

zDocument of  
The World Bank

Report No: ICR00002281

IMPLEMENTATION COMPLETION AND RESULTS REPORT  
(IBRD-47420 TF-53359)

ON A

LOAN  
IN THE AMOUNT OF US\$128.0 MILLION

AND A

GLOBAL ENVIRONMENTAL FACILITY GRANT  
IN THE AMOUNT OF US\$10.0 MILLION

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR A

GUANGDONG PEARL RIVER DELTA URBAN ENVIRONMENT PROJECT

June 22, 2012

Sustainable Development Department  
China and Mongolia Country Department  
East Asia and Pacific Region

## CURRENCY EQUIVALENTS

(Exchange Rate Effective December 31, 2011)

Currency Unit = RMB Yuan  
RMB Yuan 1.00 = US\$ 0.1587  
US\$ 1.00 = RMB Yuan 6.3

FISCAL YEAR  
January 1 – December 31

## ABBREVIATIONS AND ACRONYMS

AMS	Automatic Monitoring Stations
BOD	Biochemical Oxygen Demand
BOT	Build-Operate-Transfer
CAS	Country Assistance Strategy
COD	Chemical Oxygen Demand
CPS	Country Partnership Strategy
DBO	Design-Built-Operate
EDZ	Economic Development Zone (of Guangzhou)
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GDPMO	Guangdong Project Management Office
GEF	Global Environmental Facility
GEO	Global Environmental Objective
GDEIC	Guangdong Environmental Information Center
GDEPB	Guangdong Environmental Protection Bureau
GETEC	Guangzhou Environmental Technical Engineering Company
GSTC	Guangzhou Sewerage Treatment Company
GSWMC	Guangzhou Solid Waste Management Center
GWAB	Guangzhou Water Affairs Bureau
GWIG	Guangzhou Water Investment Group
GWSC	Guangzhou Water Supply Company
GZEDZ	Guangzhou Economic Development Zone
GZEPB	Guangzhou Environmental Protection Bureau
GZMFB	Guangzhou Municipal Finance Bureau
GZPMO	Guangzhou Project Management Office
ICR	Implementation Completion Report
IPCAP	Industrial Pollution Control Action Plan
M&E	Monitoring and Evaluation
NH3-N	Ammonia
NPV	Net Present Value

O&M	Operation and Maintenance
PAD	Project Appraisal Document
PAP	Project Affected People
PDO	Project Development Objective
PIU	Project Implementation Unit
PRD	Pearl River Delta
PRD2	Guangdong Pearl River Delta Urban Environment Project II (Ln. 4856)
PRDCP	Pearl River Delta Clean-up Plan
PSP	Private Sector Participation
QAG	Quality Assurance Group (of the Bank)
RAP	Resettlement Action Plan
SS	Suspended Solids
TOR	Terms of Reference
TP	Total Phosphorus
WWTP	Wastewater Treatment Plant

Vice President:	Ms. Pamela Cox, EAPVP
Country Director:	Mr. Klaus Rohland, EACCS
Sector Manager:	Mr. Mark Lundell, EASCS
Project Team Leader:	Mr. Sing Cho, EASCS
ICR Team Leader:	Mr. Victor Vazquez Alvarez, EASIN

**CHINA**  
**Guangdong Pearl River Delta Urban Environment Project**

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MAP IBRD32949R



A. Basic Information			
Country:	China	Project Name:	Guangdong Pearl River Delta Urban Environment Project
Project ID:	P075728,P084003	L/C/TF Number(s):	IBRD-47420,TF-53359
ICR Date:	06/04/2012	ICR Type:	Core ICR
Lending Instrument:	SIL,SIL	Borrower:	PEOPLE'S REPUBLIC OF CHINA
Original Total Commitment:	USD 128.00M,USD 10.00M	Disbursed Amount:	USD 126.89M,USD 9.99M
Environmental Category: A,A		Focal Area: I	
Implementing Agencies: Guangdong World Bank Financed Projects Management Office, Department of Finance			
Cofinanciers and Other External Partners:			

<b>B. Key Dates</b>				
<b>Guangdong Pearl River Delta Urban Environment Project - P075728</b>				
Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	12/05/2002	Effectiveness:	11/30/2004	11/30/2004
Appraisal:	12/09/2003	Restructuring(s):		02/05/2010
Approval:	06/08/2004	Mid-term Review:	06/06/2007	09/08/2008
		Closing:	12/31/2009	12/31/2011

<b>CN-GEF Guangdong PRD Urban Env - P084003</b>				
Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	12/05/2002	Effectiveness:		
Appraisal:		Restructuring(s):		02/05/2010
Approval:	06/08/2004	Mid-term Review:	06/06/2007	09/10/2008
		Closing:	12/31/2009	12/31/2011

<b>C. Ratings Summary</b>	
<b>C.1 Performance Rating by ICR</b>	
Outcomes	Moderately Satisfactory
GEO Outcomes	Moderately Satisfactory
Risk to Development Outcome	Substantial

Risk to GEO Outcome	Substantial
Bank Performance	Moderately Satisfactory
Borrower Performance	Moderately Satisfactory

## C.2 Detailed Ratings of Bank and Borrower Performance (by ICR)

Bank	Ratings	Borrower	Ratings
Quality at Entry	Moderately Unsatisfactory	Government:	Moderately 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

### Guangdong Pearl River Delta Urban Environment Project - P075728

Implementation Performance	Indicators	QAG Assessments (if any)	Rating:
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA)	S
Problem Project at any time (Yes/No):	Yes	Quality of Supervision (QSA)	None
DO rating before Closing/Inactive status	Moderately Satisfactory		

### CN-GEF Guangdong PRD Urban Env - P084003

Implementation Performance	Indicators	QAG Assessments (if any)	Rating:
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA)	S
Problem Project at any time (Yes/No):	Yes	Quality of Supervision (QSA)	None
GEO rating before Closing/Inactive Status	Moderately Satisfactory		

## D. Sector and Theme Codes

### Guangdong Pearl River Delta Urban Environment Project - P075728

	Original	Actual
<b>Sector Code (as % of total Bank financing)</b>		
Sewerage	88	88
Solid waste management	7	7
Sub-national government administration	5	5

<b>Theme Code (as % of total Bank financing)</b>		
Other financial and private sector development	17	17
Other human development	17	17
Other urban development	33	33
Pollution management and environmental health	33	33

<b>CN-GEF Guangdong PRD Urban Env - P084003</b>		
	<b>Original</b>	<b>Actual</b>
<b>Sector Code (as % of total Bank financing)</b>		
Sewerage	70	70
Solid waste management	11	11
Sub-national government administration	19	19
<b>Theme Code (as % of total Bank financing)</b>		
Environmental policies and institutions	29	29
Other human development	14	14
Other urban development	28	28
Pollution management and environmental health	29	29

## **E. Bank Staff**

<b>Guangdong Pearl River Delta Urban Environment Project - P075728</b>		
<b>Positions</b>	<b>At ICR</b>	<b>At Approval</b>
Vice President:	Pamela Cox	Jemal-ud-din Kassum
Country Director:	Klaus Rohland	Yukon Huang
Sector Manager:	Mark R. Lundell	Keshav Varma
Project Team Leader:	Sing Cho	Thomas L. Zearley
ICR Team Leader:	Victor Vazquez Alvarez	
ICR Primary Author:	Victor Vazquez Alvarez	

<b>CN-GEF Guangdong PRD Urban Env - P084003</b>		
<b>Positions</b>	<b>At ICR</b>	<b>At Approval</b>
Vice President:	Pamela Cox	Jemal-ud-din Kassum
Country Director:	Klaus Rohland	Yukon Huang
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## F. Results Framework Analysis

### Project Development Objectives (from Project Appraisal Document)

Improve the quality of the environment in key cities in the Pearl River Delta, by following an integrated regional planning approach, in order to facilitate continued economic and social development.

### Revised Project Development Objectives (as approved by original approving authority)

n.a.

### Global Environment Objectives (from Project Appraisal Document)

Reduce pollution loading to the Pearl River Delta and South China Sea through increased inter- and intra-municipal environmental services delivery. Improve water quality data for PRD and South China Sea. Reduce pollution loading to the Pearl River Delta and South China Sea through increased private sector participation in environmental services delivery.

### Revised Global Environment Objectives (as approved by original approving authority)

n.a.

