimes the government, in which each owner ceases to own the land per se and becomes a shareholder in a development entity. Another alternative is the incorporation of a public land development company that is endowed with the right to use expropriation. This company consolidates private land lots and sells land to private builders at prices that allow it to compensate the owners, pay for infrastructure and public facilities, and also receive part of the valorisation.

5.13 Case Studies In Real Estate Value Capture In Low-Income Countries

Recent estimations provided by Inter-American Development Bank[31] with regard to urban development programs in cities in developing countries prove for instance that:

- At Xalapa, Mexico, the increment in real estate value derived from an urban development program's implementation is expected to be of 23% of the present real estate stock's cadastral value, an increase considerably higher than the intervention costs (17 times), meaning that capture of only 0.6% of the projected valorization from the Program could finance the project. Similarly, a betterment levy of only 0.13% of the stock's current total value would cover the Program's total cost;[32]
- At Quetzaltenango, Guatemala, the increment in real estate value derived from an urban development program's implementation is expected to be of eight times the interventions' total cost, with about 12% of the valorization generated by the project covering project costs.

In both cases, the estimation methodology foresaw:

- The delimitation of its impact area;
- The assessment of the value of the stock of land and buildings in the impact area;
- Estimation of the increment in land value;
- Financial prefeasibility analysis;
- Identification and selection of the most viable value capture instruments.

Case study n. 1 - **Xalapa, Mexico**

In the preliminary analysis, Tax Increment Financing (TIF) and betterment levies were identified as potentially the most effective land value capture instruments. However, the very low rate of the property tax and the resulting low revenues from it (only USD 334,542.78 expected for the first five years, less than 1% of the Program's costs) greatly reduced the viability of TIF.

Therefore, the feasibility study opted for betterment levies. In this case, a property of average cadastral value within the project's impact area was expected to pay an annual levy of USD 16 during the first five years to cover the Program's total cost or make a one-time payment of USD 80. This one-time levy would be much lower than the expected valorization generated by the Program during the first five years, representing only 2.6% of the projected increase in value for a property of average cadastral value.

Finally, to assure that Program costs are equitably distributed, the affordability analysis assessed the structure of the levies in relation to payment capacity of property owners. To make the payment structure equitable, it was foreseen to allocate 68% of the project's costs to the fourth quartile (group of properties with highest cadastral value), which resulted in a one-time betterment levy of USD 163.74, compared to that of the first quartile (lowest value properties) in which the levy would be USD 4.49 per property.

For both quartiles, the levy was considered attractive for the owners, as the payment for the fourth quartile corresponded to only 2.86% of the expected valorization for the first five years, and to only 0.76% for the first quartile.

[31] Andrés G. Blanco B. / Nancy Moreno M. / David M. Vetter / Marcia F. Vetter,, op.cit
[32] https://publications.iadb.org/publications/english/document/The-Potential-of-Land-Value-Capture-for-Financing-Urban-Projects-Methodological-Considerations-and-Case-Studies.pdf

Case study n. 2 - **Quetzaltenango, Guatemala**

In legal and financial terms, also this case study showed that betterment levies were considered the most feasible instrument for land value capture.

The estimated annual levy for a property of average appraised value of USD 88,615 was estimated to equal USD 131 for five years. A 1% increase in property value would therefore be significantly higher than the levy's value.

In the affordability analysis, the payment structure was assessed using quartiles defined by property value. Higher value properties in the fourth quartile were expected to pay a levy of USD 1,738.47, compared to USD 133.68 for the first quartile.

For both cities, it was foreseen a high potential of value capture instruments for financing urban projects. In both cases, the projected valorization covered the cost of the intervention by a wide margin. This means that using land value capture to finance these projects could provide a double benefit for taxpayers by helping to revitalize abandoned structures, recover green spaces, and provide infrastructure and public facilities, as well as by generating valorization greater than its costs and also the payments required to finance them.

It must however also be pointed out that value capture, although potentially very powerful, requires adequate legal frameworks. Among the main reasons causing the under-utilization of the value capture instruments are indeed frequently reported technical difficulties in measuring the increment in value generated by public interventions and its interpersonal distribution, the risks of high initial costs and implementation problems, and in some cases, general public resistance.
As seen above, methods of value capture instruments commonly used to finance urban projects include:

- Betterment levies;
- Selling of development rights and exactions;
- Tax Increment Financing (TIF);
- Land readjustment.

