1. Key development issues and rationale for Bank involvement

- The Metropolitan Area of Barranquilla (AMBQ) is Colombia’s fourth largest conurbation with approximately 1.9 million inhabitants. The Metropolitan Area is bounded on the east by the Magdalena River and north by the Caribbean Sea and is one of the most important sea and river ports in Colombia.

- Barranquilla’s hydrology is comprised of two principal basins that divide the city’s western and eastern areas. The eastern Magdalena River Basin accounts for approximately 70% of Barranquilla’s surface area, and includes the oldest part of the city and a low flood plain that extends along the Magdalena River. High rates of urban population growth have significantly decreased permeable surface areas and most importantly, the city lacks a rainwater sewer system.

- During periods of heavy rainfall, significant volumes of water flow at high velocities through the city streets via “urban creeks” (arroyos), turning affected areas into high-risk zones. The consequences of these events are reflected in damage to urban infrastructure and service networks, paralysis or disruption of vehicular and pedestrian traffic that affect not only the general economic activity of the city, but also residents who suffer occasional destruction of their homes and loss of life. Since 1970, 59% of the recorded events have been registered as floods (Figure 2) which a result have caused 49 fatalities, 36 people missing, 160,145 people affected and 1,890 houses destroyed.

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1 There are 21 arroyos in Barranquilla with an aggregate distance of 75,638 meters.
- A study commissioned by the FONADE (Fondo Financiero de Proyectos de Desarrollo - Financial Fund for Development Projects) in 1997 found that 20% of GDP in Barranquilla was affected due to diminished productivity each year by the flooding. During periods of heavy rainfall, significant volumes of water flow at high velocities through the city streets, transforming affected areas into high-risk zones.\(^2\) The consequences of these events are reflected in damage to urban infrastructure and service networks, and paralysis or disruption of vehicular and pedestrian traffic that affect not only the general economic activity of the city, but also residents who suffer occasional destruction of their homes and loss of life.

- The Colombian National Government has affirmed urban drainage to be a new national priority and is following the integrated approach supported by the World Bank in Barranquilla as a pilot for future interventions in Colombia's cities.

- In Colombia the World Bank has support projects in disaster risk reduction through the last two CPS cycles. Currently two investment projects are under implementation: a) The National Disaster Vulnerability Reduction Project (DVRP) (Adaptable Program Loan - APL1) US$110 million, and b) The Bogota Disaster Vulnerability Reduction Project (APL2), US$80 million. The APL1 was approved by the Board in 2005 and expected to include up to four loans if local governments would meet the threshold of disaster risk reduction investment needs of more than US$30 million. These projects have five lines of action based on Colombia’s National Plan for Disaster Prevention and Relief (Decree 93 of 1998)\(^3\): (a) risk identification, (b) risk reduction, (c) institutional strengthening, (d) risk prevention and awareness, and (e) financial coverage for risk management.

- The Bank received a letter from the Minister of Environment, Housing and Territorial Development in August 2009 seeking Bank support to Barranquilla in preparation of this investment project. The District Government of Barranquilla and the Colombian national government have expressed a clear desire to work with the Bank on project preparation and the financing of the Project. The project has consequently been included in the CPSFY12-FY16.

2. **Proposed objective**

The proposed objective of the Project is to reduce the risk of urban flooding in target areas of Barranquilla. The PDO will be measured by tracking: i) percentage of streets in target areas that have drainage systems with a XX flood design return period (*to be determined*), ii) population living and working in risk-prone areas, iii) number of drainage inlets that are impeded due to solid waste in target areas.

\(^2\) There are 21 arroyos in Barranquilla with an aggregate distance of 75,638 meters.

\(^3\) In 1998, the Colombian government ratified the National Plan for Disaster Prevention and Relief (Decree 93 of January 13) which shifted the focus of disaster management from emergency response to disaster prevention, through a comprehensive disaster risk management strategy, based on four lines of action: (i) risk identification, (ii) risk reduction, (iii) institutional development, and (iv) risk awareness.
3. Preliminary description

The Project will be limited to the Eastern watershed for which solutions can be implemented independently of progress on the Western watershed. Barranquilla is currently exploring support from the Andean Development Corporation (CAF) for a project in the Western watershed. The Project will be designed and implemented to provide an integrated solution to the flooding problem at the city level, and intends to focus on the introduction of physical, institutional, and social measures that will ensure the sustainability of a flood mitigation framework.

There are known and tested measures for urban flood risk management, typically classified as structural or engineered measures, and non-structural, management techniques. A combination of measures to form an integrated management approach is most likely to be successful in reducing flood risk in the short and medium terms. Structural solutions can be thought of as engineering solutions to storm water management used to manage storm water at the point of generation, the point of discharge, or at any point along the flood path. Structural solutions can serve many different functions based on their design and include investments in hard infrastructure (large drainage networks comprised of embankments, pumps, flood gates, etc.) and routine operations and maintenance. Non-structural issues are more complex due to social variability, but can include responses such as improved land use and site planning, regulatory reforms, behavior change, institutional coordination and engagement with the greater civil community. It also includes social resettlement plans and environmental mitigation measures.

