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The World Bank

Report No: ICR03019

IMPLEMENTATION COMPLETION AND RESULTS REPORT
(TF-91692)

ON A

GRANT FROM THE

GLOBAL ENVIRONMENTAL FACILITY

SPECIAL CLIMATE CHANGE FUND

IN THE AMOUNT OF US$ 3.8 MILLION

TO THE

REPUBLIC OF GUYANA

FOR A

CONSERVANCY ADAPTATION PROJECT

March 7, 2014

Sustainable Development Department
Caribbean Country Management Unit
Latin America and the Caribbean Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective August 28, 2013)

Currency Unit = GYD
GYD 1.00 = US$ 0.00493
US$ 1.00 = GYD 202.94885

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

ACP	African-Caribbean-Pacific
ADCP	Acoustic Doppler Current Profiler
ASDU	Agricultural Sector Development Unit (MoA)
CAP	Conservancy Adaptation Project
CAS	Country Assistance Strategy
CDC	Civil Defence Commission (Guyana)
CEMCO	Engineering firm (Guyana)
DEM	Digital Elevation Model
DfID	Department for International Development (United Kingdom)
DRM	Disaster Risk Management
EA	Environmental Assessment
EDWC	East Demerara Water Conservancy
EIA	Environmental Impact Assessment
EIP	Environmental Implementation Plan
EPA	Environmental Protection Agency (Guyana)
EU	European Union
FM	Financial Management
FY	Financial Year
GD	Guyana Datum
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEO	Global Environmental Objectives
GFDRR	Global Facility for Disaster Reduction and Recovery
GIS	Geographic Information System
GL&SC	Guyana Land and Surveys Commission
GoG	Government of Guyana
GRIF	Guyana REDD+ Investment Fund
GWI	Guyana Water Incorporated
Hydromet	Hydro-meteorological Office of Guyana
IDA	International Development Association
IDB	International Development Bank
IS	Implementation Secretariat
ISR	Implementation Status and Results
JICA	Japan International Cooperation Agency

L&SC	Land and Survey's Commission (Guyana)
LiDAR	Light Detection and Ranging
MoA	Ministry of Agriculture (Guyana)
MoF	Ministry of Finance (Guyana)
MoU	Memorandum of Understanding
MTR	Mid-term review
NDIA	National Drainage and Irrigation Authority (Guyana)
OP	Office of the President (Guyana)
PAD	Project Appraisal Document
PDO	Project Development Objective
PEU	Project Execution Unit
QAG	Quality Assurance Group
QALP-2	Quality Assessment of Lending Portfolio
REDD	Reducing Emissions from Deforestation and forest degradation in Developing countries
RTK	Real Time Kinematic GPS
S&RD	Sea and River Defences
SCCF	Special Climate Change Fund
SRKN'gineering	Engineering firm (Guyana)
TOR	Terms of Reference
TTL	Task Team Leader
UG	University of Guyana
WB	World Bank

Vice President:	Hasan A. Tuluy
Country Director:	Sophie Sirtaine
Sector Manager:	Anna Wellenstein
Project Team Leader:	John Morton
ICR Team Leader:	Armando Guzmán

REPUBLIC OF GUYANA
CONSERVANCY ADAPTATION PROJECT
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I. Disbursement Graph

A. Basic Information			
Country:	Guyana	Project Name:	Conservancy Adaptation Project
Project ID:	P103539	TF Number(s):	TF091692
ICR Date:	11/22/2013	ICR Type:	Core ICR
Lending Instrument:	SIL	Borrower:	GOVERNMENT OF GUYANA
Original Total Commitment:	US$ 3.80M	Disbursed Amount:	US$ 3.8M
Revised Amount:	US$ 3.80M		
Environmental Category: B		**Global Focal Area: C**	
Implementing Agencies: Agriculture Sector Development Unit (ASDU), Ministry of Agriculture (MoA)			
Cofinanciers and Other External Partners:			

B. Key Dates				
Process	**Date**	**Process**	**Original Date**	**Revised / Actual Date(s)**
Concept Review:	04/25/2006	Effectiveness:		01/28/2008
Appraisal:	01/29/2007	Restructuring(s):		04/04/2011 03/22/2013
Approval:	10/11/2007	Mid-term Review:		06/21/2010
		Closing:	06/30/2011	08/30/2013

C. Ratings Summary	
C.1 Performance Rating by ICR	
Outcomes:	Moderately Satisfactory
Risk to Global Environment Outcome	Moderate
Bank Performance:	Moderately Satisfactory
Borrower Performance:	Moderately Satisfactory

C.2 Detailed Ratings of Bank and Borrower Performance			
Bank	**Ratings**	**Borrower**	**Ratings**
Quality at Entry:	Moderately Unsatisfactory	Government:	Satisfactory
Quality of Supervision:	Moderately Satisfactory	Implementing Agency/Agencies:	Moderately Satisfactory
Overall Bank Performance:	Moderately Satisfactory	**Overall Borrower Performance:**	Moderately Satisfactory

C.3 Quality at Entry and Implementation Performance Indicators			
Implementation Performance	**Indicators**	**QAG Assessments (if any)**	**Rating**
Potential Problem Project at any time (Yes/No):	Yes	Quality at Entry (QEA):	Satisfactory
Problem Project at any time (Yes/No):	No	Quality of Supervision (QSA):	Satisfactory
GEO rating before Closing/Inactive status	Satisfactory		

D. Sector and Theme Codes		
	Original	**Actual**
Sector Code (as % of total Bank financing)		
Central government administration	3	3
Flood protection	97	97
Theme Code (as % of total Bank financing)		
Natural disaster management	67	67
Water resource management	33	33

E. Bank Staff		
Positions	**At ICR**	**At Approval**
Vice President:	Hasan A. Tuluy	Pamela Cox
Country Director:	Sophie Sirtaine	Caroline D. Anstey
Sector Manager:	Anna Wellenstein	David N. Sislen (Acting)
Project Team Leader:	John Morton	Francis Ghesquiere
ICR Team Leader:	Armando Guzmán	
ICR Primary Author:	Claudia Isabella Bovolo	

F. Results Framework Analysis

Global Environment Objectives (GEO) and Key Indicators (as approved)

The objective of the project was "to reduce the Recipient's vulnerability to the catastrophic flooding of its low-lying coastal area due in part to the rise in sea level as a result of global climate change". The project Global Environment Objective (GEO) aimed to raise awareness to promote the application of physical infrastructure upgrades to reduce vulnerabilities brought on by climate change. This focus shifting of the GEF Adaptation Program from the development and implementation of adaptive measures to strengthen infrastructure, was to increase the program's robustness and effectiveness.

Revised Global Environment Objectives (as approved by original approving authority) and Key Indicators and reasons/justifications

There were no changes to the Project Development Objective (PDO) or to the Global Environment Objective (GEO) throughout the life of the Project.

(b) Intermediate Outcome Indicator(s)

(a) Project Indicator(s)

Indicator	Baseline Value	Original Target Values	Formally Revised Target Values	Actual Value Achieved at Completion
Indicator 1:	Hydraulic engineering foundation, critical for flood control management Developed.			
	Models not completed	Hydraulic model calibrated		Hydraulic model calibrated, validated and quality controlled
Date achieved	10/11/2007	06/30/2011		08/30/2013
Comments (Incl. % of achievement)	100% Achieved. Extension of the Project's final closing date to 08/30/2013 allowed for the completion of model calibration following detailed technical review and revision of the model. The model was used to explore options to improve drainage under various extreme rainfall scenarios both for the EDWC and East Coast drainage systems. Recommendations and designs for key future interventions were produced. Dam stability was also assessed and designs for upgrading the dam produced.			
Indicator 2:	Identification of at least 10 drainage interventions for follow-on intervention			
	Model not completed and works not identified	10 key drainage interventions identified and pre-engineering studies completed		14 key drainage interventions identified and pre-engineering studies completed
Date achieved	10/11/2007	06/30/2011		08/30/2013
Comments (Incl. % of achievement)	150% Achieved. Exceeded expectations. Eleven drainage areas were modeled and pre-engineering studies completed for 14 interventions along Region 4's East Coast (including additional pumping capacity, separation of urban and agricultural drainage areas, rehabilitation of culverts and widening of channels). Pre-engineering studies were also completed for additional drainage interventions from the EDWC into the Demerara River (modifications to the Kofi Canal).			
Indicator 3:	Increase drainage relief capacity of EDWC to Demerara River by 35%			
	0% (No drainage relief capacity increase)	Drainage relief capacity increased by 35%	Withdrawn	N/A
Date achieved	10/11/2007	06/30/2011	March 24, 2011 Restructuring (approval April 4, 2011)	N/A
Comments (Incl. % of achievement)	Withdrawn. Following restructuring, this indicator was eliminated following withdrawal of donor funding. Linked with the above, the government financed Component 2.1 – Widening of key drainage relief canals (i.e.Cunha Canal rehabilitation), was withdrawn from the project and was developed as a stand-alone project.			

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
COMPONENT 1: Pre-investment studies for engineering design of works				
Indicator 1.1:	Detailed topographic and land use mapping			
Light detection and ranging (LiDAR) data capture of coastal lowlands for Region 3, 4 and 5 completed for input into 3D Digital Elevation Model (DEM)	0 (LiDAR not completed)	DEM created for Region 3, 4 and 5		DEM created for Region 3, 4 and 5
Date achieved	10/11/2007	06/30/2011		08/30/2013
Comments (Incl. % of achievement)	70% Achieved based on population coverage and 100% achieved over project area (Region 4). LiDAR surveys were successfully carried out and high resolution photography was taken. LiDAR data were ground-truthed using bench-marks. These activities were quality controlled by external peer-review. Other regions (3 and 5) were outside the project area and not relevant to this project, suggesting that this indicator was originally over-stated. A DEM was produced for the project area, using the newly acquired LiDAR data. GPS horizontal and vertical control benchmarks, temporary ground control surveys and conservancy leveling and bathymetry were also carried out. These activities were quality controlled by external peer-review. Other regions (3 and 5) were outside of the project area and not relevant.			
Indicator 12:	Hydrologic modeling			
1D-2D model developed to identify key drainage regimes and map key interventions to be made within conservancy to improve water flow to the Demerara River	0 (1D-2D not developed)	Model Calibrated		Model calibrated
Date achieved	10/11/2007	06/30/2011		08/30/2013
Comments (Incl. % of achievement)	100% Achieved. A model for the EDWC was set up and calibrated. This was quality controlled by external peer-review. Recommendations for interventions to improve internal EDWC water conveyance and water flow to the Demerara river were made based on the model outputs. In addition, models for eleven selected drainage regimes were also set up and run in order to improve drainage into the Atlantic Ocean from the East Coast.			
Indicator 1.3:	Assessment of EDWC system integrity			
Measurements taken and dam safety analysis completed to highlight areas	No measurements taken	Measurements taken and dam safety analysis completed		Measurements taken and dam safety analysis completed

in critical need of repair				
Date achieved	10/11/2007	06/30/2011		08/30/2013
Comments (Incl. % of achievement)	100% Achieved. Geotechnical measurements were taken and models set up to complete the dam safety analysis. Areas of dam in critical need of repair were identified and designs for rehabilitation provided.			
Indicator 1.4:	Assessment of EDWC system integrity			
Leveling and bathymetry completed	0 (No measurements taken)	Leveling and bathymetry completed		Leveling and bathymetry completed
Date achieved	10/11/2007	06/30/2011		08/30/2013
Comments (Incl. % of achievement)	100% Achieved.			
COMPONENT 2: Investments in specific adaptation measures				
Indicator 2.1:	Increased discharge capacity of key relief canal from EDWC to Demerara River			
2.1a. % of key canal widened in compliance with national and project level environmental and safety requirements	0 (No canals widened)	Key canal widened	No canal widened	No canal widened
Date achieved	10/11/2007	06/30/2011	March 24, 2011 restructuring (approval April 4, 2011)	
Comments (Incl. % of achievement)	Withdrawn. Following restructuring, GEO indicator 3 was withdrawn. Linked with this, the proposed GoG financed component 2.1a was withdrawn from the project was considered a stand-alone project.			
2.1b. % Increase in discharge capacity of key relief canal from EDWC to Demerara River	0 (No increase in discharge capacity)	Discharge capacity doubled	No increase in discharge capacity	No increase in discharge capacity
Date achieved	10/11/2007	06/30/2011	March 24, 2011 restructuring (approval April 4, 2011)	
Comments (Incl. % of achievement)	Withdrawn. Following restructuring, GEO indicator 3, and the linked component 2.1b were withdrawn to reflect the reality of the project activities which focused essentially on providing technical engineering baseline studies for future interventions designed to reduce flood vulnerability.			
2.1c. % Increase in discharge capacity to the Demerara River	0 (No increase in discharge capacity)	Discharge capacity increased by 35%	No increase in discharge capacity	No increase in discharge capacity
Date achieved	10/11/2007	06/30/2011	March 24, 2011	