A key distinction is between projects that are an initiative of the public sector, such as the provision of infrastructure or public facilities, and projects that the private sector originates, such as real estate development in a specific area. Instruments such as betterment levies and TIF are best for public sector projects because they capture the value from residents as final users. Instruments that capture value directly from the developer (such as exactions and charges for building rights) work better for private projects since they collect directly from the project's developer.

In general terms, TIF as a higher prerequisite for implementation, as it assumes the use of future flow of property tax increases generated by a public intervention to finance its costs, thus relying on a high level of financial market development. It therefore has proven not efficient when property tax rates are relatively low[33].

Here below we develop a scenario for alternative application of TIF or betterment levies to the Sheger Project.

[33] Andrés G. Blanco B. / Nancy Moreno M. / David M. Vetter / Marcia F. Vetter (2016). The Potential of Land Value Capture for financing urban projects: methodological considerations and case studies. Inter-American Development Bank

5.14 Application To The Sheger Project

5.14.1 IP01 Area

The following inputs are here assumed:

- Total beneficiary population: 177,975
- Average size of household: 4.6[34]
- Average size of household per building: 1
- Total number of buildings is: **177,975/4.6 = 38,690**
- Average surface for a building is 50 square meters
- Market value of houses is: USD 632.1 per square meter (private market) and 80.5 USD per square meter (public market)[35]
- The formal and informal sector of housing supply accounts for 69.8% and 30.2%, respectively. Within the formal sector housing supply by the real estate developers is 0.4% while 49.6% and 19.8% is supplied by the government and individuals (cooperatives and lease), respectively[36]. We assume therefore that non over 10% of houses belongs to the upper level (3,869 houses) with 90% (34,821) belonging to the bottom level
- The whole set of identified physical projects, shall result in an average estate value increase (at present prices) respectively at 1% and 2% per year for low-level/ upper-level houses, thus being 115,414,853 USD. This amount is higher than the foreseeable total amount of the public investment.

This estate value increase would accrue to the two kinds of owners approximately as follows:

- Low-income owners, 90% share, 42.046,594 USD
- Up-income owners, 10% share, 73,368,259 USD

The first observation to make is that the State might directly capture the increase in real estate value of public property, which accounts for 49.6%[37] , that is some 78,1 million USD, so already recovering its investments, which accounts to 31.7 million USD.

SCENARIO 1: Property Tax

The methodology assumes the following input.

Input data	Value
% value of RESIDENTIAL property	0.1

Table 5 26– Property rate upon immovable property[38]

According to Ethiopian legislation, the implementation of property tax might be subject to strong limitations. For the sake of the simulation we however do not consider such constraints.

At current conditions, assuming that the real estate value of the stock of buildings is 262,435,745 USD, the property tax revenues, if applicable, would be 262,435 USD, out of which the share related with private buildings would be 132,267 USD.

Should we double such property rate, the effect would be an additional 132,267 USD per year, which over the 30 years period would make for 7,936,020 USD. Adding the estate value increase this figure should be multiplied by 1.3, i.e. 10,316,826 USD.

SCENARIO 2: Betterment levies introduction
Assuming that betterment levies are charged only on private property and that they amount to some 30% of the estate value increase they would result to be: **30% x 58,169,086 US= 17,450,726 USD.**

[34] Central Statistical Agency Addis Ababa, Ethiopia (2017). Demographic and Health Survey 2016. Addis Ababa, Ethiopia, and Rockville, Maryland, USA: CSA and ICF
[35].Source: Yohannes S. and Dinky A. (2018). "Housing provision and affordability in private residential real estates in Addis Ababa". Journal of EEA, Vol. 36, July
[36].Based on the 2015 Ministry of Urban Development and Housing (MOUDH) survey, quoted in Yohannes S. and Dinky A. (2018), op. cit.

[37].Source: Yohannes S. and Dinky A. (2018). Op. cit.
[38].Source: The Property Tax Act No. 14 of 2008, including The Revised Edition of 2020

The exercise proves that the betterment levy is a preferable feasible tool to contribute to finance the investment project.