#### (a) PDO Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
<b>Indicator 1 :</b>	Increased percentage of domestic wastewater collection and treatment			
Value (quantitative or Qualitative)	Wastewater volume treated: 50%	Wastewater volume treated: 90%		Wastewater volume treated: 97%
Date achieved	01/29/2004	12/31/2009		12/31/2011
Comments (incl. % achievement)	The indicator refers to wastewater treated in the GSTC service area (6 districts out of 12 in Guangzhou city), of the total wastewater collected. Therefore, the percentage of wastewater treated is 97%.			
<b>Indicator 2 :</b>	Increase pre-treatment of industrial wastewater before discharge, and relocation of highly polluting industries			
Value (quantitative or Qualitative)	Compliance with discharge standard: 90%	Compliance with discharge standard: 95%		Compliance with discharge standard: 95%
Date achieved	01/29/2009	12/31/2009		12/31/2011
Comments (incl. % achievement)	Achievement of this indicator was not directly linked to a project component and was not closely monitored during implementation. No information is available on how many or types of industries relocated.			
<b>Indicator 3 :</b>	Increased collection and treatment of hazardous waste			
Value (quantitative or Qualitative)	Quantity of hazardous waste treated and disposed of within Guangzhou= 0 tons/year	Quantity of hazardous waste treated and disposed of=45,000 tons/year		Quantity of hazardous waste treated and disposed of=0 tons/year

Date achieved	01/29/2004	12/31/2009		12/31/2011
Comments (incl. % achievement)	The hazardous waste facility was not 100% completed at Loan closing. Problems with this indicator are discussed in Section 2.3.			
<b>Indicator 4 :</b>	Strengthen financial sustainability of wastewater services			
Value (quantitative or Qualitative)	Average wastewater tariff is Y0.70/m3	Average wastewater tariff is Y1.50/m3		Average wastewater tariff is Y1.07/m3 as of July 2009
Date achieved	01/29/2004	12/31/2009		12/31/2011
Comments (incl. % achievement)	Financial viability has improved, but was not achieved to full extent. Only O&M and part of financial costs are covered with total revenues, but not the provision for depreciation as required by the financial covenant. Y2.94/m3 is necessary to cover depreciation.			
<b>Indicator 5 :</b>	Strengthen hazardous waste fees and charges to cover collection and disposal costs			
Value (quantitative or Qualitative)	1,800 Yuan/ton	2,500 Yuan/ton		Facility not completed, but full cost recovery plan prepared.
Date achieved	01/29/2004	12/31/2009		12/31/2011
Comments (incl. % achievement)				

**(b) GEO Indicator(s)**

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
<b>Indicator 1 :</b>	Improve quality monitoring and data-sharing for environmental management			
Value (quantitative or Qualitative)	No firm plan to improve quality monitoring or data-sharing existed	Installation of water quality information equipment, data and decision-making support systems		Monitoring station completed and system populated with data
Date achieved	01/29/2004	12/31/2009		12/31/2011
Comments (incl. % achievement)	The database is up and running, but data-sharing is limited compared to the amount of data collected.			
<b>Indicator 2 :</b>	Piloting of improved and expanded infrastructure facilities constructed and operated by more than one local government in PRD			
Value (quantitative or Qualitative)	No evidence of inter-municipal cooperation taking place in planning and implementation of environmental infrastructure	Two to three pilot projects completed and in operation		Two pilots were completed to serve four districts in two cities
Date achieved	01/29/2004	12/31/2009		12/31/2011
Comments (incl. % achievement)	A third pilot subproject proposed in the PAD was dropped when it did not meet appraisal standards; another was dropped due to repeated procurement failures.			

achievement)	
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**(c) Intermediate Outcome Indicator(s)**

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
<b>Indicator 1 :</b>	Percentage of samples from key PRD rivers meeting Chinese surface water quality standard (of Class III) increased gradually			
Value (quantitative or Qualitative)	58%	80%		70.4%
Date achieved	01/29/2004	12/31/2009		12/31/2011
Comments (incl. % achievement)	This indicator measures not only the effect of project-financed activities, but also the effects of other factors outside the scope of the project that affected the target values, such as non-point pollution sources.			
<b>Indicator 2 :</b>	Establish shared environmental infrastructure facilities designed, constructed and operated jointly by neighboring municipal districts			
Value (quantitative or Qualitative)	No shared facilities in PRD Region	At least two to three facilities in operation		Two facilities constructed, but only one in operation
Date achieved	01/29/2004	12/31/2009		12/31/2011
Comments (incl. % achievement)	It is not clear how this indicator differs from GEO indicator #2, so the same comments apply.			
<b>Indicator 3 :</b>	Improve and expand hazardous waste treatment and disposal services for Guangzhou metropolitan area			
Value (quantitative or Qualitative)	No hazardous waste treatment facility exists in Guangzhou - 0 tons per year	Quantity of hazardous waste treated and disposed of is 45,000 tons/year.		Quantity of hazardous waste treated and disposed of is 0 tons/year.
Date achieved	01/29/2004	12/31/2009		12/31/2011
Comments (incl. % achievement)	It is not clear how this indicator differs from PDO indicator 3. The same comments apply.			
<b>Indicator 4 :</b>	Strengthen institutional arrangements for managing and financing wastewater sector in Guangzhou city			
Value (quantitative or Qualitative)	Wastewater services are part of a municipal department without dedicated staff, inventory of assets, and financial autonomy	Guangzhou wastewater utility corporatized, and financial and institutional capacity is sustainable		New wastewater company established, but is still operating under a deficit.
Date achieved	01/29/2004	12/31/2009		12/31/2011
Comments (incl. % achievement)	Company established with capacity development of staff well underway; however the tariff is not able to recover O&M and depreciation costs.			

achievement)	
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## G. Ratings of Project Performance in ISRs

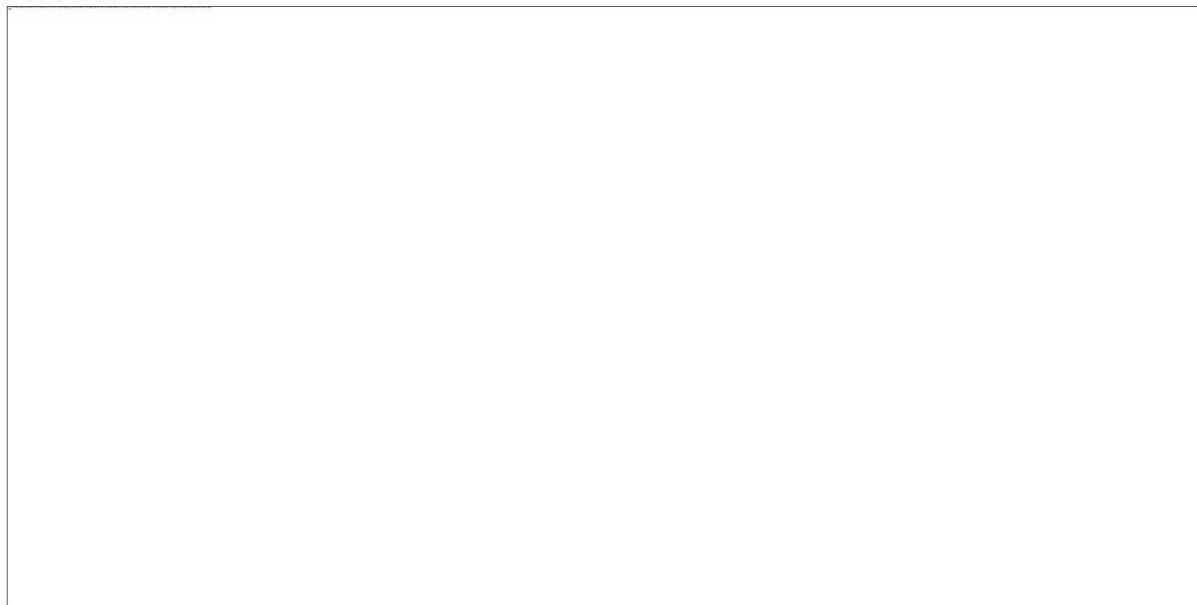
-						
No.	Date ISR Archived	DO	GEO	IP	Actual Disbursements (USD millions)	
					Project 1	Project 2
1	06/25/2004	S	S	S	0.00	0.00
2	12/08/2004	S	S	S	0.64	0.00
3	04/22/2005	S	S	S	0.64	0.00
4	09/09/2005	S	MS	S	10.12	0.00
5	01/10/2006	S	S	S	13.93	0.00
6	11/15/2006	S	S	S	41.86	0.18
7	11/06/2007	MS	MS	MS	52.82	0.30
8	02/07/2009	MS	MS	MS	59.40	0.55
9	10/28/2009	U	MU	U	63.74	0.75
10	03/16/2010	U	MU	U	66.71	0.77
11	10/22/2010	MS	MS	MS	68.64	1.97
12	01/10/2012	MS	MS	MS	95.02	5.83