			restructuring (approval April 4, 2011)	
Comments (Incl. % of achievement)	Withdrawn. Following restructuring, GEO indicator 3, and the linked component 2.1b were withdrawn to reflect the reality of the project activities which focused essentially on providing technical engineering baseline studies for future interventions designed to reduce flood vulnerability.			
Indicator 2.2:	Improvement of water flow system within EDWC			
Internal hydraulic flow model completed and report available	0 (No model)	Flow model and report available		Flow model and report available
Date achieved	10/11/2007	06/30/2011		08/30/2013
Comments (Incl. % of achievement)	100% Achieved. The flow model for the EDWC was calibrated and run and recommendations for improvement were made. A report is available.			
Indicator 2.3:	Upgrading of EDWC control structures			
100% of repairs identified at appraisal executed	0 (No upgrading)	EDWC control structures upgraded		EDWC control structures upgraded
Date achieved	10/11/2007	06/30/2011		08/30/2013
Comments (Incl. % of achievement)	100% Achieved. The two sluices at Lama were rehabilitated under the project. The GoG carried out further improvements to the EDWC and East Coast system independently of the project.			
Indicator 2.4:	Selected equipment purchase and installation			
Key monitoring, communication and other equipment purchased and fully operational	0 (No equipment purchased)	Key equipment purchased and operational		Key equipment purchased and operational
Date achieved	10/11/2007	06/30/2011		08/30/2013
Comments (Incl. % of achievement)	100% Achieved. Although procurement and therefore installation was delayed by about 8 months, all key monitoring and communication equipment was purchased and installed and are operational. In addition a punt and pontoon barge, and a long boom excavator and survey equipment were purchased under the project.			
Indicator 2.5:	Major infrastructure civil works and operational improvements			
Infrastructure works to be developed by GoG upon completion of hydraulic engineering foundation	0 (No infrastructure works developed)	No works developed	Withdrawn following mid-term review	N/A
Date achieved	10/11/2007	06/30/2011	06/21/2010	08/30/2013
Comments (Incl. % of achievement)	Withdrawn.			

COMPONENT 3: Institutional strengthening and project management				
Indicator 3.1:	Contingency plan for flood events			
Contingency Plan developed with clear lines of responsibility	0 (No contingency plan developed)	Contingency plan developed		Inception report only
Date achieved	10/11/2007	06/30/2011		08/30/2013
Comments (Incl. % of achievement)	0% Achieved. This deliverable was not completed within the project time-frame.			
Indicator 3.2:	Institutional analysis of the drainage sector			
Institutional analysis concluded and recommendation proposed to GoG	0 (No institutional analysis concluded)	Institutional analysis concluded and recommendations made	Withdrawn following mid-term review	No institutional analysis conducted
Date achieved	10/11/2007	06/30/2011	06/21/2010	
Comments (Incl. % of achievement)	Withdrawn.			
Indicator 3.3:	Development of flood control thematic committee			
3.3a. Implementation secretariat (IS) formed and operational	0 (No IS established)	IS established and operational		IS established and operational
Date achieved	10/11/2007	06/30/2011		08/30/2013
Comments (Incl. % of achievement)	50% Achieved. An IS was formed but did not meet regularly.			
3.3b. At least 10 IS committee meetings held	No meetings held	10 meetings held	Withdrawn following mid-term review	N/A
Date achieved	10/11/2007	06/30/2011	06/21/2010	
Comments (Incl. % of achievement)	All indicators relating to bureaucratic functioning of IS were withdrawn following mid-term review			
3.3c. 3 annual reports provided by IS	No annual reports	3 annual reports	Withdrawn following mid-term review	N/A
Date achieved	10/11/2007	06/30/2011	06/21/2010	08/30/2013
Comments (Incl. % of achievement)	All indicators relating to bureaucratic functioning of IS were withdrawn following mid-term review			
3.3d. Prioritization strategy to improve water management developed by IS	No prioritization strategy developed	Prioritization strategy developed	Withdrawn following mid-term review	N/A

Date achieved	10/11/2007	06/30/2011	06/21/2010	08/30/2013
Comments (Incl. % of achievement)	Withdrawn but 100% achieved. The GoG have developed a prioritized strategy to improve water management based on this Climate Adaptation Project (CAP) results and recommendations.			
Indicator 3.4	Donor meeting to be held at project completion			
Donor meeting held with representatives	No donor meeting held	Donor meeting made.		Donor meeting held
Date achieved	10/11/2007	06/30/2011		08/30/2013
Comments (Incl. % of achievement)	100% Achieved. At project completion, a donor meeting was held on Jan 22, 2014 with participants representing IDB, EU, JICA and the World Bank. A further donor meeting is scheduled to be held in Feb 2014. Initial discussions indicate that donors are willing to fund CAP related works based on GoG overall flood risk management.			
Indicator 3.5:	Operational capacity building			
Number of key staff trained in use of Digital Elevation Models, Flow Models, and Monitoring Equipment	0	10		95
Date achieved	10/11/2007	06/30/2011		08/30/2013
Comments (Incl. % of achievement)	100% achieved. A total of 6 workshops/training events were attended by 95 GoG and other agency staff (a total of 95 people): [1] 22 staff attended workshops by the contractor on 8/8/2011 on GPS Data Acquisition and Processing, Bathymetry and RTK; [2] 14 staff (incl. 8 Hydromet, 3 CEMCO) attended workshops by the supplier in December 2011 on the use of the monitoring equipment; [3] 9 staff (incl. 7 Hydromet, 1 CEMCO) attended workshops by the contractor in February 2012 on data collection; [4] 13 staff (incl. 9 EDWC, 1 CEMCO, 2 NDIA) attended a workshop by the contractor and CEMCO in April 2012 on dam safety; [5] 18 staff (incl 2 NDIA, 5 Hydromet, 2 Guysuco, 1 ASDU, 2 CEMCO, 2 UG, 1 SRKN'gineering) attended a workshop in August 2012 on hydrological modeling. [6] 19 staff (3 EPA, 2 GWI, 1 CEMCO, 2 CDC, 2 MoF, 2 MoA, 4 NDIA, 3 Hydromet) attended a workshop in September 2012 on hydrological modeling.			

G. Ratings of Project Performance in ISRs

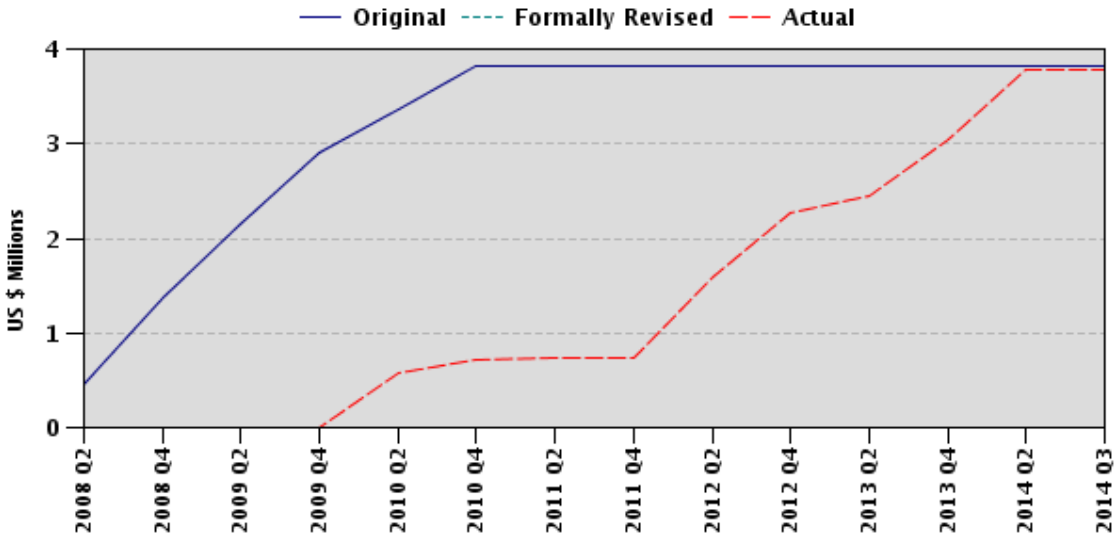
No.	Date ISR Archived	GEO Progress towards achievement of GEO	IP Implementation Progress	Actual Disbursements (US$ millions)
1	12/17/2007	Satisfactory	Satisfactory	0.00
2	06/17/2008	Satisfactory	Satisfactory	0.00
3	11/30/2008	Satisfactory	Satisfactory	0.00
4	05/06/2009	Satisfactory	Satisfactory	0.00
5	11/30/2009	Moderately Satisfactory	Moderately Satisfactory	0.57
6	05/19/2010	Moderately Satisfactory	Moderately Satisfactory	0.69
7	02/23/2011	Moderately Satisfactory	Moderately Satisfactory	0.71
8	08/28/2011	Moderately Satisfactory	Satisfactory	1.45
9	04/23/2012	Moderately Satisfactory	Satisfactory	1.73
10	11/14/2012	Moderately Satisfactory	Satisfactory	2.28
11	05/21/2013	Satisfactory	Satisfactory	2.72

H. Restructuring

March 2011 Project Restructuring. The level two project restructuring approved on April 4, 2011 included: (i) withdrawing the Project indicator "increased drainage relief capacity of the EDWC to the Demerara River by 35%" (outcome indicator 3 of the CAP project document, Annex 3), to reflect the reality of the project activities and main focus of the project to provide technical engineering baseline studies for future interventions, designed to reduce flood vulnerability; (ii) reallocating unused related funds from component 2 to component 1 to cover the costs of the engineering studies (the proposed government financed Component 2.1 – Widening of key drainage relief canals was withdrawn from the project and was considered as a stand-alone project for the Cunha Canal -- one of five options selected on the basis of least cost, maximum improvement in discharge capacity and ease of implementation according to the Economic Analysis of the CAP project document, Annex 9); (iii) extending the project closing date from 30 June 2011 to 31 March 2013 to allow time to complete the studies.

March 2013 Project Restructuring. The level two project restructuring, approved March 22, 2013 included extending the project closing date from March 31, 2013 to August 30, 2013 to allow quality control and appropriate review of the work under the 'Pre-investment Studies for Design of Engineering Works and Supervision of Specific Adaptation Works' and to allow for preparation and completion of a contingency plan, that in compliance with the Safety of Dams policy, would serve in case of an emergency situation of a breach of the East Demerara Water Conservancy.

I. Disbursement Profile



1. Project Context, Development Objectives and Design
1.1 Context at Appraisal

1. At least three-quarters of the Guyanese population of 762,300[1] live in a 30 km band along the Atlantic coast. This is an area of reclaimed lands, much of it below the regional mean sea level. At least 40% of the population resides in Region 4[2,3] Demerara-Mahaica with the majority living along the low-lying coastal plains situated between a water storage basin and a protective seawall complex that includes the City of Georgetown, the capital of Guyana[4]. The East Demerara Water Conservancy (EDWC) and East Coast drainage and irrigation systems together provide water storage and flood control mechanisms, and also allow for bi-annual harvests of rice and sugar sectors that account for approximately 27% of the nation's GDP. The system is however, highly vulnerable to sea level rise and changes in rainfall patterns. Gravity-based drainage systems in these areas are increasingly compromised by rising sea-levels whilst unmanaged developments and poorly maintained infrastructure have limited the efficiency of the system to cope with excess rainfall.