5.14.2 IP08 Area

The following inputs are here assumed:

- Total beneficiary population: 158,550
- Average size of household: 4.6[39]
- Average size of household per building: 1
- Total number of buildings is: 177,975/4.6 = 38,690
- Average surface for a building is 50 square meters
- Market value of houses is: USD 632.1 per square meter (private market) and 80.5 USD per square meter (public market)[40]
- The formal and informal sector of housing supply accounts for 69.8% and 30.2%, respectively. Within the formal sector housing supply by the real estate developers is 0.4% while 49.6% and 19.8% is supplied by the government and individuals (cooperatives and lease), respectively[41] . We assume therefore that non over 10% of houses belongs to the upper level (3,869 houses) with 90% (34,821) belonging to the bottom level
- The whole set of identified physical projects, shall result in an average estate value increase (at present prices) respectively at 1% and 2% per year for low-level/ upper-level houses, thus being 59,120,322 USD. This amount is higher than the foreseeable total amount of the public investment.

This estate value increase would accrue to the two kinds of owners approximately as follows:

- Low-income owners, 90% share, 21,538,026 USD
- Up-income owners, 10% share, 37,582,296 USD

[39] Central Statistical Agency Addis Ababa, Ethiopia (2017). Demographic and Health Survey 2016. Addis Ababa, Ethiopia, and Rockville, Maryland, USA: CSA and ICF

[40] Source: Yohannes S. and Dinky A. (2018). "Housing provision and affordability in private residential real estates in Addis Ababa". Journal of EEA, Vol. 36, July

[41] Based on the 2015 Ministry of Urban Development and Housing (MOUDH) survey, quoted in Yohannes S. and Dinky A. (2018), op. cit.

The first observation to make is that the State might directly capture the increase in real estate value of public property, which accounts for 49.6%[42] , that is some 29,3 million USD, so already almost recovering its investments, as IP08 investment accounts to 29,6 million USD.

5.14.2.1 SCENARIO 1: Property Tax

The methodology assumes the following input.

Input data	Value
% value of RESIDENTIAL property	0.1

Table 5 27- Property rate upon immovable property[43]

According to Ethiopian legislation, the implementation of property tax might be subject to strong limitations. For the sake of the simulation we however do not consider such constraints.

At current conditions, assuming that the real estate value of the stock of buildings is 233,792,315 USD, the property tax revenues, if applicable, would be 233,792 USD, out of which the share related with private buildings would be 117,831 USD.

Should we double such property rate, the effect would be an additional 117,831 USD per year, which over the 30 years period would make for 7,7,069,860 USD. Adding the estate value increase this figure should be multiplied by 1.3, i.e. 9,190,818 USD.

5.14.2.2 SCENARIO 2: Betterment levies introduction

- Assuming that betterment levies are charged only on private property and that they amount to some 30% of the estate value increase they would result to be: 30% x 29,796,642 US= 8,938,993 USD.

The exercise proves that for IP08 the betterment levy is a tool comparable to property tax increase to contribute to finance the investment project.

[43] Source: The Property Tax Act No. 14 of 2008, including The Revised Edition of 2020

6. Conclusions

Month 2 Report - Data collection and alignment with Sheger Vision provides a comprehensive collection and analysis of existing documents in the light of the Sheger Vision; the data are stored in an IT Platform accessible to the Stakeholders.

The Month 4 Report – Draft Background Plans has identified the existing and planned Urban, Wastewater and Stormwater infrastructures, and the ongoing initiative and projects.

On this basis an infrastructure plan has been developed and costed. A set of parametric unit cost for the main categories of works has been worked and the unit cost have been multiplied for the quantities of works identified in the Infrastructures Plan providing the cost of works.

Cost of work has finally been increased by 60% (K=1,6) to take into consideration the following additional costs:

- Land acquisition
- Rights of way
- Design and supervision costs
- Administrative costs
- Contingencies
- Financing costs
- Taxations

The Sheger overall costs are summarized in the following table.