## H. Restructuring (if any)

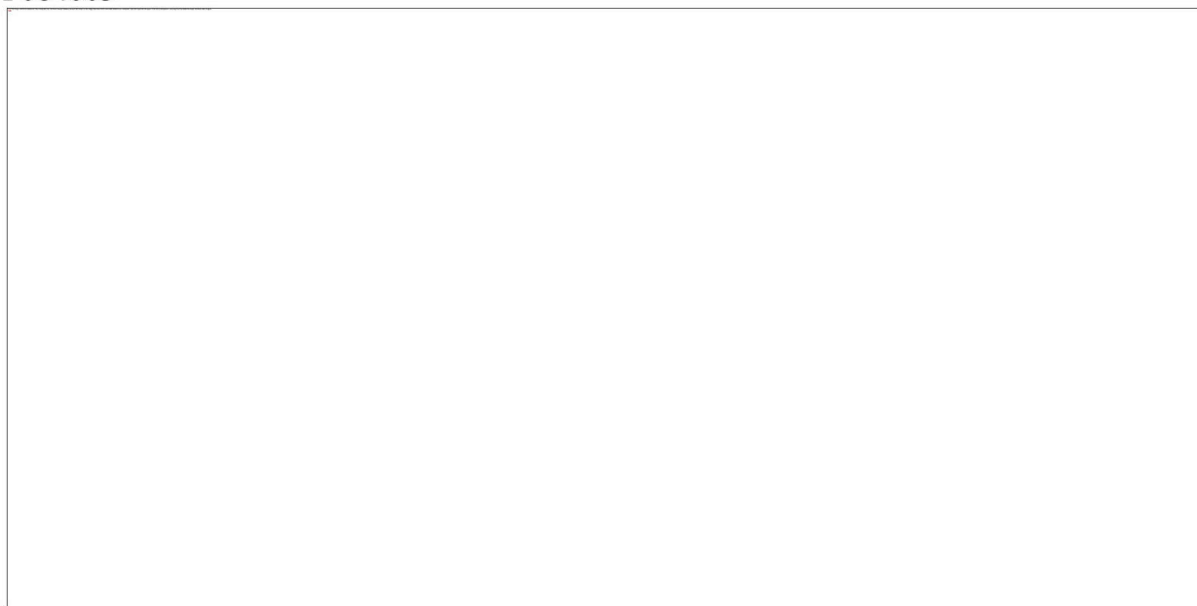
Restructuring Date(s)	Board Approved		ISR Ratings at Restructuring			Amount Disbursed at Restructuring in USD millions		Reason for Restructuring & Key Changes Made
	PDO Change	GEO Change	DO	GEO	IP	Project1	Project 2	
02/05/2010			U		U	66.71		
02/05/2010				U	U		0.77	

## I. Disbursement Profile

P075728



P084003





## 1. Project Context, Development Objectives, Global Environment Objectives and Design

### 1.1 *Context at Appraisal*

Guangdong Province is an economic powerhouse, led by its Pearl River Delta (PRD) region, which, from 1990 to 2000, witnessed **phenomenal economic growth**, driven predominantly by the manufacturing sector. GDP was rising by an average of 14.7 percent annually, and in 2002, Guangzhou made the highest contribution to the GDP of the Province, with US\$80.5 billion equivalent. However, **the PRD's rapid economic growth came at a heavy environmental cost**. Water quality in many stretches of the Pearl River was worse than Class V standard (Chinese water classification system is explained in Annex 10), which made the river system unsuitable for irrigation, aquaculture, or even recreational use. It also contributed to serious pollution of the South China Sea.

**Domestic and industrial wastewater.** The main sources of pollution entering the river were from untreated domestic and industrial wastewater and non-point sources. In 2000, total wastewater generation (domestic and industrial) was estimated at about 11.5 million m<sup>3</sup>/day. Projections for 2010 were about 12.3 million m<sup>3</sup>/day, of which 17% was from industry. In 2004, the total treatment capacity in the PRD was only about 2.6 million m<sup>3</sup>/day, or approximately 28% of domestic wastewater. By 2010, it was expected that the wastewater treatment capacity in the PRD would increase by 8.8 million m<sup>3</sup>/day to 11.4 million m<sup>3</sup>/day. To reduce industrial wastewater, an Industrial Pollution Control Program (2005-2015) was put in place to monitor and control industrial discharges from 179 polluting industries, including the relocation of the worst polluting industries. Another problem arising in the wastewater sector was the proper treatment and disposal of sludge.

A related problem for water and wastewater services was the **institutional and financial viability** of the sector institutions. Although Guangzhou Sewerage Treatment Company (GSTC) had just been created at appraisal, the institution was still weak and could not collect its own revenues through tariffs. Rather, the Guangzhou Municipal Finance Bureau (GMFB) collected fees for its services, then reallocated the revenues to its various municipal departments, including GSTC, to carry out operations and maintenance (O&M). There was little awareness of the importance of cost recovery, financial planning and budgeting.

**Hazardous waste.** Another environmental problem was the growing volume of hazardous waste and illegal dumping, which posed considerable risks to public health and to surface and ground water. During preparation, there was one hazardous waste treatment plant in Shenzhen, and construction of incinerators was being considered by other PRD municipalities. In 2005, Guangzhou was generating about 224,900 tons of hazardous waste annually, most of which was shipped away for treatment and disposal, except approximately 3,300 tons that were incinerated by one private incinerator in Guangzhou. This situation was costly and unsustainable and capacity needed to be built.

**Regional planning** for environmental infrastructure in the PRD was based on narrow administrative boundaries rather than drainage catchments or rational planning. The PRD Clean-up Plan (PRDCP) called for the construction of 162 wastewater treatment plants (WWTPs), but the expected result was a proliferation of uneconomic small capacity plants requiring high capital and recurrent costs. Planning at that time did not adequately emphasize regional considerations, economies of scale and

least-cost strategies. Making planning more difficult was the fact that regulation and enforcement of water quality standards were hampered by uncoordinated and inadequate water quality monitoring and data management by the responsible agencies. As such, opportunities for regional environmental planning and management of the PRD and the South China Sea, involving a range of stakeholders in Guangdong, Hong Kong SAR, China and Macao SAR, China, had not been adequately explored.

### *Rationale for Bank involvement*

When Guangdong Province requested Bank assistance for the project, the Bank already had a substantial body of expertise from over 20 projects in the water supply and wastewater sector in China, and had obtained mostly satisfactory, sustainable results. The Bank had gained expertise on (a) regional environmental issues; (b) issues unique to mega-cities; and (c) issues related to the clean-up of water bodies (Lakes Dianchi and Tai) and water resources management (Huai River Basin). For this project, the Bank's cumulative experience was sought to design a project to reduce pollution in another mega-city, located in one of the most environmentally stressed areas of the world, the PRD. Guangdong Province requested Bank financing primarily to employ methodologies, standards, and techniques to improve wastewater planning, construction and management. It also sought the Bank's technical expertise and leveraging power by supporting technically and institutionally sound initiatives and promoting innovative activities to help address the main environmental problems more efficiently.

### *1.2 Original Project Development Objectives (PDO), Global Environmental Objectives (GEO) and Key Indicators:*

**PDO:** To assist in addressing the environmental problems of the Pearl River Delta in Guangdong Province and the South China Sea, through the improvement and rationalization of environmental service delivery based on a regional planning approach.

**GEO:** To improve the environmental condition of the South China Sea's large marine ecosystem, by addressing the major threat of land-based pollution.

**Key indicators** (PAD, page 3) included: (a) increased percentage of domestic wastewater collection and treatment; (b) increased pre-treatment of industrial wastewater before discharge, and relocation of highly polluting industries; (c) increased collection and treatment of hazardous wastes; (d) increased water quality monitoring information, and data sharing for environmental management; and (e) increased collaboration between Guangdong and Hong Kong SAR, China Special Administrative Region for environmental management of the PRD and the South China Sea region. (Note that the PAD does not differentiate which indicators are for the PDO and which are for the GEO, but the ISRs used (d) and (e) above as GEO indicators as reflected in the datasheet.)

Key Performance Monitoring Indicators (PAD, page 32) included: (a) wastewater volume treated; (b) compliance with discharge standards; (c) compliance with water quality objectives in Guangzhou PRD area; (d) quantity of hazardous waste treated and disposed; (e) wastewater tariffs implemented to meet financial projections; and (f) hazardous waste fees and charges implemented to cover costs of collection and disposal.

1.3 *Revised PDO, GEO and Key Indicators, and reasons/justification:* n.a.

1.4 *Main Beneficiaries.*

The intended beneficiaries were the approximately 30 million people living within the PRD, including the 14 million residents of the Guangzhou metropolitan area, who would benefit through improved quality of the environment and river systems. It was also expected that approximately 6.9 million residents of Hong Kong SAR, China would benefit through protection of the vital drinking water supply from the PRD, and from reduced water pollution in the South China Sea. GSTC and the Guangdong Solid Waste Management Center (GSWMC) stood to benefit from the project's specific institutional strengthening activities to support ongoing reforms in the wastewater sector and the creation of a new institutional framework in the hazardous waste sector respectively.

1.5 *Original Components (as approved):*

(1) **Wastewater Management** (total cost US\$325 million, or 75% of total). In Guangzhou, the project was to finance: (a) construction of a new wastewater treatment plant (WWTP) at Dashadi with a capacity of 200,000 m<sup>3</sup>/d; (b) expansion of the Liede WWTP by 200,000 m<sup>3</sup>/d ("Liede Phase III"), and (c) about 500 km of trunk sewers to convey wastewater from the drainage catchments of Dashadi and Liede, and four other drainage catchments.