2. Every year floods affect the population of Guyana and in recent years more extreme rain events have also highlighted the vulnerability of the system to catastrophic failure. For example in January 2005, extreme rainfall caused widespread flooding which affected almost half of Guyana's population. It is estimated that total damages from the disaster cost US$ 465 million or 59% of Guyana's Gross Domestic Product for 2004. In addition to regular flooding along the east coast, water levels in the EDWC have also regularly been above safe operating levels, weakening the dam and putting the dam at risk of catastrophic breaching. These flood events highlighted the shortcomings in the infrastructure (the canals, the sluices and the pumps) to drain flood water away quickly enough.

3. Since the devastating 2005 flood, the World Bank (WB) has been working with the GoG and other donor agencies in the development of a comprehensive strategy to increase the drainage capacity of the EDWC and coastal drainage systems, a multimillion effort that requires careful long term planning and close donor inter-agency coordination. This Conservancy Adaptation Project (CAP) was developed as a way to identify key future interventions and provide the donor community with a strategic master plan of pre-designed priority works, generating comprehensive hydrological and topographical datasets as well as hydraulic studies and modelling to inform GoG's decision makers. Strengthening the EDWC system is a top priority for the GoG, who requested WB assistance in accessing GEF resources and supporting its efforts to mitigate the country's vulnerabilities to flooding. The project was one of the first to be funded under the GEF Special Climate Change Fund (SCCF) and that fully met their criteria. The CAP built on the GoG's Initial National Communication to the UNFCCC (2002), the Guyana National Vulnerability Assessment (2002) and the Integrated Coastal Zone Management (ICZM) Action Plan (2000).

4. This project emerged at a time when the Bank had a limited role in the country and was focusing on supporting the country's Poverty Reduction Strategy and debt relief, in the context of the Enhanced HIPC (E-HIPC) of 2000. The Bank's activities were more focused on providing non lending services on core economic and sector work. The GEF Special

[1] 2013, National Statistic Authority.
[2] Based on 2002 Population & Housing Census (www.statisticsguyana.gov.gy/census.html#popcenfinal)
[3] Guyana is divided into 10 regions and sub-divided into neighbourhood councils.
[4] Land use includes agricultural, urban and suburban areas supporting housing and businesses.

Climate Change Fund provided the opportunity to solve a national problem by assessing risk and generating analytical tools to effectively reduce vulnerability of catastrophic flooding.

1.2 Original Project Development Objective (PDO)/Global Environment Objective (GEO) and Key Indicators (as approved)

5. The Project Development Objective was to reduce the Recipient's vulnerability to the catastrophic flooding of its low-lying coastal area due in part to the rise in sea level as a result of global climate change.

6. This PDO was designed to be achieved through:
   - Strengthening of GoGs and donor understanding of the EDWC system and coastal drainage regimes while identifying key drainage regimes for follow-on intervention;
   - Implementing infrastructure investments aimed at increasing the drainage capacity of the EDWC; and
   - Strengthening institutional capacity of the GoG to manage water levels in the EDWC and to guide interventions aimed at reducing Guyana's vulnerability to floods.

7. Accordingly, the Project's original key indicators were:
   1) Development of a hydraulic engineering foundation critical for flood control management;
   2) Identification of at least 10 key drainage regimes for follow-on intervention; and
   3) Increased drainage relief capacity of the EDWC to the Demerara River by 35%.

8. The project Global Environment Objective (GEO) aimed to raise awareness to promote the application of physical infrastructure upgrades to reduce vulnerabilities brought on by climate change.

1.3 Revised PDO (as approved by original approving authority) and Key Indicators, and reasons/justification

9. There were no revisions to the PDO/GEO during the life of the project, although following recommendations from the Project's Mid-Term Review (MTR), a second level restructuring introduced changes to the scope of some of the components and to the PDO indicators. Details are summarized below.

10. This US$ 5 million-project included a contribution of US$ 1.2 million from the Government for widening of key drainage relief canals. The GoG sought external funding/co-financing from donors to secure these resources for the Cunha Canal Rehabilitation works, one of the works under Component 2. In March 2010, an Environmental Assessment (EA) for the Cunha Canal indicated that lands originally conceived as vacant (CAP PAD, section IV Appraisal- e: Environmental Management) were in fact occupied, and that the proposed re-alignment of the canal was encumbered by a fence, a steel bridge and a shed. The evaluation indicated that the proposed works at the Cunha Canal would require triggering the Involuntary Resettlement Safeguard (OP/BP 4.12), and the development of a resettlement plan, which would add considerably to the timeline for this investment.

11. A Mid-Term-Review (MTR) was carried out in June 2010, which considered the recommendations of the EA, and discussed with other partner agencies proposed next steps for implementation. At that time and considering the progress of the project, the UK's

Department for International Development (DfID) had to reallocate funds originally expected to finance works at the Cunha Canal.

12. Based on the final MTR recommendations, a project restructuring included the following revisions to the project: (i) eliminate the Project indicator "increased drainage relief capacity of the EDWC to the Demerara River by 35%" (outcome indicator 3 in the Project Results Framework and Monitoring), to reflect the reality of the project activities, reflecting the focus on providing technical engineering baseline studies to reduce flood vulnerability; (ii) reallocate unused related funds from component 2 to component 1 to cover the costs of the engineering studies, given that the proposed government financed Cunha Canal's work was withdrawn from the project and was considered as a stand-alone project; and (iii) extend the project closing date from 30 June 2011 to 31 March 2013 to allow time to complete the studies. It is worth noting that some funds from component 3 were also reallocated to component 1 for the same engineering studies.

13. The MTR recommended a revision of the PDO/GEO objective to emphasize that the reduction of vulnerability to catastrophic flooding was going to be achieved by "providing a comprehensive engineering baseline and analytical tools allowing Guyana to develop a program of strategic interventions and policies to address recurrent flooding and the anticipated impacts resulting from climate change and sea level rise". This new expanded PDO/GEO would have more explicitly reflected the main objective of supporting the GoG in the reduction of their vulnerability through a program consisting of structural and non-structural measures (i.e. repair of sluices and hydraulic modelling). However, given that the revised wording would not substantially change the PDO, and that the processing of a first order restructuring would have required approval from the GEF council resulting in an implementation delay at a time when moving forward and ensuring successful completion of the engineering designs was critical to meeting project objectives, it was decided to carry out a second order restructuring of the Project, maintaining the safeguards category and the PDO/GEO. A level two restructuring of the project was approved on April 4, 2011.

14. The Cunha Canal rehabilitation project remained a top priority for the country. Funding for this work was obtained from the Guyana REDD+ Investment Fund (GRIF) which was established in October 2010. The project is currently in its final stage of appraisal.

1.4 Main Beneficiaries

15. The beneficiaries identified are the populations located to the north and west of the EDWC dam representing the majority of Guyana's Region 4 population of 310,300[5] (around 40% of Guyana's population, 49% males, 51% females). Included in this population is the capital city, Georgetown with a population of 134,497[6]. The general population and in particular farmers and businesses will benefit because investments made during and resulting from the CAP are designed to help reduce the vulnerability of the highly populated coastal regions to catastrophic flooding, as well as reduce the impact of flooding on agricultural activities, one of Guyana's main products, thus directly affecting GDP.

16. GoG national agencies dealing with drainage and irrigation and disaster risk management also benefit, including the Ministry of Agriculture (MoA), the National Drainage and Irrigation Authority (NDIA), the Office of the President (OP), the MoA Hydrometeorological

[5] 2002 Population & Housing Census www.statisticsguyana.gov.gy/census.html#popcenfinal
[6] 2002 Population & Housing Census Town Level data

service (Hydromet), Guyana Land and Surveys Commission (GL&SC) and the Civil Defence Commission (CDC), Ministry of Works' River and Sea Defence Unit and the Guyana Environmental Protection Agency (EPA) through better flood risk planning capacities, institutional strengthening and enhanced communications between agencies leading to an updated and strengthened national flood control strategy and through the availability and use of new datasets developed in the project;

17. GoG hydraulic engineers and hydrologists have benefitted through training in the operation and maintenance of hydro-meteorological monitoring instrumentation, and the use of new datasets and flow model technology to better plan follow-up interventions and more effectively manage water flows.

18. Indirect beneficiaries include coastal countries of the region (similar mainland areas and Caribbean islands at risk from flooding and sea-level rise) that could benefit from replicating tried and tested models and technologies used and developed within the CAP. The project serves as a demonstration for the development of adaptation interventions that can be implemented in similar contexts.

1.5 Original Components (as approved)

19. The CAP was designed to finance a combination of non-structural and structural measures aiming at reducing the country's vulnerability to flooding. This two-pronged approach involved, on the one hand, the development of a long-term comprehensive set of analytical tools that were needed for the design of a comprehensive flood management program for the coastal lowland drainage system. On the other, a few medium-term rehabilitation works and operational improvements aimed at enhancing the flood control capacity of the EDWC.

20. **Component 1 – Pre-investment studies for engineering design of works** (US$ 2.0 million from GEF). This component was designed to provide the hydrologic baseline necessary for contemplating rational interventions aimed at increasing the current discharge capacity of the flood control system, and included the following sub-components (from CAP, Annex 3, Results Framework and Monitoring):

    i) Detailed topographic and land use mapping;
    ii) Hydrologic modelling of coastal lowlands;
    iii) EDWC hydraulic modelling;
    iv) Assessment of EDWC system integrity;
    v) Pre-feasibility studies for coastal lowland interventions (omitted in the Annex 3 but included in the section II. Project Description); and
    vi) Operational capacity building.

21. One of the key outcomes of the pre-investment studies was a high resolution topographic model of the inhabited coastal plain designed to be used as the basis for hydrologic analysis of the region under observed and projected climate scenarios. The hydrologic analyses were designed to pinpoint key areas where interventions would improve the system discharge capacity critical for flood zone management. Pre-engineering designs for a set of prioritised interventions were also developed under this component. Training in the application of the analytical tools produced under the project was included for specialized staff within the GoG agencies.

22. **Component 2 – Investments in specific adaptation measures** (US$ 2.9 million; US$ 1.7 million from GEF and US$ 1.2 million from GoG). Investments to be made under this component were designed to improve the ability of the GoG to manage water levels behind the EDWC dam during heavy rains by improving internal water flows in the EDWC and increasing EDWC drainage relief capacity to the Demerara River. This component allowed for additional upgrading of water control structures based on the analytical outputs produced in Component 1 and included the following sub-components (from CAP, Annex 3):

    i) Increased discharge capacity of key relief canal form EDWC to Demerara river;
    ii) Improvement of water flow system within EDWC
    iii) Upgrading of water control structures;
    iv) Selected equipment purchase and installation; and
    v) Major infrastructure civil works and operational improvements.

23. The key outcomes of this component include an increased drainage capacity of the EDWC to the Demerara River by roughly 35% (with the exact figure to be finalised during the first year of implementation), and additional investments made by the GoG, through the NDIA, to strengthen the drainage and irrigation infrastructure based on the engineering foundation developed under Component 1.

24. **Component 3 – Institutional strengthening and project management** (US$ 0.1 million from GEF). This component was designed to strengthen the institutional framework for flood control within the context of the national emergency management sector headed by the Civil Defence Commission. The project was designed to also support an institutional consolidation of flood control in Guyana to help create consensus around a medium and long term intervention strategy to help Guyana adapt to sea level rise. Sub-components include (from CAP, Annex 3):

    i) Contingency plan for flood events;
    ii) Institutional Analysis of the Drainage Sector;
    iii) Development of flood control thematic committee (Implementation Secretariat); and
    iv) Donor meeting to be held at project completion.

25. The outcome is to better position the GoG to respond to flood emergencies. The role of the Implementation Secretariat was to consolidate flood control work in Guyana, leading to greater information sharing and institutional memory throughout the government.