	SHEGER OVERALL PARAMERTIC COST	WORKS US $	TOTAL COST US $
WASTEWATER			
ABCDEF	Main Pipes D= 30mm	928,500.00	1,485,600.00
	Secondary Pipes D= 200/250 mm	3,312,250.00	5,299,600.00
	VIP latrines	960,000.00	1,536,000.00
	TOTAL	5,200,750.00	8,321,200.00
STORMWATER			
ABCDEF	Detention Ponds	5,270,000.00	8,432,000.00
	River Reshaping		
A	Trapazoidal shaping of river's channel, banks stabilization with hydroseeding and live wilow faggots	7,909,687.00	12,655,500.00
B	Trapazoidal shaping of river's channel, banks stabilization with hydroseeding and live wilow faggots. Pedestrian facilities	28,153,125.00	45,045,000.00
C	Cleaning and widening of river's channel, banks stabilization with rockfiled gabbins where necessary.	38,185,156.25	
D	Cleaning and widening of river's channel, banks stabilization with reinforced concrete retaining wal where necessary.	13,416,406.25	21,466,250.00
E	Trapazoidal shaping of river's channel, banks stabilization with hydroseeding and live wilow faggots or gabions where necessary.	31,167,343.75	49,867,750.00

F	Trapazoidal shaping of river's channel, banks stabilization agricultural terraces	2,681,250.00	4,290,000.00
	TOTAL	126,782,968.75	202,852,750.00
	URBAN INFRASTRUCTURES		
A	Natural/rural context	2,786,608.33	4,458,573.33
B	Peri-urban areas	20,968,491.00	33,359,585.60
C	Danse Urban areas	18,897,750.00	30,236,400.00
D	Central districts	10,731,925.00	17,171,080.00
E	Transformation pilots and open spaces in dense urban areas	11,781,775.00	18,850,840.00
F	Urban gardens	2,465,680.00	3,345,088.00
	TOTAL	67,632,229.33	108,211,566.93
	OVERCALL COST	199,615,948.08	319,385,516.93

Table 6-1 Sheger overall costs

Using the parametric cost estimate a proposal of 10 Investment Packages (IP) was draft in order to facilitate the Bank and the Stakeholders to assess the priority of interventions. The figure below present in a comprehensive way.

A: the location of the ongoing cooperation projects:

- Centre for Environmental Science (CES) – AA University - Pilot studies in Kebene and Kurtumi (IP 01 and IP 08)
- China-aided Ethiopian Addis Ababa RiverSide Green Development project, Kechene and Banteyketu (IP 02 and IP 05)
- AICS – Italian Agency For Development Cooperation Little Kebena (IP 07a)
- UN Habitat Sheger Project bottom Ginfile (IP 05) .
- KOICA – Korean cooperation, Little Kebena (IP 06 and IP 08)
- UNDP Sheger Resilience Programme (All Sheger River)

B: the location of the 6 categories A, B, C, D, E, F marked with different colours
C: the boundaries of each intervention Package.