(2) **Regional Hazardous Waste Management** (total cost US\$24 million, 6% of total). This component entailed the construction of the first phase of a hazardous waste treatment facility comprising a pre-treatment center and a secured landfill capacity of 150,000 m<sup>3</sup> in phase 1, to treat waste from all districts of Guangzhou and neighboring municipalities, including preparation of a regulatory framework for hazardous waste management, and selection of a private sector service provider to operate the facility. A waste market survey and corporate market assessment were also to be carried out.

(3) **Inter-Municipal Environmental Infrastructure** (total cost US\$65 million, 15% of total). Promotion, as a pilot activity, of shared environmental infrastructure development for two or more municipalities, districts or towns willing to plan, construct and manage shared facilities. This component included preparation of the framework for cost-sharing, ownership and O&M. Following establishment of the framework, two or three subprojects, identified during preparation, were to be financed for demonstration purposes. This component also included a review and update of the PRD wastewater management plan (the PRDCP) which was expected to result in more efficient use of resources, least cost wastewater facility planning, and enhanced inter-municipal collaboration.

(4) **Water Quality Monitoring and Information Systems** (total cost US\$11.6 million, 3% of total). Support for physical investments and information systems to enhance the capacity of the Guangdong Environmental Protection Bureau (GDEPB) for water quality monitoring, consistent with the national program of the State Environmental Protection Agency. This included installation of a network of automatic monitoring stations (AMS), real-time data assembly and processing at a control center, development of databases, a website, management information system, and data sharing arrangements with Hong Kong SAR, China.

(5) **Institutional Strengthening and Training** (total cost US\$6.4 million, 2% of total). Provision of technical assistance for: (a) financial, institutional and project management support; (b) public hygiene promotion; (c) strategic studies for private sector participation (PSP), regional planning and urban development; and (d) training and study tours.

1.6 *Revised Components:* n.a.

1.7 *Other significant changes:*

The project underwent several Level II restructurings between 2005 and 2010. In 2005, the purpose of the restructuring was to remove the disbursement condition of hiring a supervisory consultant before disbursing for works for GSTC. In 2006, the legal agreements were amended to facilitate disbursements for GEF sub-grants and to increase the financing percentage for consultant services. The restructuring in 2010 increased the percentage of Bank financing for works, canceled US\$284,180 of the Loan, extended the closing date to December 31, 2011 and added a four-month grace period for the submission of eligible expenditures incurred on or before the closing date. The restructurings did not result in any changes in scope or design, but the components and their corresponding indicators and target values were modified as described below, with delays resulting in a cumulative two year extension of the Loan/Grant closing date.

Component 1: The number of kilometers of sewerage network was reduced from 500km to 371km due to inaccurate feasibility studies and to construction difficulties which arose when laying new sewers in densely populated areas of the city and the related resettlement challenges.

Component 2: The capacity of the secure landfill (phase 1) was increased from the planned capacity of 150,000 metric tons to 290,000 metric tons following the results of a detailed site survey. The new area required increased from 20 to 33 hectares. The facility suffered extensive delays due to difficult land acquisition and inadequate counterpart funds.

Component 3: During implementation, three pilot subprojects (Luoxi Island, Nangang District and Foshan) were confirmed. However, the Luoxi Island Wastewater Treatment System suffered repeated procurement failures and was ultimately dropped late in 2011. The allocated funds were re-invested in the Nangang sub-component. The Shenzhen Pingshang River Wetland Treatment Works, identified during preparation, were also dropped as further appraisal deemed them inappropriate for funding.

Component 4: Four revisions were made as follows:

Activity	Status	Comments
Source investigation, research, and data-mining	cancelled	A central government program launched in 2007 addressed this activity, making this work redundant.
GIS development	revised	The database was extended to the remaining 15 cities to increase provincial coverage.
Launch a collaborative conference on water quality management for the South China Sea area	cancelled	The provincial government recognized the difficulties of launching such a conference on a regional basis and reallocated the funds to other components.
Training	cancelled	The Province had already allocated a training budget and because it became more difficult to secure overseas training, these funds were reallocated to other activities.

Component 5: A program for hygiene promotion was included to upgrade public toilets in low-income neighborhoods in Guangzhou city. However, Guangzhou ended up launching its own upgrading program using own funds in order to save the Bank loan for institutional strengthening activities. A study on Metropolitan Regional Planning was also included during preparation but finally was not pursued. The study on PSP and Build-Operate-Transfer (BOT) in the wastewater business was modified when Jiangmen Municipal Government changed its plans of tendering a BOT contract for the Duran WWTP and decided to finance the facility with public funds. Therefore, the original task of drawing up the terms of reference for the BOT contract was substituted by a mid-term review of the existing BOT contracts in Jiangmen and the development of a regulatory system on concessional operation.

## 2. Key Factors Affecting Implementation and Outcomes

### 2.1 *Project Preparation, Design, and Quality at Entry*

#### *(a) The soundness of background analysis, lessons learned and rationale for Bank involvement*

During project preparation, the Bank recognized Guangdong's progress in economic, financial and institutional reforms over the previous years in order to start addressing the serious environmental problems of the Pearl River Delta. Building on ongoing initiatives, the Bank designed a project to extend innovations to the environmental infrastructure sector.

Background analysis. The Borrower, with Bank assistance, conducted a comprehensive background analysis, assessing urban, regional and environmental trends in the PRD, identifying key wastewater and solid waste management infrastructure, and analyzing sector priorities for investment under the proposed loan and GEF grant. The analysis included existing policy instruments, like the PRDCP and the Industrial Pollution Control Action Plan (IPCAP), the assessment of feasibility studies, definition of project objectives and components and site selections for works. Different alternatives for design and implementation were analyzed, considering the scale of the project, the choice of a local versus a more regional approach, the adequacy of different financing instruments, whether to focus on one versus more than one environmental sub-sector (wastewater and solid waste), and the analysis of more specific options for each component.

Lessons learned from earlier operations were considered during preparation and introduced in the final project design, like the need to pay attention to setting tariffs by the level of average incremental costs; or the emphasis on establishing an autonomous wastewater company as a key feature for sustainability. The benefits of including private sector participation were also introduced in the project design of the hazardous waste component.

The rationale for Bank involvement was clear and straight-forward. The PDO was well aligned with government priorities stated in the PRDCP and IPCAP and with the goals of the Country Assistance Strategy (CAS) as the project supported environmentally sustainable development processes related to the rapid urban transition in China by improving the management of water resources and hazardous waste. The GEO was consistent with GEF's Operational Program and the Sustainable Development Strategy for the Seas of East Asia that referred to the PRD as China's largest source of land-based pollution by helping to reduce land-based pollution in the South China Sea.

*(b) Assessment of project design*

Project design responded to a clear need to contribute to improve the environmental conditions of the Pearl River Delta. The choice of supporting investments in two different environmental sub-sectors rather than concentrating just on wastewater, can be considered successful since project contributions in the incipient solid hazardous waste sector in combination with key activities to improve the water quality monitoring system are expected to positively contribute to the capacities of the local and regional governments to address some of those key environmental challenges.

Stakeholder participation. Preparation of the project involved most major stakeholders, and plans were in place to keep them engaged during implementation. GDPMO, with the support of solid international consultancies to define the scope of the different project activities, organized consultative meetings on environmental and social issues with a broad range of stakeholders, including women and low income communities. These meetings facilitated participatory consultations in the preparation of the safeguards documentation, gaining stakeholder support for the project. Affordability analyses were carried out to ensure that proposed tariffs were affordable by the poorer segments of the population.

Safeguards. The project was designed as Category "A" with two safeguards triggered: OP 4.01 on Environmental Assessment and OP 4.12 on Involuntary Resettlement. In response, a comprehensive environmental assessment (EA) was carried out in close conformity with Bank and Chinese national policies, and the final version was disclosed to the public through the Bank's Infoshop in December 2003. Specific EAs were conducted for the Dashadi and Liede III WWTPs, the trunk sewer networks for four other WWTP catchments and for the hazardous waste facility and landfill. Public consultations are well documented in Annex 14 of the PAD. In compliance with OP4.12, Resettlement Action Plans (RAPs) were developed including a main volume with a policy framework. The RAPs were disclosed in December 2003 and notice of their availability was publicized in Chinese newspapers in January 2004. The project included provisions to monitor compliance with EIA, EMP, and RAP implementation, by independent monitoring agencies.

Sustainability and complexity of the selected project design were assessed from the technical, financial, environmental, social and institutional perspectives. Implementation arrangements were made in advance, except for the inter-municipal component that was designed during implementation. Adequate arrangements for financial management during the entire implementation period and the procurement plan for the first year were done before project approval.

In 2005, the Quality Assurance Group (QAG) carried out a review of the project's "quality at entry" and rated it "satisfactory", with compliments given to the pilot initiatives on inter-municipal cooperation and PSP. The team was encouraged to focus on the "evolution of the institutional framework for the Pearl River basin management, even if the process itself will inevitably be long-term". This assessment agrees with this recommendation, but it found other areas where quality at entry was soft as discussed next.