1.6 Revised Components

26. The 2011 restructuring involved changes in the three components and sub-components that modified indicators:

- Component 1 was adjusted so that the capacity building activities originally listed under this component were transferred to Component 3.
- Component 2 key outcome and project indicator 3 “increased drainage relief capacity of the EDWC to the Demerara River by 35%” was dropped. This affected component 2.1 – Widening of key drainage relief canals (i.e. Cunha Canal rehabilitation),

withdrawn according to ISR report No.8. The funds of the withdrawn activities were transferred to component 1 to cover additional costs of the engineering studies.

- Component 3 activities and indicators related to institutional analysis of drainage sector was withdrawn and the scope of the Implementation Secretariat reduced. Some funds resulting from these changes were also transferred to component 1.

1.7 Other significant changes

27. As mentioned previously, the 2011 restructuring included some reallocations:

- Unused funds from components 2.2, 2.3, 2.4 and 3.1 were mainly reallocated to component 1 to cover the costs of the engineering studies (see table 1. below).

Table 1: Revised funding allocations following the March 2011 project restructuring

Project Costs (US$ 3.8 million)			
Components/Activities	**Original**	**Revised**	**Variation**
1. Pre-investment studies for engineering design of works			
1.1 System Mapping: Use of topographic and bathymetric mapping to support modelling	1,300	1,440	+140
1.2 Assessment of EDWC system integrity	250	295	+45
1.3 Flow modelling of EDWC system and coastal lowlands for flood control management	300	545	+245
1.4 Pre-feasibility studies - EDWC dam and coastal lowlands drainage analysis and works identification	150	420	+270
Total Component 1	**2,000**	**2,700**	+700
2. Investments in specific adaptation measures			
2.1 Widening of key drainage relief canals	0	0	0
2.2 Improvement of water flow system within EDWC[a]	250	0	-250
2.3 Upgrading of flood control structures	950	400	-550
2.4 Selected equipment purchase and installation	500	460	-40
Total Component 2	1,700	860	-840
3. Institutional strengthening and project management			
3.1 Development of a contingency plan	50	25	-15
3.3 Consensus building and project management	50	165	+115
Total Component 3	**100**	**200**	+100
Total (variation was not allocated)	**3,800**	**3,760**	**-40**

[a] **Internal Flow Model only**

- The project closing date was extended from 30 June 2011 to 31 March 2013 to allow the completion of activities of the study.

28. In March 22, 2013 a second restructuring of the CAP was approved:

- The project closing date was extended from March 31, 2013 to August 30, 2013 to (i) allow quality control and appropriate review of the work under the "Pre-investment Studies for Design of Engineering Works and Supervision of Specific Adaptation Works" and (ii) to allow for preparation and completion of a contingency plan that, in compliance with the Safety of Dams policy, would serve in case of the emergency

situation of a breach of East Demerara Water Conservancy. The latter was not completed within the project time-frame.

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

29. **Soundness of background analysis:** The project concept was developed after the devastating 2005 flood. The fundamental focus of the project was to reduce flood disaster risk. The strategic choices underlying the project design reflect the need to develop a technical baseline as a basis for making rational investment decisions. On this basis, the project design emphasised understanding the hydrological behaviour of the EDWC and East Coast drainage systems, alongside understanding the technical stability of the EDWC dam. The pre-investment studies are essential for proper planning and sighting of key investments.

30. The project design was based on recommendations resulting from previous projects (the 1998 El Nino Emergency Assistance Project P057271 and the 2005 Water Sector Consolidation Project P088030) carried out with the Guyana MoA. The following lessons were taken into account:

- The project aimed at minimizing procurement delays due to poor response leading to re-bidding, higher than estimated bid-costs, inconsistency between bid-evaluation reports and recommendations, small pool of able contractors, system deficiencies including no penalties for delays or poor quality work, and slow decision making by limiting the number of tenders. This was done by bundling all technical tasks under one contract, which reduced and optimized procurement timing and processes. Overall risk for procurement and financial management was considered moderate at appraisal. However, the complexity of the main contract to carry out pre-investment studies and the required local technical and administration capacity may have been underestimated, resulting in contracting delays.
- The institutional capacity of the country was taken into account by limiting the number of contracts in the project, with implementation streamlined and executed by international experts. The implementation capacity at the local level and limited capacity in procurement and financial management were identified at appraisal as a substantial risk.
- Previous attempts to strengthen the capacity of Hydromet (under the 1998 El Niño Emergency Assistance Project) were thwarted by high turnover, lack of knowledge and poor physical condition of Hydromet's facilities, therefore the CAP limited its assistance to Hydromet to donating hydro-meteorological instrumentation for management purposes and training initiatives.

31. **Project Design & Quality:** The implementation arrangements for the project were aimed at maximising cost effectiveness, promoting timely execution and ownership, and ensuring transparency amongst stakeholders. This arrangement consisted of:

- An Implementation Secretariat (IS) responsible for the project oversight and coordination. IS included NDIA, CDC, S&RD and L&SC and was consolidated through an MoU. Advisory members included the MoF, Ministry of Housing and Water, EPA, Hydromet and international donors (observers), with the Minister of Agriculture acting as chair and the MoA Permanent Secretary (PS) as deputy

chairman. The IS was successfully set-up, generally regarded as beneficial but met officially only 4 times. Nevertheless, IS members were involved in all CAP activities including dissemination and training events.

- The Project Execution Unit (PEU) ASDU, housed within the MoA, was responsible for administrative and fiduciary aspects of the project, including payments to contractors. However, the PEU was not funded directly from the project, so had competing priorities. Moreover, the PEU was not familiar with Bank procedures and specific training was not provided. The overall risk for procurement and financial management was considered moderate during appraisal[7] and despite the funding issues, this rating increased to satisfactory near the end of project implementation[8].

32. The PDO was and remains highly relevant to WB and GoG development priorities. The CAP was not included in the CAS issued May 17, 2002 however the catastrophic floods of 2005 and 2006 showed the need for intervention and the development of the CAP. The CAS valid for 2009-2012 was based in part on the goals and objectives of the CAP.

33. Project components were clearly formulated and well-linked to the PDO. However the complexities of the planned structural-investments were underestimated as sub-component 2.1, the main structural investment identified for the project (i.e. the Cunha Canal Rehabilitation), which was to be funded by or through the GoG (according to the PAD), had to be dropped following recommendations made in the MTR, which also pointed to the need to trigger the Involuntary Resettlement Safeguard should the GoG had decided to keep the sub-component. This safeguard could have been triggered as a precautionary measure at appraisal.

34. Some project intermediate indicators were not well defined. For example, only coastal areas in Region 4 were related to achieving the PDO key indicators, therefore Regions 3 and 5 should not have been included in indicator 1.1 (as LiDAR data collection over these other areas would have involved excessive costs). Furthermore, the indicators related to the functioning of the Implementation Secretariat were overly ambitious and not calibrated for purpose and the need of the project, as noted in the mid-term review of June, 2010.

35. It is worth noting that a Bank Quality Assessment of Lending Portfolio (QALP-2)[9] prepared by the Quality Assurance Group (QAG), rated the "Quality of Design" satisfactory overall in June, 2010, around the time the mid-term review mission was taken place. (The details of the QAG assessment are presented under Bank Performance in Section 5.1).

36. **Risk rating:** Overall, project risk was deemed Substantial at appraisal. In retrospect, the rating seems to have correctly gauged the challenges posed to the project. The substantial risks of limited implementation capacity at the local level and capacity in procurement and financial management materialised and were partially mitigated by support and communication with the WB. Regular, localised flooding events did occur throughout the project duration, but major risks were mitigated by continuous GoG maintenance and improvements along the EDWC dam wall and repairs to sluices. In particular the project found that the new GoG Hope-Dochfour canal, due to become operational early in 2014, will

[7] See CAP Project Appraisal Document, Fiduciary section, page 18
[8] See Financial Management Implementation Support and Supervision Report (FISSR) dated April 22, 2013.
[9] Guyana: GY-GEF Conservancy Adaptation Project (P103539) Second Quality Assessment of the Lending Portfolio (QALP-2) – Final Report, June 30, 2010.

significantly lower water levels in the EDWC. Works to further improve the drainage system and rehabilitate the EDWC dam are being considered under a Bank funded DRM project, complementing JICA (dam wall rehabilitation works) and EU (sea wall retrofitting) investments.

2.2 Implementation

37. For most of its lifespan, project implementation was rated Satisfactory (with some Moderately Satisfactory ratings at mid-project).

38. **Factors that supported implementation were:**

- *Strong GoG commitment to the project.* The GoG demonstrated its full commitment to the project objectives through financing of for example (i) the new Hope-Dochfour canal linking the EDWC with the Atlantic Ocean, and (ii) repair and rehabilitation of the EDWC dam and interventions along the East Coast. The CAP financed pontoon and excavator, with additional units provided by JICA, have helped the GoG monitor and immediately repair weaker sections of the dam, considerably improving dam safety. The newly installed hydrometeorological instrumentation and on-line database are used to monitor EDWC water-levels on a near-time basis for improved EDWC management.

- *Continuous GoG and WB collaboration.* The GoG and the WB collaborated closely throughout the project in order to improve implementation performance. The WB provided technical and project management support to the GoG when required. At mid-term review, the project had made substantial progress in strengthening its financial management capacity due to the hiring of additional staff within the PEU. Audit reports were unqualified and there were no internal control issues.

- *Continuous GoG engagement with other donors.* In particular, other donor projects such as those financed through the IDB working with ASDU, helped to build capacity and finance the PEU team.

- *Successful contract awards.* Despite delays, the project benefitted from limiting the number of tenders for the main technical part of the project to one. A further contract for quality control and assurance ensured that project deliverables were at a high standard.

39. **Several factors however, adversely affected project implementation:**

- *A Slow disbursement rate (leading to extensions of the project closing date) was mainly due to procurement and other issues:*
  - Bidding processes were generally lengthy and unsuccessful due to a limited number of bids and / or excessive costs which required re-bidding or extension of deadlines. The main contract covering engineering studies, which represented more than 60% of funds, was awarded almost two years after effectiveness.
  - Technical reviews were lengthy due to the highly technical nature of the project.
  - The PEU was not familiar with Bank procurement procedures and didn't receive training.
  - Initial disbursement arrangements which did not include a Designated Account that would have facilitated operational expenses.
  - Other secondary effects such as delayed primary data collection in two wet seasons and LiDAR data collection in the dry season due to the procurement delays (in contracting and procurement of equipment).

2.3 Monitoring and Evaluation (M&E) Design, Implementation and Utilization

40. Monitoring and evaluation was mainstreamed under all project components through: (i) contract compliance, (ii) project implementation and (iii) impact monitoring. The PEU (ASDU) managed procurement, performance monitoring and acceptance certification. An external engineering firm with expertise in water projects, mapping and surveying was recruited to monitor and evaluate progress and project results. The Bank worked closely with the PEU and retained the services of the engineering firm to follow project implementation and review progress reports presented by the main contractor.

    The 2010 Mid-Term Review (MTR) was a turning point in project implementation. The team focused on: (i) progress in achieving outcomes; (ii) institutional arrangements for project implementation; (iii) effectiveness and suitability of the monitoring system; and (iv) review of project implementation plan, disbursement schedule and operation manual. The MTR mission recommended to: (i) adhere to the reviewed project implementation schedule, (ii) withdraw the Cunha canal rehabilitation works given the uncertainty of funds availability and newly identified resettlement issues, (iii) redefine the PDO/GEO and expected indicators subject to GoG decision, and (iv) extend the project closing date. Progress towards achievement of the Global Environmental Objectives and Implementation Progress was at the time rated Moderately Satisfactory. The last ISR (No. 11) dated May 2013 rated both GEO and Implementation progress Satisfactory.

2.4 Safeguard and Fiduciary Compliance

Safeguard compliance

41. The project is a Category B project. The following safeguards policies were triggered at appraisal.
    - Environmental assessment (OP/BP/GP 4.01)
    - Natural Habitat (OP/BP 4.04)
    - Forest (OP/BP 4.36)
    - Safety of dams (OP/BP 4.37)

42. *Environmental Safeguards*

    Environmental requirements for small maintenance works were applied in the form of contract clauses.