6. Conclusions

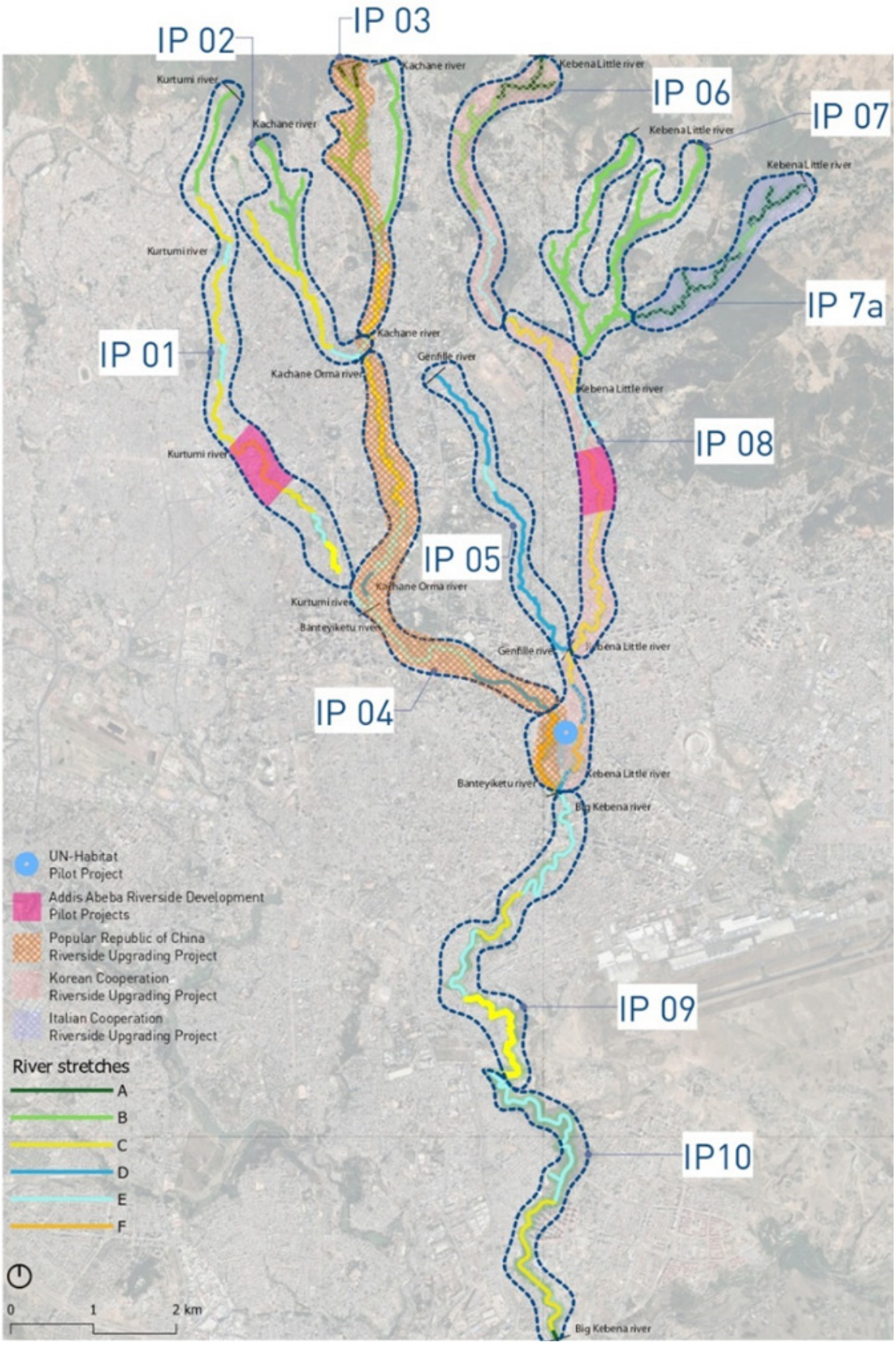

Figure 6-1 Intervention Packages and location of ongoing Cooperation Projects

6.1 Multiple-Criteria Decision Analysis (Mcda),

After conducting a Multiple-Criteria Decision D (MCDA), excluding the IPs where other Cooperation Projects are developed and IPs with a low Benefit/Cost Ratio two IP where chosen: IP 01 and IP 08.

IP	Benefits/Costs Ratio	Investment (USM)
IP05	80.44	31.9
IP04	32.10	34.7
IP01	25.03	30.5
IP09	21.01	26.8
IP03	19.49	35.6
IP02	14.82	25.0
IP08	13.35	29.6
IP06	6.36	24.5
IP10	5.87	24.5
IP07	1.44	55.9