### **Shortcomings of Quality at Entry**

The project's broad *regional scope and approach, although well justified, proved to be too ambitious* for a first intervention in the sector in Guangdong. The specific goals of moving towards regional collaboration between the principal urban centers of the PRD were very difficult to introduce in the local and provincial political agendas. Furthermore, the Bank did not appreciate the challenges or the risks of implementing a more rational, cost effective wastewater plan through inter-municipal collaboration. The project was right to include the establishment of an institutional framework for inter-municipal collaboration, but instead of going ahead with actual works, it should have included a dissemination strategy geared toward building political commitment. Works might have been financed after political will was established, either with additional financing, own financing, or under a separate operation.

Very wisely during preparation, the necessity of accelerating institutional development changes in the environment sector was strongly emphasized, as seen in the formation of the GSTC as a financial autonomous enterprise before appraisal, and an institutional strengthening component was included to help the project institutions consolidate ongoing reforms; however, as GSTC had just been formed, it had no corporate identity or culture and no experience in managing a large Bank-funded construction program. *The institutional strengthening component should have included additional consulting services* to augment GSTC's and GSWMC's management capacity and as well as a project implementation management consultant to provide close oversight and on-the-job training.

**Critical risks** related to the achievement of project outcomes and outputs were identified but none was assessed as high or substantial. Corresponding mitigation measures were clearly spelled out and risks related to environmental, social and fiduciary aspects were implicit in the individual assessments. Significant difficulties with *resettlement* that arose during implementation indicate that more attention should have been paid to investigating Government commitment to following Bank social safeguards and fiduciary policies, or the potential implications of high land price increases in land compensation on counterpart funding availability (See section 2.2.). However, this was the first urban project in Guangzhou financed by the Bank and GDPMO had already successfully implemented other RAPs linked to construction projects in a context of sharp land price increases, so the task team's underestimation of those risks is understandable. Similarly, the *procurement capacity* assessment indicated an "average" risk, overestimating the PIUs' familiarity with Bank procurement



methods. *Financial management* risks were rated low to moderate, which again proved to be too soft considering the weaknesses reported in Section 2.4. This, together with the institutional weaknesses found in the hazardous waste sector, evidenced by the difficulties in producing the bidding documents to contract the private operator, leads to the conclusion that *institutional capacity was over-assessed*.

Another under-assessed risk was “*provincial and city level governments will not support the proposed shared infrastructure management, least cost solutions or location of wastewater facilities*.” This was rated “moderate”, when it should have been rated “high”. The risk assessment related to *implementation of reforms* assessed at “modest”. Some reforms were carried out, but others are still pending, such as the cost recovery of GSTC depreciation and debt service costs<sup>1</sup>. This last requirement was ambitious given how new the reforms in the sector were.

One risk that was not identified was *delays due to the complexity of the construction* of the sewerage network and the corresponding resettlement and counterpart funding needs. Given the Bank’s prior experiences in Beijing, Tianjin and Shanghai, this risk should have been “substantial”. In fact, the overall risk of the project should have been rated as “substantial” instead of “moderate”.

**Reach of the PDO/GEO**, was too broad considering the size of the project and the scope of the environmental problems in Guangdong (see Section 3.2). A better formulated PDO would have aimed at reducing pollution loads due to domestic wastewater and reducing hazardous waste. Lastly, as explained in Section 2.3, the **results framework** had many inconsistencies and the indicators could have been better defined and aligned more closely with PDO and GEF objectives.

**Sludge treatment.** GSTC prepared a sludge management plan as covenanted in the Project Agreement. Following the presentation of the plan, GSTC proposed to build a sludge drying facility to be financed by the Bank, but the Bank was not convinced of the cost effectiveness of the solution proposed, and it was recommended that it be financed with government funds. Given the expected increase of sludge production, not only due to the wastewater treatment capacity expansion financed by this project, but also by other new plants developed under GSTC’s jurisdiction, it would have been appropriate to include technical assistance to help GSTC identify an appropriate solution to this issue, as today, this solution has not yet been fully developed. There is considerable space for innovation in this field and GSTC has already indicated the need to improve sludge handling.

The Results Framework contained one indicator at the PDO level linked to the implementation of the IPCAP, requiring 95% of the industries to comply with discharge standards and the relocation of highly polluting industries. Even though this action was included as a covenant in the Project Agreement, the project did not finance any directly related activity. Consequently, compliance was not routinely monitored, and its usefulness as a mitigation strategy against the risk of “lax enforcement of pollution control policies” is somewhat dubious.

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<sup>1</sup> The financial covenant required total revenues to be greater or equal than operating expenses (O&M and depreciation) and the amount of debt service exceeding depreciation. The term “total revenues” is defined as the sum of total operating revenues and net non-operating income.



Therefore, although the project had a pioneering spirit and was aimed at the right sectors, the overall **Quality at Entry rating is Moderately Unsatisfactory** due to the above shortcomings, which had a lasting effect on implementation.

## 2.2 Implementation:

As reported in Section 1.7 above, the project was restructured three times, with closing date extensions totaling two years. By December 31, 2011, all project activities were completed except for the hazardous waste component and some unresolved resettlement issues.

**Design changes.** Regarding the construction of the sewerage network, detailed designs conducted during implementation found that the initial objective of constructing 500 km of sewers as mainly a separate system was both *unrealistic*, because of the construction and resettlement related challenges implied, and *unnecessary* because it was possible to make use of the existing combined sewers as part of the new network. The network was also re-designed since GSTC could use its own funding to build new sewers, so the length of network constructed declined to 371 km.

The **challenges of building a new sewerage network in densely populated and rapidly growing urban and peri-urban areas** became evident during implementation. Contractors often encountered traffic disruptions and problems of not knowing the location of existing underground utilities in very dense urban areas. Also, *many villagers in one particular site refused to be relocated in 2006 because, in a context of sharp increases of land and house prices, they found cash compensation insufficient.* The need to pay market prices for cash compensation was continuously discussed with the Borrower, but this issue remained unresolved for almost two years, when the Borrower finally accepted to construct acceptable replacement housing (see Section 2.4 and Annex 7). Ultimately delays in completing the sewer networks led to lower capacity utilization of the Dashadi WWTP.

The **construction of the hazardous waste facilities also met with serious delays** which resulted in its not being completed at closing. The feasibility studies prepared during preparation failed to properly identify the topographic characteristics of the selected construction site. This resulted in a near doubling of the site capacity with a 65% increase in the required area. Consequently, the *budget for land acquisition failed to take into account the higher cost due to an increase in land requirements. The result was insufficient counterpart funds, causing major implementation delays.*

The Borrower's lack of *full understanding of the institutional framework for private operation of the hazardous waste plant* – and the Bank's failure to recognize this -- caused further delays that resulted in the plant's not having a private operator ready to start operations at closing. Water quality monitoring activities were also significantly delayed due to a series of issues related to the GDEPB's *lack of familiarity with Bank procurement procedures.*

**Fiduciary difficulties.** During the mid-term review, the Bank rightly downgraded the rating for implementation progress from marginally satisfactory to unsatisfactory, due to the lack of progress on the construction of the sewer network and the suspension of work on the hazardous waste facilities. There was also an urgent need to *resolve pending fiduciary issues* raised by the external auditors in the 2007 and 2008, including the use of fraudulent documents to claim reimbursement from the Bank loan, and overstatement and “improper” procurement. The need to refund the Bank

for these ineligible expenditures, and to put in place stronger financial and contract management systems to address these weaknesses, also contributed to implementation delays.

The Luoxi Island inter-municipal project was dropped because the procurement process for civil works to construct river-crossing pipelines and pumping stations failed three times. With the Loan Closing imminent, there was not enough time to complete a fourth bidding process and the works, so the Grant allocation for Luoxi Island was reallocated to the Nangang WWTP.

**Institutional difficulties.** GSTC was not able to generate total revenues to cover operating expenses (including depreciation) and debt service costs. Guangzhou Financial Bureau would not consider raising tariffs to a sufficient level due to issues of social stability during an inflationary period. The lack of progress on the project's regional sharing objectives was also found to be too politically sensitive to be implemented.

During preparation it was agreed that the inter-municipal component would be fully defined during implementation after a study of constraints to inter-municipal infrastructure development was carried out and the regulatory framework was developed. Unfortunately that *study devolved into a series of study tours and workshops that were incapable of detecting locally specific problems in developing shared environmental infrastructure projects. The regulatory framework seemed to overlook these challenges too.* At appraisal it was expected that a small proportion of the GEF funds would be reserved to support operations in the early stages, but the amendment of 2006 allowed the use of all the funds in the construction stage. As a result, there is no incentive to secure available operation funds to support operational start-up due to complicated tariff allocation among different districts.