43. In accordance with the Environmental Implementation Plan (EIP) (from the initial EA), an environmental and social assessment of the proposed Cunha Canal works was completed in March 2010. The findings were incorporated in the draft construction TORs for the project and the GoG advanced on the recommendations in the report with respect to resettlement requirements (by preparing a draft resettlement plan). The EA was reviewed by the Bank and comments were incorporated into the final document.

44. With respect to Natural Habitat (OP/BP 4.04) and Forest (OP/BP 4.36) safeguards, the project did not involve interventions with respect to forests and natural habitats and no such activities were contemplated. The project included activities impacting Safety of dams (OP/BP 4.37) but these activities related to the assessment of the integrity of the EDWC dam and the development of engineering data not physical interventions.

45. *Social Safeguards*

The triggering of the Involuntary Resettlement safeguard (OP/BP 4.12) was not foreseen during the design of the project but the March 2010 EA for the rehabilitation of the Cunha Canal indicated that this safeguard was necessary. The safeguard was not triggered however, as the rehabilitation of Cunha Canal (component 2.1) was removed from the project because of: (i) the complexity of the land-tenure issues related to the Cunha Canal, (ii) the subsequent withdrawal of donor funding and related financial uncertainties and (iii) completion of the component within the time-frame of the project.

Fiduciary Compliance

46. No major fiduciary issues requiring Government or Bank attention emerged throughout the Project implementation period, as corroborated by audit reports and procurement post-reviews.

47. *Financial Management.* At project closing, the overall Financial Management was rated as Satisfactory.

2.5 Post-completion Operation/Next Phase

48. The key indicator of success and sustainability of the project is the follow-on financing to climate change-proof the EDWC and other conservancy systems. The CAP generated a portfolio of recommended discrete and strategic investments totalling approximately US$ 123 million (see Table 2. below).

Table 2: Summary of all investment recommendations resulting from the Conservancy Adaptation Project

Description of Proposed Interventions	Cost US$
EDWC Interventions:	**45,000,000**
Excavations within EDWC (widening of channel from Flagstaff to Kofi, connectivity channels)	40,000,000
Optimization of Demerara drainage (works, dredging, channel upgrading)	5,000,000
EDWC dam upgrading:	**54,002,500**
Reconstruction of the Northeast dam	12,780,000
Reconstruction of North dam	9,220,000
Reconstruction of East dam	10,800,000
Reconstruction of West dam	9,200,000
Heavy Earth Moving Plant equipment	12,000,000
Dam inspection & maintenance equipment	2,500
East Coast drainage interventions:	**20,048,000**
Liliendaal: Additional pumping capacity	1,130,000
Ogle: Additional pumping capacity	2,328,000
Embankment raising between pump station & outfall koker	21,000
Mon Repos/Annandale	
Additional pumping capacity at Good Hope	2,019,000
Additional pumping capacity at Lusignan	2,052,000
Additional pumping capacity at Annandale	2,062,000
Enterprise/Strathspey/Paradise	
New pump station 1 + culverts + channel widening	1,189,000
New pump station 2 + culverts + channel widening	7,190,000
Additional pumping capacity at Hope + culverts + channel widening	2,057,000
East Coast drainage interventions (separation of urban & agricultural drainage):	**4,735,000**
Mon Repos/Annandale	1,200,000
Enterprise/Strathspey/Paradise	1,600,000
Beehive/Clonbrook	435,000
Montrose/Sparendaam	1,500,000
Safety improvements to existing water control structures	**730,000**
Total	**123,385,500**

49. The GoG is planning to initially finance CAP follow-up investments totalling US$11.89 million from the IDA-16 allocation for a Disaster Risk Management Project (P147250, Board presentation scheduled May 20, 2014). The works being considered for the project given the available financing, involve the reconstruction of part of the EDWC North-East dam, identified during CAP as the part of the dam in most need of attention and/or the installation of 3 new pumping stations in catchments along the East Coast.

50. Furthermore, the Cunha Canal Rehabilitation project (P132408) for US$ 2.51 million is being developed as a stand-alone project through the Guyana REDD+ Investment Fund (GRIF) and is scheduled for presentation on April 15, 2014.

51. The CAP was designed in close collaboration with the donor community and is being used by the GoG to guide future interventions aimed at minimising flood risk in the EDWC and East Coast. A meeting held with the donor community (WB, EU, JICA, and IDB) at project completion (January 22, 2014) indicated that there is continued interest from the donor community in using the technologies developed during the project for follow-up work (e.g. LiDAR and DEM) as well as financing of specific works recommend by the studies.

52. The WB is also considering supporting the development of a proposed umbrella Climate Resilience Strategy and Action Plan for Guyana project through technical assistance.

53. The results of the CAP are being disseminated and communicated using an ACP-EU Global Facility for Disaster Reduction and Recovery (GRDRR) Grant (TF013119, Strengthening Guyana's Coastal Land's Information Systems and Adaptation Awareness) for US$260,000 with the objective of improving knowledge and awareness of Guyana's flood control efforts. Dissemination activities under the grant have included: the development of a technically accurate animation describing the EDWC and East Coast drainage systems for public dissemination; a further technical animation aimed at decision makers explaining in a visual way the results of the modelling study; and a booklet showcasing the technologies developed under the project and various stakeholder workshops. A further dissemination workshop is planned for March 2014.

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design and Implementation

54. The PDO and GEO remain highly relevant and are consistent with the current Bank strategy, country strategy (CAS) as well as Guyana's national development plan, the 2013-2018 Disaster Risk Management Plan for the Agricultural Sector, and for drainage and irrigation master-plan for Region 4 up to 2030.

3.2 Achievement of Project Development Objectives

55. The original key project development objectives were partially achieved:

- The project successfully delivered substantive non-structural vulnerability reduction measures aiming to reduce Guyana's vulnerability to catastrophic flooding in the long run. The baseline hydrological assessment of the EDWC and East Coast drainage areas as well as technical studies identifying follow-up investment strategies and designs were fully completed, as originally proposed. The relevance of the pre-investment studies is exemplified by the follow on US$123 million of investments that has been developed, and that is to be partially financed by IDA, REDD and GRIF among others.

- As indicated above, potential mid-term structural measures originally proposed under the project to be financed by or through the GoG, namely the rehabilitation of the Cunha Canal, did not materialized, but are to be funded by other sources. Other structural measures, such as the upgrading of the flood control structures (i.e. complete rehabilitation of the two Lama sluices) were successfully completed and selected equipment (i.e. a pontoon barge and excavator) was purchased. These directly contributed to reducing flood risk by increasing the drainage capacity of EDWC and facilitated the mobilization of equipment to repair critical sections of dam, and respond to dam slips and breaches. Additionally, the hydro-meteorological instrumentation was purchased and installed enabling real-time management of EDWC water-levels, and contributing to the national weather-forecasting program..

56. In terms of key PDO indicators:

(i) **Indicator 1 – Completed:** A **hydrologic engineering foundation** suitable for contemplating rational investments aimed at increasing the current discharge capacity of the flood control system was developed for both the EDWC and East Coast drainage systems using aerial surveys including LiDAR and aerial photography, ground-truthed using a network of ground-control benchmarks.

- Hydrological and hydraulic models were set up, calibrated and verified against observed datasets to understand water movement within the EDWC system.
- Geotechnical studies of the EDWC dam enabled an assessment of its current stability and highlighted areas in critical need of repair.
- An assessment was made of the reliability with which the EDWC can meet the water demands placed on it and an operations manual for the EDWC was developed including flood management, water resources operation, maintenance and monitoring.
- An Environmental Assessment was developed for the proposed construction activities using EPA guidelines.

(ii) Indicator 2 – Completed: During the project, 11 key drainage regimes for follow-on intervention were identified **and pre-engineering studies for 14 interventions were completed along Region 4's East Coast**. A multi-criterion analysis (based on frequency of flooding, rate of dissipation, population, affected agricultural area and infrastructure/agricultural significance) was used to prioritize and select drainage regimes to be carried forward to the modelling stage. Pre-engineering studies were also completed for additional drainage interventions from EDWC into the Demerara River (modifications to the Kofi canal and internal drainage system) and for the rehabilitation of the EDWC dam.

(iii) Indicator 3 – Dropped at March 2011 Project restructuring

In addition to the above, the project also achieved the following:

- The results and investments identified under the CAP have contributed to and have been incorporated within the GoG drainage and irrigation master-plan for Region 4;
- Inter-agency coordination at the national level has been strengthened through continuous involvement in all aspects of the project, dissemination activities and training events;
- Capacity of GoG personnel related to disaster risk management has improved due to training in hydro-met instrumentation installation, monitoring and data usage, processing and use of LiDAR datasets, hydrological modelling and dam safety;
- The national hydro-meteorological network has been improved. Hydro-meteorological instrumentation purchased under the project consisted of 8 automatic tipping-bucket raingauges, 29 water level sensors and loggers and 1 Acoustic Doppler Current Profiler to measure flows. The raingauges and water level sensors include an inbuilt telemetry system. Data from the instrumentation is automatically sent via a phone signal to an internet data repository where it is available to policy makers, planners and conservancy managers on a near-real basis. The instrumentation has been handed over to Hydromet and now forms part of the national monitoring system;
- Improved access to information systems for DRM-related planning due to the availability of the new LiDAR and DEM datasets and the new on-line hydro-met database; and

- Raised awareness of flood risk through Project dissemination activities funded through the ACP-EU GFDRR including workshops, animations, brochures and publications.

Please see Annex 2 for summary table of outputs.

3.3 Efficiency

57. Rating: **Satisfactory**

58. **Project Outcome Impact.** The Conservancy Adaptation Project (CAP) had positive impact in Guyana and its population, as it has: a) reduced the risk of overflow of EDWC; b) made more efficient the operational system of the EDWC; and c) provided tools to the GoG for planning and managing climate change events.

59. During appraisal, the economic analysis used a cost effectiveness approach to evaluate subprojects in Component 2, and specifically one related to the works of widening of the drainage Cunha Canal. This subproject, among 5 alternatives considered, was never implemented and was withdrawn from the project and therefore it was not evaluated in this analysis. Instead, the economic evaluation for this ICR was carried out for works actually implemented.

60. Overflow or dam-breach risk reduction was obtained through the rehabilitation of the two Lama sluices, which have enabled the conservancy to drain more water when needed, thereby lowering water levels and reducing the pressure upon the dam. Additionally, operation of the EDWC improved through the acquisition of equipment, such as: a) a new punt, pontoon and excavator that made it easier and faster to access and repair areas of the dam, b) a hydro-meteorological monitoring system, which contributes to the management of water levels in EDWC on a near real-time basis.

61. Details of the calculations and methodologies employed in the Economic analysis are given in full in Annex 3.

62. a) The *Avoided Cost Approach* for the rehabilitation works and heavy-duty equipment involves comparing the costs incurred in the operation of the two sluices, and use of equipment for maintenance of the dam before Project implementation and after. For example, before rehabilitation, the Lama sluices had to be opened with an excavator, at a higher cost and with less reliability than after rehabilitation. Similarly, before the punt and pontoon were purchased, in order to carry out repairs to the dam, an excavator was needed to be located, hired and brought to the EDWC then transported by pontoon to the relevant site, a procedure which could take several days.

63. The results of the analysis show that the savings in operating costs alone are twice as high as the costs of rehabilitation and purchase of the heavy-duty equipment and that the return on the investments is 29%.

64. Even though the results are satisfactory, the actual benefits of overflow and dam-breach risk reduction are huge and go beyond any savings made on operating costs, yet the magnitude of the project's contribution towards risk-reduction could not be quantified. Past events have caused severe damages and any risk reduction is significant. The most vulnerable area if

overflow or a dam-breach occurs is the coastal area of Region 4, which has a population of about 300 thousand (40% of total population of Guyana).

65. b) *Benchmarking Methodology.* This approach was used to calculate the potential benefits of investing in a hydro-meteorological system, and is based on a study by Hallegatte (2012)[10] using the country's GDP.

66. When applied to the 2007 GDP of Guyana (US$ 1.7 billion), the results show that the likeliest benefit expected in Guyana from hydro-meteorological services is close to US$ 1 million per year; US$ 59 thousand of those correspond to avoided asset losses, and US$ 870 thousand correspond to additional economic gains in weather related sectors. Improvement in the use of the services could benefit up to US$ 3.7 million if strong management practices were adopted.