IPs chosen for implementation of economic analysis

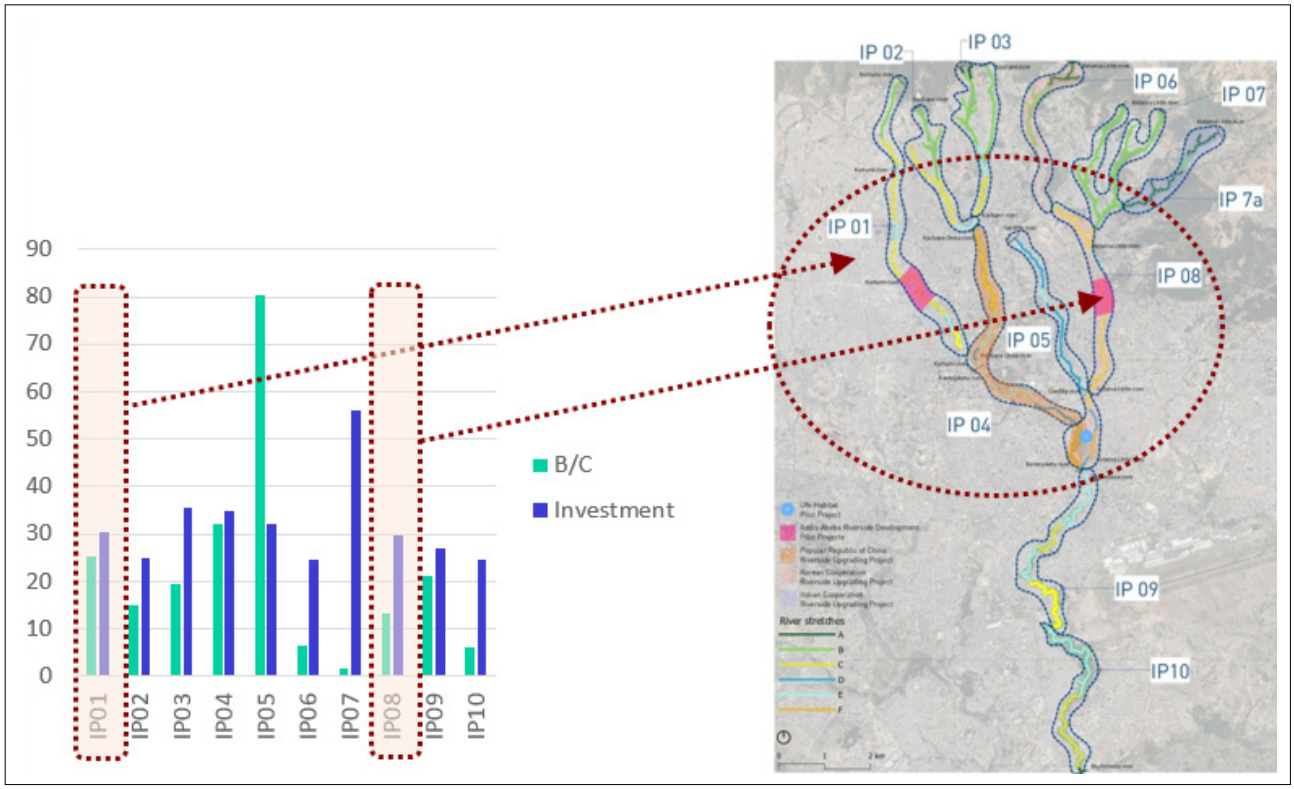

Figure 6-2 Selected Intervention Packages: IP 01 and IP 08

6.2 Financial and Economic Analysis

The financial and economic analysis has been conducted in three steps:

- Economic appraisal of IP01 and IP08 according to CBA approach
- Generation of EIRR to prove sustainability of related investments
- Analysis of value capture through Real Estate Valorization

The Financial and Economic analysis proved the viability of the investment, with specific regard to IP 01 and IP 08, which were selected as "pilot areas" after the conduction of the MCDA.

- Benefit/cost ratio resulted respectively up to 5.59 for IP 01 and 2.47 for IP 08,
- EIRR (30-year) standing respectively at 111.8% for IP 01 and 87.9 for IP 08,

In addition the analysis proved a balanced effect of different benefits.

- improvement of residents' health,
- safety and security of personal belongings,
- increase of residents' wealth,
- savings to public sector associated to increased prevention.

The value might be integrated by the increase of value of private property, then Increase in the value of all public property is estimated for around 49.6% which would exceed or equal the cost of the investment respectively:

- 78,1 M USD against 31,7 M USD for IP 01
- 29,3 M USD against 29,6 M USD for IP 08

7 Annexes

7.1 Sheger Month 2 Report - Data Collection And Alignment With Sheger Vision Revision 1

7.2 Sheger Month 4 Report – Draft Background Plans - Revision 1

7.3 Sheger Month 4 Report – Maps

7.4 Sheger Draft Final Report And Investment Plan

8.5 Final Workshop Full Presentation

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