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

**Design.** The Project's Results Framework was modeled on the Logframe, which defined a comprehensive monitoring and evaluation (M&E) system. The Logframe, however, lacked clarity and specificity. Indicators were difficult to measure, and their baselines were nonexistent, inaccurate, or had contradictory target values.

**Evaluation of indicators.** The GEO and the PDO were too global, making it difficult to isolate the effect of project activities and to design appropriate indicators. The PDO indicators did not fully reflect the objective itself as they did not incorporate any aspect about rationalization of infrastructure or use of regional planning. GEO indicators (improved water quality monitoring and increased collaboration) are actually more related to the PDO than to the GEO, as they included rationalization of infrastructure and inter-municipal cooperation as an approach to regional planning. PDO Indicator #2 focused on increasing pre-treatment of industrial wastewater and relocation of highly polluting industries, but there is no mention of industrial pollution in the PDO and no accompanying component. PDO Indicator #3, on increasing collection and treatment of hazardous waste, referred to a baseline value of 45,000 tons/year. However, Guangzhou had no hazardous waste treatment, so the baseline should have been zero. The understood target was 45,000 tons/year. Intermediate Outcome Indicator #1, "*percentage of river samples over Class III*", measured broader outcome level results rather than intermediate results. Even more problematic is that this indicator is so global that it actually captures impacts not directly related to this project, such as domestic or

industrial effluents from other areas or agricultural and non-point pollution. Intermediate Outcome Indicator #4 measured the strengthening of the institutional arrangements for the wastewater sector that aimed to achieve the corporatization (not well defined) of the regional wastewater company. However, no similar indicator existed for the development and improvement of the institutional framework of the hazardous waste facility. Hence, although the project devoted considerable effort to developing the hazardous waste framework contributing to transformation in the sector, it cannot be properly assessed. The project would have benefitted from an indicator such as “establishment of a regulator and operator”.

Additionally, the PAD states that inter-municipal components would pursue full cost recovery by newly established separate utilities. Nevertheless, there were no indicators set up to evaluate this achievement for the sustainability of the interventions; therefore no quantifiable evidence is available.

**Implementation of M&E.** Despite these problems, project progress was regularly monitored and reported in the periodic progress reports. The Bank kept track of progress of physical, financial, environmental and resettlement and land acquisition aspects, which were reported in the semi-annual progress reports. External resettlement monitoring reports were prepared and submitted periodically. A constant flow of M&E information during implementation allowed the Bank team to assess the performance of project components (except for the inter-municipal component as stated above) and their potential sustainability. Monitoring data was assembled by the respective agencies, namely GSTC, GEPB, GZPMO, GDPMO and GSWMC. Some indicators were updated and modified several times during implementation, to improve specificity, but their inconsistent baselines and target values remained from the design phase.

**Utilization/sustainability of M&E arrangements.** The water quality indicators are being used to improve field inspections and to detect potential polluters, which facilitates the enforcement of environmental regulations and provides valuable inputs to inform the design of new environmental policies or update old ones. This data is also used to ensure the adequate functioning of the wastewater treatment plants, as samples of the river at discharge points are regularly taken.

#### *2.4 Safeguard and Fiduciary Compliance (focusing on issues and their resolution, as applicable):*

**Social safeguards.** Resettlement was coordinated by the Guangzhou Project Management Office (GZPMO), who began RAP implementation in 2004. Resettlement was undertaken in the wastewater and hazardous waste components, where the main issues were permanent acquisition of 128 ha of land and the temporary acquisition of 217 ha of land. The corresponding number of people to be resettled was originally 44,641. However, the actual number of people resettled was only 6,780—an 85% decrease (see Annex 7). The number of Project Affected People (PAP) was lower because of the use of effective construction techniques, such as pipe-jacking, pipeline layout modification, and reductions in the extension of the network vis-à-vis the original design. All PAPs were compensated prior to asset-taking and the compensation offered at least met RAP standards.

**RAP Implementation.** Implementation of the RAP was monitored by external consultants who provided external monitoring reports regularly. Random investigations on the restoration of livelihoods were conducted and they confirmed that the livelihoods of the PAPs have been fully

restored. Land acquisition had a minimal effect on PAPs whose main sources of income were wages, rentals or dividends. Regarding the hazardous waste facility, the two affected villages distributed land compensation among the villagers through transparent procedures. The living standards survey concluded that the livelihoods of the PAPs were fully restored.

Resettlement was almost entirely completed by the end of 2011, except for replacement housing construction for Chebei Village (under the wastewater component). By 2009, a total of 154 households (550 people) at the village had been relocated, but replacement housing had not been completed at Loan closing, which implies a need for continuing supervision from the Bank. GZPMO is ensuring the completion of this activity.

**Environmental safeguards.** No unforeseen adverse environmental problems arose during implementation. Effective mitigation measures were taken promptly to ensure that all environmental indicators remained within acceptable levels. Public consultations and information disclosure were carried out continuously. Semi-annual environmental monitoring reports and EMP implementation reports were submitted to the Bank regularly. Guangzhou Environmental Protection Research Academy was entrusted to conduct environmental monitoring during the construction phase, while Guangzhou City Drainage Monitoring Station and Guangzhou Municipal Environmental Monitoring Center conducted environmental monitoring during the operation stages. The monitoring results showed that effluent, ambient air quality, odor, noise, and sludge complied with the relevant environmental standards during the operation of the three WWTPs of the project.

**Financial management.** Several issues related to poor financial management performance arose during implementation. The GZPMO was hosted by two different institutions which compromised its financial management performance. The new PMO's internal controls and efficiency were quite weak, as demonstrated by the fact that it delegated the owner's responsibility to a third entity and hired an international consulting firm for supervision.

In several aspects, GSTC did not adequately fulfill its responsibilities as it failed to adequately conduct supervision of project activities. As a result, some serious issues were disclosed by the external auditors in their annual audit reports, such as the use of fraudulent documentation, overstated completed activities and "improper" procurement. GSTC implemented the mitigating measures required by the Bank. These consisted of implementing improved financial and contract management measures to enhance its internal control system, which resulted in improvements that were noted later in implementation.

In addition, project accounting was also weak, and some outstanding issues have still not been resolved: the total project investment at completion is understated because the eligible documents for resettlement expenditures could not be obtained by GSTC. The auditors raised this problem several years ago, but it remained unresolved in August 2011.

The Bank monitored and supervised the project twice a year following these issues closely and proactively. The project was required to refund the Bank ineligible expenditures equivalent to US\$ 284,180 from 2007 and \$226,388.45 from 2008 and additional mitigation measures were put in place, such as establishing a set of sound internal control systems to ensure all the completed activities and the related document could be verified by qualified staff, hiring some staff with

construction engineering background, and establishing frequent communications with external auditors to better understand related regulations.

**Procurement.** Contract management by the PIU of GSTC experienced major issues of over-measurement for civil works and non-compliance with prior review requirements stipulated in the Loan Agreement. Procurement implemented by the PIU of Panyu District, where the Luoxi Island works would have been located, failed several times and had to be repeated due to non-compliance with the Bank's procurement guidelines which ultimately resulted in the cancellation of this activity. Several gaps in the process justified this decision. These could be summarized as: publishing the advertisement in inappropriate media; giving insufficient time to the bidders for preparation of the bids; requiring bidders to participate in the bid opening; failing to adopt the standard bidding document; rejecting all the bids on the grounds that the number of the bids was less than specified numbers; and rejecting the bids on the grounds of non-substantial deviation without any clarifications sought from the bidders.

## *2.5 Post-completion Operation/Next Phase*

**Wastewater sector.** GSTC has adequate staff who have been trained to carry out their jobs efficiently and effectively and are learning new skills to prepare themselves for future challenges. They have comprehensive knowledge of relevant national and international best practices and can apply them. An effective process for succession management is in place. Training carried out during the project is listed in Annex 2 under Component 5. GSTC has prepared financial projections and company performance is being monitored against the financial covenants used during implementation. The company still needs to make adequate provisions to fully cover operational expenses (O&M, depreciation and debt service). Key operational and financial indicators are provided in Annex 3.

GSTC's main challenge is to increase the treatment capacity fast enough to stay one step ahead of current economic and population growth, for which sound planning is key. GSTC needs to keep expanding the separate network in order to improve the strength of the raw wastewater at the intake and improve the efficiency at which its treatment plants operate. Its other technical challenge is the handling and management of sludge. Currently, part of the sludge is deposited in a landfill and the rest is incinerated or treated for composting, but neither option is optimal due to the amount of energy used and the indirect health impacts caused by incineration.

**Hazardous waste.** Perhaps the most important post-completion challenge refers to the operation of the hazardous waste facilities which, if done properly, will guarantee the sustainability of the hazardous waste sector in Guangzhou. On April 27, 2012, the Guangzhou Solid Waste Management Center (GSWMC) issued the bid document for outsourcing a private sector operator. The final selection of a successful operator was still pending upon completion of this report. The selected operator will be involved in testing the equipment and processing facility. In addition, there is a call for continued strengthening the corporate capacity of the Guangzhou Environmental Technical engineering Company (GETEC). Lastly, if the plant is operated adequately and the landfill fills at expected rates, it could be exhausted in three to four years, meaning that it would be necessary to start planning for a subsequent landfill right away.