67. To quantify the net benefits expected from the hydro-meteorological system, the flow of annual benefits were projected during the life-time of the system (estimated as 10 years), and compared with the flow of costs of the system[11] during the same period. The results show that net benefits for the low-estimate scenario are almost twice as much as the costs for the hydro-meteorological system; and are 16 times higher in the likely scenario. Net benefits are between US$ 134 thousand and US$ 4.6 million, with returns from 21% to 293%. If additional improvements are achieved, benefits will grow as well.

68. *Additional benefits from the CAP:* These are associated with strengthening of the GoG for planning and managing flood risk, which will give assurance to sustainability of future interventions. Moreover, the engineering studies financed under the project will allow GoG prioritizes investment in critical areas and coordinate the use of funds that may become available from donors. These studies generated a portfolio of investments amounting US$123 million, including drainage interventions on the East Coast for a 1:50 year event and for the EDWC dam for a 1:10,000 year event.

3.4 Justification of Overall Outcome Rating

69. Rating: **Moderately Satisfactory**

70. The outcome rating reflects the satisfactory and moderately satisfactory ratings of the assessment of progress towards PDO achievement in the ISR reports. The project design and objectives remained highly relevant during project implementation. Most of the project indicators were achieved or partially achieved. This is reflected in the development of a hydrologic engineering foundation and the identification and recommendation of 14 most-effective engineering works to be carried out within 11 key drainage regimes along the East Coast, within the EDWC drainage system itself and recommendations and designs for EDWC dam rehabilitation. Despite the withdrawal of a GEO indicator that implied the cancellation of related intermediate outcome indicators, the results of the project are contributing to the GoG drainage and irrigation master-plan for Region 4 that contains at least 40% of the population and the capital city of Georgetown. Recommendations and designs are helping

[10] Hallegatte, Stéphane, 2012. *A Cost Effective Solution to Reduce Disaster Losses in Developing Countries: Hydro-Meteorological Services, Early Warning, and Evacuation*, World Bank Policy Research Working Paper #6058

[11] The costs include investment cost of the hydromet system, training of personnel, and a portion of the strengthening activities addressed by the GoG, plus 5% of maintenance.

guide future investments by both the GoG and other bilateral and multilateral financial institutions.

3.5 Overarching Themes, Other Outcomes and Impacts

(a) Poverty Impacts, Gender Aspects, and Social Development

71. The project's main results involve the development of a technical engineering foundation for reducing the risk of flooding in Guyana's low lying coastal area. As such, it has limited direct impacts on poverty, gender and social developments, but the medium and long term impacts on all of these sectors will be significant due to the follow-up projects (such as DRM and Cunha Canal Rehabilitation Projects). Since disasters affect the poor disproportionally, follow-up projects will contribute to the increased resilience of these more vulnerable substrata within the general population and will benefit both men and women equally for the reduction of flood risk.

(b) Institutional Change/Strengthening

72. The project contributed to institutional capacity-building through training workshops (in the use of hydro-monitoring instrumentation, modelling, data acquisition and storage, use of LiDAR data, etc.) and fostered inter-agency co-operation and communication, initially through the formation of the Implementation Secretariat and then through targeted workshops and meetings.

(c) Other Unintended Outcomes and Impacts (positive or negative)

73. The project helped to promote GoG drainage and irrigation sector activities and raise awareness of the functioning of the EDWC system through a complementary project, the US$260,000 ACP-EU GFDRR grant (TF013119), which funded the communication activities of the project. Two short visually accurate animations, one for a general audience introducing the EDWC, and a one for policy makers to visually communicate the results of the project are being developed under the grant. In addition, a booklet showcasing the techniques applied in the project was developed, and various stakeholder workshops and public dissemination activities are in progress.

74. The LiDAR data is being used by the GoG for various other purposes (e.g. development and planning) and there is interest in replicating the technologies used within the project for other conservancies around Guyana. Further workshops on the use and application of LiDAR data are being planned with the GoG under the GFDRR grant. There is government interest in developing a data-storage and data-sharing platform (such as GeoNode) to make data such as the LiDAR and DEMs developed within the project, easily available to government agencies and other interested parties. The DEM produced by the project will be useful in many applications, including as a basis for further modelling studies, line of sight studies, biomass measurements, 3D building-modelling, further climate change impact studies and visualisations, and land-use planning.

75. The hydro-monitoring instrumentation has been incorporated within the national hydro-monitoring network. The availability of near real-time data sets are helping the GoG monitor water levels in the conservancy for management purposes and indicate areas where dredging of channels is required.

76. The excavator and pontoon bought under the project have been used in the Conservancy for emergency repairs and for other works and has a beneficial impact.

3.6 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops

77. On Jan 22, 2014, a meeting was held in the MoA with representatives of MoA, MoF, NDIA, ASDU and WB to present and discuss the findings of this ICR and the comments received have been incorporated into this report. The participants commented on various sections of the report. Overall, participants found the meeting useful for reviewing project implementation progress and felt the lessons learned could be incorporated into new project designs (DRM and Cunha rehabilitation projects). Please refer to Annex 6 for details.

4. Assessment of Risk to Development Outcome

78. Rating: **Moderate**

79. The GoG has demonstrated a strong commitment to improving flood risk within the most populated coastal areas. Examples in the EDWC include (i) the development of the new Hope-Dochfour canal (ii) the rehabilitation of sections of dam, and (iii) securing additional donor funding (JICA) for excavation equipment and sluice rehabilitation. The CAP recommended engineering works to improve drainage in the EDWC and East Coast of the project are already being incorporated in follow-up activities (DRM and Cunha Canal Rehabilitation Projects) and are helping to shape the upcoming GoG comprehensive Drainage and Irrigation Masterplan Plan. However, there is a possibility that the implementation of the proposed investments and the identification of funding may not take place in a timely manner. There is also the possibility that during the implementation of follow-up activities, new floods could divert government attention from the need to formulate and/or implement a longer term strategic flood control plan.

80. Based on the above and taking into account the operational, sector and country context, the likelihood that changes may negatively affect the development outcome of the CAP are considered moderate.

5. Assessment of Bank and Borrower Performance

5.1 Bank Performance

(a) Bank Performance in Ensuring Quality at Entry

81. Rating: **Moderately Unsatisfactory**

82. The CAP project design reflects both innovation and effective response to client needs. It was designed to finance a combination of non-structural and structural measures aiming are reducing the country's vulnerability to flooding. The Project design was focused on the development of a long-term comprehensive set of analytical tools that were needed for the design of a comprehensive flood management program for the coastal lowland drainage system, and on a lesser scale on few medium-term rehabilitation works and operational improvements aimed at enhancing the flood control capacity of the EDWC. There was a close and continued collaboration between the WB and the GoG as well as the donor community during project preparation.

83. The project objective remains relevant. However, given the context, difficulties during implementation and the need for project restructuring to withdraw key activities, lead to conclude that the project objective was overambitious. Indicators were adequate but needed to be adjusted to reflect these changes.

84. The above would call for a Satisfactory rating. However, the rating also takes into account the following:
    - The core of the Project was designed with non-structural risk reduction activities. The envisioned interventions[12] of widening of key drainage relief canals such as the Kofi Canal, which operated under-capacity due to restrictions caused by sedimentation and vegetation growth and possibly widening of the Cunha Canal, were based on feasibility and availability of funds. A more in-depth assessment of the potential structural measures being considered would have likely resulted in the precautionary triggering of the Involuntary Resettlement Safeguard (OP/BP 4.12), during the preparation stage of the project;
    - A more realistic assessment of the incremental staffing and training that would be required could have facilitated implementation.
    - The modelling studies and technologies that were ultimately financed under the project were highly sophisticated and required advanced technical expertise. The project ultimately completed the technical studies that were necessary and delivered the proposed results, greatly strengthening the capacity of counterpart agencies. However, the technical level of support that was required was much higher than originally envisioned.
    - Project implementation could have been more efficient if arrangements had been made to directly finance technical, financial and administrative staff to be devoted to the project.
    - As indicated previously (2.1 Project Preparation, Design and Quality at Entry), some project intermediate indicators were not well defined (only Region 4 was related to PDO) or overly ambitious (the Implementation Secretariat did not function as expected).

85. In June 2010, QAG's assessment rated the project quality of design as satisfactory overall. The report indicates that the team did a very good diagnostic analysis in identifying the main weaknesses in past flood control practices and identified clearly that a systems approach was needed to replace the existing water management practice. According to QAG, the team also correctly noted that a thorough planning study and systems modelling were necessary. However, the assessment also found that the design was less than satisfactory in the development objectives, which were too broadly defined, and in the results framework, which lacked baseline data. These weaknesses later showed to impact the implementation of the project.

(b) Quality of Supervision

86. Rating: **Moderately Satisfactory**

87. The rating reflects recognition that supervision missions were generally both timely and solution-oriented, and that the Bank team closely supported the GoG throughout implementation. There was at least one supervision mission per year and supporting grant was mobilized for communications. The 2011 restructuring adequately addressed all the issues that were identified in the Mid-term Review; and the project was extended to allow the completion of the engineering studies.

88. The rating also reflects the technical and administrative limitations experienced in the project causing delays in the hiring process. These may have been mitigated by providing

[12] As described in the CAP, Annex 16 GEF STAP Review and other sections of the PAD.

uninterrupted technical supervision of the main engineering studies and timely procurement training.

89. In June 2010, QAG's assessment rated the project quality of Bank supervision satisfactory overall. The report reads "the Bank team has been very focused on the need for effective strategic planning as key to sustainability of the water management system and the prospect of avoiding floods". The report also mentions that the aide memoirs provided clear and candid reporting of the main issues, which were also well summarized in the ISRs. The report found less consistency between ISRs' supervision reporting and certain ratings and sub-ratings, "in particular in FY08 and FY09 when the task team was a year late in signalling an MS rating for implementation status".

(c) Justification of Rating for Overall Bank Performance

90. Rating: **Moderately Satisfactory**

91. The overall rating takes into account the WB moderately unsatisfactory performance in ensuring quality at entry and moderately satisfactory quality of supervision.

5.2 Borrower Performance

(a) Government Performance

92. Rating: **Satisfactory**

93. The rating is based on consideration of MoF's sustained commitment to the project and PDO achievement. The GoG, mainly through MoF and MoA, consistently supported the project implementation and dissemination of results, and has requested and supported the development of follow-on projects.

(b) Implementing Agency or Agencies Performance

94. Rating: **Moderately Satisfactory**

95. The rating reflects the performance and commitment of the PEU to achievement of the PDO. The PEU was involved in all aspects of the project including stakeholder consultations. Despite initial staffing and financial management computing issues (due to the project not directly funding the unit), and slow disbursement level (due to procurement delays), the project financial management at closing and implementation progress were rated Satisfactory[13]. The continued support of the implementing agencies towards successful delivery of the project is evidenced by the partial achievement of the original PDO/GEO and the preparation of follow-up projects.

(c) Justification of Rating for Overall Borrower Performance

96. Rating: **Moderately Satisfactory**

97. The overall borrower performance rating is based on a combination of GoG and implementing agency moderately satisfactory performance.

[13] See ISR 1 and Financial Management Implementation Support and Supervision Report (FMISSR) dated April 22, 2013

6. Lessons Learned

98. There are several lessons to be learned from the CAP as described below.

Project design: (i) It is recommended that all future projects enable the use of a Designated Account as a mode of disbursement and budget should be made available to directly fund staff under the project; (ii) a detailed procurement plan should be established at appraisal for all key components of the project, especially those that directly impact the timing of other project components (such as equipment purchase, key contracts); (iii) TOR specifications should incorporate close and continued technical supervision to avoid delays and/or misunderstandings; and (iv) technical review of the project should run throughout project implementation and include aspects for quality control.

Contract awards: Use of a single contract award, to implement large parts of the project, facilitated implementation and ensured consistency across deliverables.

Training: Provisions for continuous training, practice and supervision (e.g. data acquisition, hydrological modelling, GIS) should be incorporated throughout the life-span of the project minimising the use of one-off workshops or training events.