Project Components

Component 1: Flood Risk Identification and Awareness

A. Stormwater Drainage Master Planning: The outputs of the feasibility study of technical solutions will contribute to the definition of a Stormwater Drainage Master Plan with strong linkages to urban and transport planning that will guide the sequencing and nature of physical interventions required across the city.

B. Flood Risk Knowledge: This involves studies for completing flood hazard identification, vulnerability and risk assessments (for example, probability of loss of life and property if the vulnerability is not addressed).

C. Education and Information Campaigns: The importance of risk mitigation and disaster preparedness will be introduced at various levels of the educational system and will involve the development and implementation of a multifaceted public information campaign improving public awareness of urban flooding and of roles and responsibilities of individual households and communities.
Component 2: Flood Risk Reduction

A. Based on the Stormwater Drainage Master Plan and flood risk mapping undertaken in Component 1, this component would initiate the first phase of physical interventions with investments in selected micro-basins.

B. **Structural Solutions:** Current best management practice for high-impact and cost-effective solutions for flood mitigation is to retard peak flows in upstream/midstream areas by focusing on retention and detention. Such measures are high-impact as they slow the transfer time by capturing large volumes of water and utilize areas of infiltration. This component would therefore include detailed diagnostics of each ‘arroyo’ with the objective of defining the appropriate portfolio of response measures to promote hydraulic capacity and reduce run-off levels following rain events by increasing water capture, making use of above- and below-ground storage, and promoting infiltration rates. Investments would be focused on identification and assessment of potential infrastructure and complementary alternatives. Investments would be focused on potential infrastructure alternatives and involve construction of selected options to promote hydraulic capacity and reduce run-off levels following rain events, including but not limited to canalization, pipes, culverts, pedestrian bridges, or use of Low-Impact Development (LID) solutions (i.e., pervious pavement).

C. **Non-Structural Solutions:** Some of the contributing causes to the urban flooding in Barranquilla include blocking of the flood path as a result of litter and sediment deposition, and private properties (e.g., residential, commercial, industrial) draining run-off directly onto city streets. Similarly, flood risk is increased by the presence of homes, businesses, and infrastructure in high-risk zones adjacent to the arroyos. This component would therefore focus on environmental mitigation measures such as assessing potential use of green infrastructure, improving solid waste collection/management practices,\(^4\) and evaluating potential application of incentive mechanisms (i.e., property tax credits/subsidies) for implementation of run-off reducing measures (e.g., rainwater capture, green roofs, pervious driveways). This subcomponent should be strongly articulated within the public awareness strategy (Component 1).

Component 3: Institutional Strengthening and Preparedness

Given the long time horizon that is projected for the full execution of physical works that would be required, institutional capacity within city government and public service providers would require strengthening to appropriately prepare for and respond to the residual flood risk. This component would include the following subcomponents:

A. **Project Administration:** This includes the provision of consulting services, office equipment, and supplies, and covers operating expenses for the coordinating unit of the

\(^4\) On a daily basis, large amounts of trash generated in the city end up in the canals. Addressing solid waste before it enters the system would have a tremendous impact on operation and maintenance of installed infrastructure and would be more cost-effective.
proposed project. The subcomponent would also finance the training of participating agencies’ staff in safeguard, fiduciary, and technical aspects of the project.

B. Capacity Building: Within the context of defining a disaster prevention strategy for the city, this component would include a review of roles and responsibilities for flood risk management in Barranquilla. Based on this analysis, and taking into account the structural solutions that would be put in place, an assessment would be undertaken of required technical capacity for day to day operations and maintenance of drainage systems and associated resource allocation. The objective of these measures would be to streamline operations and maintenance and flood risk management in the city’s political and policy framework, operational water and sewer management, and DRM strategies and tools.

C. Early Warning System: The provision of early warning system to a forthcoming event is increasingly being recognized as an important approach to reducing loses due to floods. To be effective, such warning should not only be reliable but also timely enough to provide city residents sufficient lead time to respond. This subcomponent would focus on the development of an end-to-end flood forecast, warning and response system for those events which supersede the installed hydraulic capacity of Barranquilla’s urban drainage system (Component 2). The system would support Barranquilla’s Government in establishing an important non-structural response to urban flooding and encompass data collection (quality and analytic capacity for monitoring and risk mapping), communication, forecasting, decision support, notification, coordination, and preparatory actions.

4. Safeguard policies Potentially Triggered by the Project

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5. Tentative financing

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6. **Contact point**

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