The **inter-municipal project** of Foshan depends on the finalization of the construction of the sewerage network under the Second Guangdong PRD Urban Environment Project (PRD2, Loan 4856). Once works are completed, Foshan municipality will operate the system. Yet, there is currently a dispute between Chancheng and Nanhai District on the tariff allocation, which was not clearly defined under the cooperation agreement between the two districts, so they are still waiting for resolution from Foshan Municipal Government. After discussions about sharing operating costs, the Guangzhou Economic Development Zone (EDZ) assumed responsibility. Both inter-municipal projects will still need to establish adequate tariff levels to recover at least O&M costs.

Last, the Province currently provides an annual budget of RMB 7.7 million as the operating budget of the water quality monitoring network. Total staff engaged in water quality monitoring activities in the PRD area reached 1,511 in 2010. GDEPB should continually budget for adequate O&M of the network.

### **3. Assessment of Outcomes**

#### *3.1 Relevance of Objectives*

##### **RATING: Satisfactory**

The PDO and GEO remained relevant throughout implementation to completion. The PDO was consistent with the two main CAS themes which were key development priorities, notably: (a) strengthening environmental protection and natural resource management; and (b) improving urban environmental management and public service provision. At completion, the PDO and GEO remained relevant with the draft Country Partnership Strategy (CPS) (to be discussed in early FY13), whose first strategic theme is “supporting greener growth” by “enhancing urban environmental services”; and “demonstrating pollution control measures”. Some project activities were adapted to the challenges that arose during implementation, such as the re-design of the sewerage network or the design of the inter-municipal infrastructure, which was deliberately designed as an open pilot activity to be fully defined during implementation. At completion, except for a few small sub-components in the institutional strengthening component, all components remained relevant to achieving the objectives of China, the Bank, Guangdong Province, and the project itself.

#### *3.2 Achievement of Project Development Objectives and Global Environmental Objectives*

##### **RATING: Moderately Satisfactory**

Before assessing the achievement of the PDO and GEO, it is necessary to understand the size of the PRD relative to the size of the project interventions. The project’s service area is only 2.3% of the total PRD area, and the population served by the project’s new infrastructure represents only about 16% of the PRD total. Therefore the PDO/GEO of improving environmental conditions in the PRD and the South China Sea was too high a reach for a project of this scope. A better PDO might have focused on reducing pollution.

##### **Environmental Improvement through Wastewater Infrastructure. Rating: Satisfactory**

The project financed wastewater treatment facilities and related investments in Guangzhou, domestic wastewater being the biggest single source of water pollution in the PRD, accountable for 34% of the organic pollution load. Under the wastewater and inter-municipal environmental infrastructure components, the project financed the construction and/or expansion of 371km of sewerage networks<sup>2</sup>, two pump stations and the construction/expansion of three WWTPs: (a) Dashadi WWTP was constructed with a capacity of 200,000 m<sup>3</sup>/day; (b) Liede was expanded an extra 200,000 m<sup>3</sup>/day; and (c) the Nangang WWTP was expanded from 25,000 to 100,000 m<sup>3</sup>/day, for a **total capacity expansion of 475,000 m<sup>3</sup>/day**. The Liede WWTP operates at 100% hydraulic capacity, Dashadi operates at 75% hydraulic capacity and Nangang at 87% hydraulic capacity. Dashadi's organic load of recipient influent is still low, with only 68 mg/l. For both Dashadi and Nangang, a gradual increase of hydraulic and organic loads is expected with the ongoing expansion and upgrading of the sewer network. For the GSTC catchment area, **the total volume of domestic wastewater treated has increased from 50% in 2003 to 97% in 2011** thanks in part to the project interventions which account for 18% of Guangzhou's total treatment capacity.

The WWTPs' successes in removing key pollutants - COD, BOD, SS, T-P and NH<sub>3</sub>-N – are shown in Annex 2 (see tables 3, 4 and 5). All three WWTPs are **complying with effluent standards, and are reducing pollution loads to the PRD and South China Sea, thereby improving the environment**. The quality of the PRD has improved in part thanks to the success of the project's wastewater infrastructure, as shown by the **percentage of samples from PRD rivers meeting Chinese surface water quality standards (Class III+), which has increased from 57% in 2003 to 70.4% in 2011**. This compares reasonably well to the appraisal estimate of 80%. However, this indicator has a couple key flaws: (a) domestic wastewater is not the only pollution source in the PRD; and (b) the sampling points are spread all around the PRD rather than being located near project interventions, so attribution is somewhat problematic. Sampling downstream of WWTPs would likely have shown more positive results.

On the **institutional side**, the operation and regulatory functions for the wastewater sector were successfully separated, which is a significant step towards sustainability. **The objective of transforming GSTC from a municipal department to a corporatized wastewater utility – it is now a public limited company - was achieved**. The professionalization of its staff, translated in improved technical and managerial skills, was also achieved through the project's institutional strengthening activities. *Project implementation also saw a significant improvement in the method of revenue collection, which started as a service fee and switched to structured tariff. Revenues are now collected by the water utility and are transferred fully and directly to GSTC, giving the company a predictable, uniform revenue stream that did not exist before.* However the project's key goal of cost recovery and financial viability was not fully achieved. To attain this goal, a combination of (a) further capacity building in financial management and forecasting, coupled with (b) political commitment to raise tariffs to necessary levels, are necessary. GSTC staff must be officially transferred from government employment to GSTC employment and the municipal government still needs to grant the Guangzhou Water Affairs Bureau more autonomy to set tariffs to maintain GSTC's financial viability. (Annex 8 shows an organizational chart of the water/wastewater sector.)

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<sup>2</sup> The project also financed 44 km of sewers in the Nangang and Foshan inter-municipal components.

### **Environmental Improvement through Hazardous Waste. Rating: Moderately Unsatisfactory**

The project originally was to finance a hazardous waste facility including a landfill capacity of 150,000 m<sup>3</sup>/day. However, as mentioned in Section 2.2 above, the landfill site was expanded by 93% to 290,000 m<sup>3</sup>/year, and also includes: (a) a waste receiving, sorting and transfer facility with a capacity of 45,000 tons/year; (b) a physical/chemical treatment facility for 4,000 tons/year (double the original design); (c) a stabilization and solidification facility of 20,000 tons/year; and (d) a trans-shipment capacity of 21,000 tons/year. Unfortunately, due to design changes and long implementation delays, construction of the facility was not quite complete at Loan closing, although many of the remaining construction activities were supporting services (access roads, utility supplies, site restoration and landscaping). Therefore, the indicator of treating 45,000 tons/year was not met. The Guangzhou Solid Waste Management Center has launched the process of engaging a private sector operator for the facility. The facility should be able to commence operations in the latter half of 2012.

On the **institutional side**, the operation and regulatory functions have been successfully separated -- a significant step towards sustainability of the future service. Guangzhou EPB and GSWMC have decided, using sound criteria, to retain the functions of management, oversight and billing collection through a subordinate organization called Guangdong Environmental Technology and Engineering Company (GETEC), and to outsource O&M to a private operator. The O&M contract will have a duration of three years and will include a technical assistance and training component for GETEC. This will provide GETEC the option to reassume O&M functions after termination of the O&M contract. Other important regulatory reforms have been conducted, such as the development of an annual reporting and registration program for hazardous waste generators or the issuing of permits for hazardous waste transactions (see Annex 2 for more details).

### **Regional Planning Approach. Rating: Moderately Satisfactory**

To introduce a regional planning approach, the project was to implement two to three pilots to foster **inter-municipal cooperation** in the planning and construction of shared wastewater facilities. Two pilots were completed: (a) the construction of the Nangang WWTP, shared between Guangzhou municipality and the EDZ, and (b) a sewerage network, shared between Chancheng and Nanhai districts in Foshan. Both interventions showed savings in capital expenditures and land acquisition compared with the alternative of having each district build its own system. However, the sharing of responsibilities and operational costs in the operational phase still needs to be clarified as these issues were not adequately defined in the regulatory framework created under this component. The third pilot appraised, the Luoxi Island WWT System, was dropped in late 2011 for reasons explained above.

This component also financed a study to **update the PRD Wastewater Master Plan** (PRDCP) to increase functional efficiency, optimize the number and size of wastewater treatment facilities using least-cost strategies, maximize environmental benefits and plan interventions without limiting planning to jurisdictional boundaries. The document is supposed to offer a reference baseline and guidelines to be followed in the PRD region. However, challenges in its implementation exist. Generally, each municipality still continues to use locally developed municipal plans. These plans



are supposed to follow the regional master plan, but *there is no oversight authority to guarantee that this happens*, and sometimes local interests in developing environmental infrastructure prevail.