Communication: The CAP communication plan was funded by a GFDRR grant. It was found that this helped to regularly disseminate the results of the project, facilitate knowledge transfer, boost coordination and inform future activities. It is highly recommended that all future projects incorporate a communication/dissemination plan.

Technical baseline: The remote sensing technologies and modelling methods used in the project have been tested in the CAP, and can be replicated for other regions in Guyana or in other Caribbean countries with similar situations. Development of a technical foundation for risk analysis conducive to rationalising key-investment strategies is a necessary step in reducing flood risk.

7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners

The GoG participated in a meeting to discuss the ICR report in January 2014 (see section 3.6 and Annex 6) and their comments have been included in this ICR report. The GoG has reviewed this report and have no further comments.

Annex 1. Project Costs and Financing

(a) Project Cost by Component (in US$ Million equivalent)

Components	Appraisal Estimate (US$ millions)	Actual/Latest Estimate (US$ millions)	Percentage of Appraisal
Component 1 Pre-investment studies for engineering design of works	2.0	2.0	40%
Component 2 Investments in specific adaptation measures	2.9	2.9	58%
Component 3 Institutional strengthening and project management	0. 1	0.1	2%
Total Project Costs	**5.0**	**5.0**	**100%**

(b) Financing

Source of Funds	Type of Cofinancing	Appraisal Estimate (US$ millions)	Actual/Latest Estimate (US$ millions)	Percentage of Appraisal
GEF Funds	Grant	3.8	3.8	76%
Borrower	In kind	1.2	1.2	24%
Total Project Costs		5.0	5.0	100%

Annex 2. Outputs by Component

COMPONENT 1: Pre-investment studies for engineering design of works				
Indicator	**Baseline Value**	**Original Target Values (from approval documents)**	**Formally Revised Target Values**	**Actual Value Achieved at Completion or Target Years**
Indicator 1.1:	Detailed topographic and land use mapping The LiDAR data were used to create a high resolution Digital Elevation Model (DEM)			
Value	0	100%		70%
Indicator 1.2:	Hydrologic modeling. 1D-2D models were created and validated based on observations, then used to understand water flow under scenarios of extreme rainfall and to test the impact of proposed interventions.			
Value	0	100%		100%
Indicator 1.3:	Assessment of EDWC system integrity (Dam measurements). Geotechnical measurements and modeling of the dam enabled areas in critical need of attention to be identified.			
Value	0	100%		100%
Indicator 1.4:	Assessment of EDWC system integrity (Leveling and bathymetry). Surveys were undertaken to assess the depth of water in the EDWC and cross-sectional areas of canals and channels.			
Value	0	100%		100%

COMPONENT 2: Investments in specific adaptation measures				
Indicator	**Baseline Value**	**Original Target Values (from approval documents)**	**Formally Revised Target Values**	**Actual Value Achieved at Completion or Target Years**
Indicator 2.1a:	Increased discharge capacity of key relief canal from EDWC to Demerara River (widening of key canal). This was to be accomplished by rehabilitating the Cunha Canal.			
Value	0	100%	0	0
Indicator 2.1b:	Increased discharge capacity of key relief canal from EDWC to Demerara River (doubling discharge capacity). This was to be accomplished by rehabilitating the Cunha Canal.			
Value	0	100%	0	0
Indicator 2.1c:	Increased discharge capacity of key relief canal from EDWC to Demerara River (increase discharge capacity by 35%). This was to be accomplished by rehabilitating the Cunha Canal.			
Value	0	100%	0	0
Indicator 2.2:	Improvement of water flow system within EDWC-internal flow model complete. Modeling of the EDWC to understand internal conveyance was completed and recommendations made to improve the system.			
Value	0	100%		100%
Indicator 2.3:	Upgrading of EDWC control structures. Two sluices at Lama were rehabilitated under the project.			
Value	0	100%		100%
Indicator 2.4:	Selected equipment purchase and installation. Equipment included hyro-meteorological instrumentation (8 raingauges, 38 water level sensors and loggers and an ADCP); a punt and pontoon barge; a long boom excavator; and office and survey equipment.			
Value	0	100%		100%
Indicator 2.5:	Major infrastructure civil works and operational improvements plan developed. Recommendations were made within the project for managing and maintaining the EDWC. Discrete investments totaling US$123 million were identified for both the EDWC and East Coast drainage areas.			
Value	0	100%	0%	100%

COMPONENT 3: Institutional strengthening and project management				
Indicator	**Baseline Value**	**Original Target Values (from approval documents)**	**Formally Revised Target Values**	**Actual Value Achieved at Completion or Target Years**
Indicator 3.1:	Contingency plan for flood events. An Emergency Preparedness Plan (EPP) to be developed for the EDWC (to cover e.g. dam breaches)			
Value	0	100%		0%
Indicator 3.2:	Institutional analysis of the drainage sector. Related to Indicator 3.1, clear lines of responsibility to be allocated to GoG institutions for managing the Conservancy in an Emergency situation.			
Value	0	100%	0%	0%
Indicator 3.3a:	Development of flood control thematic committee – IS established and operational to consolidated flood control work in Guyana, and to encourage information-sharing.			
Value	0	100%		50%
Indicator 3.3b:	Development of flood control thematic committee – 10 IS meetings held.			
Value	0	100%	0%	40%
Indicator 3.3c:	Development of flood control thematic committee – 3 annual reports by IS			
Value	0	100%	0%	0%
Indicator 3.3d:	Development of flood control thematic committee – Prioritization strategy. The results of the CAP informed the national drainage and irrigation masterplan for Region 4 (valid up to 2030).			
Value	0	100%	0%	100%
Indicator 3.4	Donor meeting to be held at project completion to disseminate project results.			
Value	0	100%		100%
Indicator 3.5:	Operational capacity building. Workshops and training events were held for GoG staff on GPS data acquisition, processing and bathymetry, the use of monitoring instrumentation; data collection; dam safety; and hydrological modeling.			
Value	0	100%		100%

Annex 3. Economic Analysis

Project Outcome Impact: The Conservancy Adaptation Project (CAP) had a positive impact in Guyana and its population, as it has: a) reduced the risk of overflow or dam breach of EDWC; b) made more efficient the operational system of the EDWC; and c) provided tools to the GoG for planning and managing climate change events.

Overflow or dam-breach risk reduction was obtained through the rehabilitation of the two Lama sluices, which have enabled the conservancy to drain more water when needed, thereby lowering water levels and reducing the pressure upon the dam. Additionally, operation of the EDWC improved through the acquisition of equipment, such as: a) a new punt, pontoon and excavator that made it easier and faster to access and repair areas of the dam, b) a hydro-meteorological monitoring system, which contributes to the management of water levels in EDWC on a near real-time basis.

The economic evaluation for this ICR was carried out for works actually implemented under the project and therefore does not include the rehabilitation of the Cunha Canal under Component 2.1, which was withdrawn following MTR. The two methodologies used for this evaluation are: a) the "avoided cost approach" for both the rehabilitation works (i.e. the rehabilitation of the two Lama Sluices) and the heavy-duty equipment purchased (i.e. excavator, punt and pontoon); and b) the "benchmarking approach" for the hydro-meteorological system. For other activities, such as the technical and modelling studies, the benefits are qualified, but not quantified

a) The Avoided Cost Approach for the rehabilitation works and heavy-duty equipment involves comparing the costs incurred in the operation of the two sluices, and use of equipment for maintenance of the dam before Project implementation and after. For example, before rehabilitation, the Lama sluices had to be opened with an excavator, at a higher cost and with less reliability than after rehabilitation. Similarly, before the punt and pontoon were purchased, in order to carry out repairs to the dam, an excavator was needed to be located, hired and brought to the EDWC then transported by pontoon to the relevant site, a procedure which could take several days.

The costs associated with those practices were estimated as follows:

a) excavator hire: GD$ 10,000/hour;
b) excavator operator: GD$ 5,000/day;
c) mobilization costs: GD$ 500,000;
d) contractor's pontoon/barge; GD$ 75,000; and
e) 30% for supervision, fuel, and others.

The excavator required a minimum of three days hire: a day to mobilize it, a day to work with it; and a third day to demobilize. The whole operation is therefore valued at around GD$ 2 million, or US$10,000. According to information provided by the operators of the EDWC, it was normal procedure during the raining season to hire at least two excavators at least 6 times per year, or more, depending on the severity of the rains. For this evaluation, the cost was estimated based on the normal use of 6 times per year and costs for the rehabilitation of the sluices and purchase of the heavy-duty equipment included an additional 2% operating costs. All costs were transformed to 2007 prices.

The results show that the savings in operating costs alone are twice as high as the costs of rehabilitation and purchase of the heavy-duty equipment and that the return on the investments is 29% (see Table i).

Table i: Rehabilitation of Sluices and Purchase of heavy-duty Equipment vs Operating Costs before Project

Description of equipment and rehabilitation	Present Value of Flows (000 US$)			IRR[a]	B/C[b]
	Costs	Benefits	Net Benefit		
Fabrication of Punt and Pontoon; Hydraulic Excavator; Rehabilitation of Lama Sluices 1 and 2	543	1,229	686	29%	2.26

[a] *Internal Rate of Return*
[b] *Benefits/Costs*

Even though the results are satisfactory, the actual benefits that come along with overflow and dam-breach risk reduction are huge and go beyond any savings made on operating costs, yet the magnitude of the project's contribution towards risk-reduction could not be quantified. Past events have caused severe damages and any risk reduction is significant. The most vulnerable area if overflow or a dam-breach occurs is the coastal area of Region 4, which has a population of about 300 thousand (40% of total population of Guyana). Past events that have caused flooding and overflowing of the EDWC dam which have created significant damages to the population. Heavy rains occurred in January-February 2005 which, according to the Economic Commission for Latin America and the Caribbean (ECLAC), affected 37% of the total population and caused damages worth US$ 465 million, or 59 percent of Guyana's Gross Domestic Product (GDP)14. Damages were the result of flooding due to above average rainfall and overtopping in some areas of the EDWC dam. In lowland areas, floodwaters persisted for nearly a month and the death toll reached 34, of which 27 were due to water borne diseases. One year later, floods caused by rainfall during December 2005-February 2006, generated further damages worth US$ 30 million according to ECLAC15.

b) *Benchmarking Methodology*. This approach was used to calculate the potential benefits of investing in a hydro-meteorological system, and is based on a study by Hallegatte (2012)[16] using the country's GDP. The study's results show that the total potential benefits from upgrading the hydro-meteorological data system and early-warning capacities of developing countries to developed countries standards include: (i) between US$ 300 million and 2 billion

[14] UNDP-ECLAC 2005. Subregional Headquarters for the Caribbean. *Guyana. Macro-Socioeconomic Assessment of the Damage and Losses Caused by the January-February 2005 Flooding*.
[15] UNDP-ECLAC 2006. *Guyana. The impact on Sustainable Livelihoods Caused by the December 2005-February 2006 Flooding.* October.
[16] Hallegatte, Stéphane, 2012. *A Cost Effective Solution to Reduce Disaster Losses in Developing Countries: Hydro-Meteorological Services, Early Warning, and Evacuation*, World Bank Policy Research Working Paper #6058

per year of avoided asset losses due to natural disasters; (ii) an average of 23,000 saved lives per year, which is valued between US$ 700 million and 3.5 billion per year using the Copenhagen Consensus guidelines; and (iii) between US$ 3 and 30 billion per year of additional economic benefits.

The methodology states that to achieve the assumed benefits, investments would be required in: (1) local observation systems; (2) local forecast capacity; (3) increased capacity to interpret forecasts and translate them into warnings; (4) communication tools to distribute and disseminate information, data, and warnings; and (5) institutional capacity building and increased decision-making capacity by the users of warnings and hydro-meteorological information. The CAP provided the platform for future improvement and investments in all of these critical areas.

Hallegate estimated benefits from early warning and preparation measures in three categories: a) reduction of asset losses; b) reduction of human losses; and c) other economic benefits such as productivity enhancements.

a) *Reduction of asset losses:* The study found that a well-functioning (European-like), modern early warning system reduces disaster-related asset losses by between 0.003% and 0.017% of GDP.

b) *Reduction of human losses:* Not applicable here as this evaluation did not include the benefit of reducing the loss of human lives, due to lack of information

c) *Other economic benefits.* The study found that hydro-meteorological services adds gains between 0.1 and 1% in weather-sensitive sectors, which would be approximately equal to between 0.025 and 0.0025% of GDP in European-like countries.

The study found that developing countries do not operate or respond to the hydro-meteorological services the same way as European Countries, and so the expected benefits are lower. The share of losses actually avoided depends on the income level of the country, as follows: i) for low-income countries only 10% of the benefits are achieved; ii) for lower middle income countries; 20% of the benefits are achieved; iii) for upper middle income, 50% of the benefits are achieved; and iv) for high income countries 100% of benefits are achieved. In the case of Guyana, as a lower middle country, 20% of the benefits are expected as a realistic scenario. If Guyana improves the use of these tools making them fully operational and population responds to the weather information as directed by the weather agencies, benefits could increase until they reach European-like countries. The room for additional benefits is significant as shown in Table ii. The likeliest benefit for European-like countries for reducing asset losses and from other economic gains is about 0.27% of the GDP; while in a lower middle country as Guyana is expected to be 0.05%.

Table ii: Comparison of Expected Benefits from Hydro-meteorological Systems in European-like Countries and Guyana (% GDP)

Benefits from the Hydro-meteorological system	Estimated Benefits for European-Like Countries (% GDP)		Actual Benefits expected for Guyana (% of GDP)[a]	
	Low Estimate	Likely Estimate	Low Estimate	Likely Estimate
Avoided assets losses	0.003%	0.017%	0.0006%	0.003%
Other Economic benefits	0.025%	0.250%	0.0050%	0.050%
Total	0.028%	0.267%	0.0056%	0.0534%

[a] *The actual benefits expected for Guyana are estimated as 20% of benefits for European-like Countries.*

When these percentages are applied to the 2007 GDP of Guyana (US$ 1.7 billion), results show that the likeliest benefit expected in Guyana from hydro-meteorological services is close to US$ 1 million per year; US$ 59 thousand of those correspond to avoided asset losses, and US$ 870 thousand correspond to additional economic gains in weather related sectors. Improvement in the use of the services could add benefit up to US$ 3.7 million if strong management practices were adopted (Table iii).

Table iii: Annual Benefits Expected from the Hydro-Meteorological System in Guyana

Benefits from the Hydro-meteorological system	Actual benefits expected for Guyana (000 US$)per year		Additional Benefits from improved services (strong management practices) (000 US$) per year	
	Low Estimate	Likely Estimate	Low Estimate	Likely Estimate
Avoided assets losses	10	59	42	237
Economic benefits	87	870	348	3,481
Total	97	929	390	3,717

Note: GDP 2007 was US$ 1,740 million.

To quantify the net benefits expected from the hydro-meteorological system, the flow of annual benefits were projected during the life-time of the system (estimated as 10 years), and compared with the flow of costs of the system[17] during the same period. The results show that net benefits for the low-estimate scenario are almost twice as much as the costs for the hydro-meteorological system; and are 16 times higher in the likely scenario. Net benefits are

[17] The costs include investment cost of the hydromet system, training of personnel, and a portion of the strengthening activities addressed by the GoG, plus 5% of maintenance.

between US$ 134 thousand and US$ 4.6 million, with returns from 21% to 293% (see Table iv). If additional improvements are achieved, benefits will grow as well.

Table iv: Results of the Economic Evaluation of the Hydro-meteoroloigical System

Scenarios	Present Value of Flows (000 USD)			IRR[a]	B/C[b]
	Costs	Benefits	Net Benefit		
Low estimate	413	697	134	21%	1.69
Likely Estimate	413	6,643	4,633	293%	16.07

[a] *Internal Rate of Return*

[b] *Benefits/Costs*

Additional benefits from the CAP: These are associated with strengthening of the GoG for planning and managing flood risk, which will give assurance to sustainability of future interventions. Moreover, the engineering studies financed under the project will allow GoG prioritizes investment in critical areas and coordinate the use of funds that may become available from donors. These studies generated a portfolio of investments amounting US$123 million, including drainage interventions on the East Coast for a 1:50 year event and for the EDWC dam for a 1:10,000 year event.

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
Lending			
Ana F. Daza	Language Program Assistant	LCSUW	ACS
Marc S. Forni	Consultant	LCSUW	Economist
Francis Ghesquiere	Task Team Leader	LCSUW	DRM Specialist
Patricia Lopez Martinez	Senior Infrastructure Finance	LCSUW	Infrastructure
Gerald E. Meier	Consultant	LCSUW	Environment
Supervision/ICR			
Nancy N. Agwu	Finance Analyst	CTRLD	Finance
Jocelyne Albert	Sr Regional Coordinator	LCSES	GEF Coordinator
Sylvie Debomy	Sr Urban Specialist	LCSDU	Urban Specialist
Ross Alexander Gartley	Consultant	LCSDU	DRM Specialist
M. Mozammal Hoque	Sr Financial Management Specialist	LCSFM	Financial Management
Gerald E. Meier	Consultant	LCSDU	Infrastructure
Judith C. Morroy	Consultant	LCSHH	Procurement
Ulrich Cedric Myboto	Consultant	LCSDU	DRM Specialist
Emmanuel N. Njomo	Consultant	LCSFM	Financial Management
Jason Jacques Paiement	Social Development Specialist	LCSSO	Social Specialist
Luis Tineo	Senior Operations Officer	GFDRR	Operations
Yingwei Wu	Senior Procurement Specialist	LCSPT	Procurement

(b) Staff Time and Cost

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	US$ Thousands (including travel and consultant costs)
Lending		
FY07	3.54	80.37
FY08	5.4	30.48
Total:	8.94	110.85
Supervision/ICR		
FY07	0	0.00
FY08	3.15	21.51
FY09	5.51	49.38
FY10	10.50	84.56
FY11	9.21	69.47
FY12	9.77	54.68
FY13	11.15	48.97
FY14	1.03	11.89
Total:	**50.32**	**340.47**

Annex 5. Beneficiary Survey Results

Not applicable.

Annex 6. Stakeholder Workshop Report and Results

A stakeholder workshop was held in Georgetown, Guyana on Jan 21, 2014 at the Ministry of Agriculture to discuss the findings of the ICR.

A total of 14 participants were involved:

- 5 WB staff
- 3 MoA
- 2 MoF
- 3 NDIA
- 2 ASDU

By means of introduction, participants were shown a 5 minute animation produced under the ACP-EU GFDRR grant, introducing the EDWC, which was well received. A presentation was then given on the proposed contents of the various sections of the ICR report. Each section of the report was discussed and comments made are noted below.

The ICR findings were well received. In addition, some points were raised during the meeting as follows:

(i) **Indicators:** The original project design was larger in scope and aimed to collect LiDAR data over Regions 3, 4 and 5, but the budget restricted LiDAR coverage to the coastal areas of Region 4 where most of the population lives. The project intermediate indicators 1.1 and 1.2 should therefore have been altered to reflect these changes. Despite the problem with the indicators, it was felt that the LiDAR data adequately covered the area of interest.

(ii) **Training:** It was felt that additional training both on the use of LiDAR data and in hydrological modelling would be beneficial and necessary for future planning purposes. The LiDAR training to be carried out under GRDRR grant was welcome and the incorporation of a soft component in the planned DRM project was discussed.

(iii) **EPP:** As the Emergency Preparedness Plan (EPP) relating to the EDWC was not completed within the project timeframe, there was interest in including this component in the planned DRM project.

(iv) **Operational Capacity:** The point was made that the PEU would have functioned better with direct resources made available from the project.

(v) **Consultancy contract:** Additionally, with hind-sight, it would have been beneficial to secure the availability of the Quality Assurance / Quality Control / LiDAR and Geodesy Support consultant throughout out project implementation.

(vi) **Consultancy contract:** PEU payments to the main contractor were initially to be based on deliverables not progress reports, but this was not accurately reflected and resulted in modifications having to be made to the contract at a later stage.

(vii) **Contract management:** It was mentioned that contract management needs to be planned well upfront to ensure there are no delays within project implementation.

The participants comments made during the meeting have been incorporated into this report.

Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR

The GoG participated in a meeting to discuss the ICR report in January 2014 (see section 3.6 and Annex 6) and their comments have been included in this ICR report. The GoG has reviewed this report and have no further comments.

Annex 8. Comments of Cofinanciers and Other Partners/Stakeholders

Not Applicable.

Annex 9. List of Supporting Documents

Government of Guyana, Environmental Protection Agency. 2000. Final Report On A Socio-Economic Assessment Of The Vulnerability Of Guyana's Coast.

Government of Guyana, Environmental Protection Agency. 2002. Guyana's National Vulnerability Assessment to Sea Level Rise.

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UNDP ECLAC (In collaboration with IICA). 2005. Guyana Socio-Economic Assessment of the Damages and Losses caused by the January – February 2005 Flooding.

UNDP ECLAC (In collaboration with IICA). 2006. Guyana The Impact on Sustainable Livelihoods Caused by the December 2005 – February 2006 Flooding.

World Bank. 2002. Country Assistance Strategy of the World Bank Group for the Cooperative Republic of Guyana. Report No. 24073-GUA.

World Bank. 2005. Guyana: Preliminary Damage and Needs Assessment Following the Intensve Floods of January, 2005.

World Bank. 2009. Country Assistance Strategy for Guyana for the Period FY2009-2012. Report No. 47983-GY.

GUYANA

CONSERVANCY ADAPTATION PROJECT

UPPER WATERSHED AREA
BUILT-UP AREA
CANAL
CANAL UNDER CONSTRUCTION
SLUICES
RIVERS
MAIN ROADS
SECONDARY ROAD

ATLANTIC OCEAN

GEORGETOWN

Demerara

Mosquito Hall

Hope Dochfour Canal

Kofi Canal

Land of Canaan Canal

Cunha Canal

Flagstaff (EDWC headquarters)

EAST DEMERARA WATER CONSERVANCY STORAGE AREA

Mahaica

Lama Sluices

Lama

Maduni Sluice

EAST DEMERARA WATER CONSERVANCY UPPER WATERSHED AREA

Linden Road

Cheddi Jagan (Timehri) International Airport

Maduni

Demerara

Linden Road

To Linden

58°20'W
58°10'W
58°0'W
6°50'N
6°40'N
6°30'N
6°20'N
6°10'N

0 1 2 Miles
0 1 2 Kilometers

GSDPM Map Design Unit

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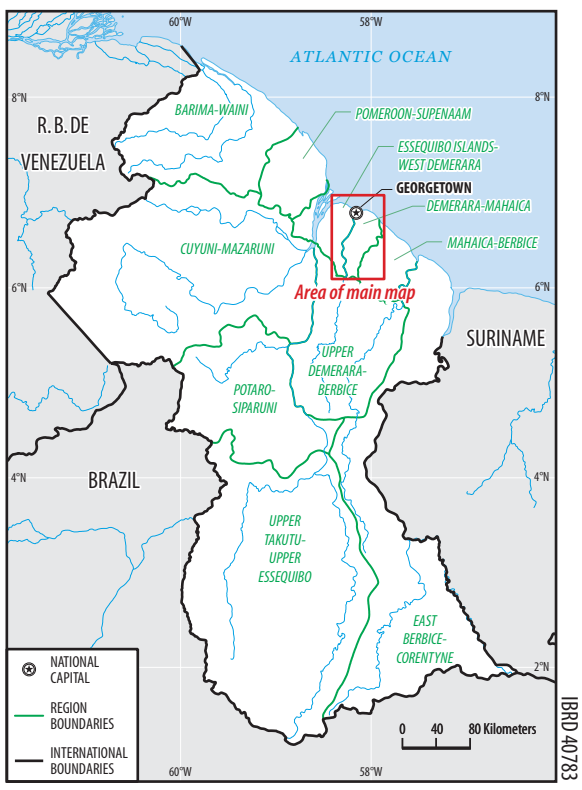
MARCH 2014



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