Another step in moving toward regional planning was to promote crucial improvements in **water quality monitoring and information dissemination** to foster regional planning and data sharing. GDEPB now has a modern GIS-based platform with real time monitoring of water quality in 57 stations across the PRD. *This information is already being used to inform the environmental enforcement department of the GDEPB of any possible anomaly or violation of discharge regulations. Data on the water quality class of the different sections of the river is published online and updated on a weekly basis.* Yet, the detailed, parameter-wise water quality information is kept internally in the GDEPB. GDEPB has shared data on air quality with other municipalities (Hong Kong SAR, China, Macao SAR, China), but this is not the case for water quality data as intended under the project. Explanations given by the Borrower<sup>3</sup> about the justification for eliminating the activity of a regional conference on water quality show the low priority given to this approach.

**In summary**, although the project was rightly designed to make key contributions in different environmental areas (hazardous waste, wastewater, environmental monitoring), it concentrated mostly on the wastewater component (75% of financing), whose desired outcomes were successfully achieved and the PDO indicator (Indicator 1) was exceeded. Moreover, the project had high institutional impact: Guangzhou now has a corporatized and independent utility whose capacity has been strengthened and is now able to produce financial projections thanks to a secured income from collected tariffs. Overall, this contributed to the solid progress made by Guangzhou in this sector resulting in a project outcome rating of MS.

### 3.3 Efficiency

#### **Rating: Moderately Satisfactory**

**Economic.** A cost-effectiveness approach was adopted in the analysis since it was difficult at appraisal to value the benefits in monetary terms due to the limited data available, the complexity of the causes of pollution, and uncertainties related to the linkage between pollution reduction in Pearl River and the benefits such as the reduction in public health costs and the positive impact on amenities, tourism, land values, agriculture, and fisheries. When the cost-effectiveness analysis was conducted at appraisal, the selected interventions with clearly stated pollution reduction targets had the least average incremental cost, a reasonable size of savings in the net present value (NPV) of total investment cost, and acceptable financial internal rates of return (FIRR).

Due mainly to increased resettlement costs (which are not precisely known as stated earlier), the total investment cost of the selected interventions increased from US\$442.4 million to US\$576.4 million at project completion despite the 85% drop in the number of PAPs. With the same treatment capacities built, the investment in wastewater management component increased 5% of its cost at appraisal. The investment in the hazardous waste management component also increased but the built landfill capacity is 93% larger than appraisal.

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<sup>3</sup> Borrower's Completion Report states "Given the organization of such a meeting being a long and complex process, and its low relevance to the project, in order to avoid delays, it was agreed to drop the South China Sea conference from the subcomponent and reallocate the financing to other tasks"

At project completion, the actual monitoring data of influent and effluent of the Liede III and Dashadi WWTPs shows that the wastewater treated and discharged into the Pearl River has met all required effluent standards. However, as stated in Section 3.2 above, the size of the project is small relative to the requirements of the much larger PRDCP, so it cannot be said that the water quality of the Pearl River at project completion has improved quite as much as expected (see corresponding indicator) due to factors beyond the control of the project.

The main investments in the hazardous waste management component were just finished before Loan closing. The landfill built can treat all hazardous waste generated by industries in Guangzhou and the surrounding cities, but because it is not yet in operation, it is not possible to evaluate the benefits of this component.

**Financial.** At appraisal financial projections were carried out for GSTC to analyze its financial viability. The revenues and expenditures of GSTC for wastewater collection and treatment were projected and the financial covenants of cost recovery and debt service coverage ratio were set leading to targeted wastewater tariff increases.

The wastewater tariff was increased to its current level in the first half of 2009. GSTC has conducted financial projections every year since the 2009 increase. At closing the financial covenants had not been met according to GSTC's own financial projections. The latest financial projections done by GSTC indicated that GMG needed to increase the average wastewater tariff from the current RMB 1.07/m<sup>3</sup> to RMB 2.94/m<sup>3</sup> in 2012 in order to comply with financial covenants. However, due to the necessity of maintaining social stability during an inflationary period, the GMG has been reluctant to increase the wastewater tariff. Additional information on compliance with financial covenants is provided in Annex 3.

### *3.4 Justification of Overall Outcome Rating*

#### **Rating: Moderately Satisfactory**

Relevance of the PDO and GEO was satisfactory because they were well aligned with the Borrower's strategy and with the CAS and CPS throughout the project's life cycle. The project relied mostly on supporting the wastewater sector, and the activities under this component were mostly successfully completed. However, the assessment of outcome and efficiency are rated moderately satisfactory for reasons provided above, and therefore the overall rating is MS.

### *3.5 Overarching Themes, Other Outcomes and Impacts*

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

This project did not specifically focus on improving the lives of particular target groups, but it is well known that economically disadvantaged populations suffer disproportionately from a poor living environment, so those groups are likely to have benefitted most from the project, although there is no supporting data. With respect to the affordability of the wastewater treatment services, the

economic analysis (Annex 3) concluded that both the previous and future expected increases in wastewater tariffs are broadly affordable even for the bottom 1% of low-income families.

After a tour of Guangzhou city revealed a significant shortage of public sanitation facilities, particularly for taxi drivers and low-income residents, the project did include a program to promote public hygiene, but in the end, Guangzhou city officials launched a program with its own funds. Nevertheless Bank support for the program likely had a catalytic effect in getting over 300 public toilets installed during the project period.

*(b) Institutional Change/Strengthening:* The project supported innovative institutional changes in the two environmental sub-sectors. The foundations were laid for sustainable development, but work remains in progress.

With respect to the **wastewater** sub-sector, the corporatization of GSTC and the professionalization of its staff mark an important step towards improving the quality of the service and its future sustainability. The separation of the capital investment function (Guangzhou Water Investment Group) and the regulatory (Guangzhou Water Affairs Bureau), from the management and operation of both the water and wastewater operations (GWSC and GSTC) set up a very solid institutional framework with opportunities for expansion and improving performance. If GSTC is able to implement its vision as an independent, self-financed professionalized utility, it will become a strong service provider to Guangzhou and its model could be replicated in similar urban contexts in China.

**Hazardous waste management** services have traditionally been funded from the general revenues of local governments. However, where individual users of the services have been identified, local governments have, as a matter of policy, charged such users for the services provided. Local governments expect to rely increasingly on user fees and charges to finance these services in the future. The intent now is to gradually introduce charges for treating and disposing of hazardous wastes in order to encourage enterprises producing hazardous wastes to bring the wastes to the facility rather than disposing of them in an environmentally unsafe manner.

The project's main contribution was in helping set up the institutional framework for hazardous waste, a new sector where there were few precedents. Although the main activities were not fully completed at Loan closing, the facility will soon be ready to begin operations. The key remaining challenge is the successful hiring of the private sector operator.

Finally, other **PSP** models apart from BOTs should be tested. The assessment of BOTs found that this kind of contract could be better designed, as there are now some clauses that are not suitable to local conditions, and adequate supervision of BOT contracts by local governments is still missing.

#### **4. Assessment of Risk to Development Outcome**

##### **Rating: Substantial**

In the **wastewater sector**, it is necessary to continue making progress in the institutional trajectory of the sector development, to continue implementing reforms that lead to the consolidation of a good

quality service. Increasing the operating revenue through an increased tariff to cover the operation, maintenance, depreciation and debt service costs is a crucial step in that direction. Rating: Moderate.

Regarding the **hazardous waste plant**, if the private operator being selected currently is able to mobilize in a timely manner and operates the plant and landfill adequately, and if industries producing hazardous waste bring their waste for disposal as foreseen, the landfill could be exhausted in three to four years, meaning that it would be necessary to start planning for a subsequent landfill right away. Moreover, the incentive system for industries to send their hazardous waste to the facility (a combination of affordable tariffs and sanctions for non compliance), still needs to be proved. The oversight and regulatory functions of GETEC and GSWMC are also yet to be proven. Rating: Substantial.

The introduction of a **regional approach** in planning and developing new wastewater infrastructure has been only partially realized, and strong political leadership and commitment at the highest level will be needed for this to become a reality. It is also necessary to investigate new strategies to engage local governments by emphasizing the clear benefits of shared infrastructure. This will require a better understanding of the administrative constraints of implementation and more creative solutions to overcome them. The risk of continued inefficiency in the way environmental infrastructure is built and managed is rated substantial if these measures are not undertaken.

The risks to successfully using the **water monitoring system** are negligible, as the GDEPB has already allocated an adequate budget and staff have received sufficient training in its use. However, in order to fully exploit the new system and maximize the benefits of the new monitoring network, *Guangdong Province should establish a collaborative partnership for sharing information among the various municipalities and relevant institutions of the PRD*, as was originally intended. A more integrated water resource management approach is necessary to develop and improve water quality modeling using a basin-wide approach, with sharing of data and resources. The PMO should complete this approach as soon as possible, with Bank supervision under the ongoing PRD2.

Last, despite some good ongoing initiatives to increase the sludge treatment in the PRD area<sup>4</sup>, this region, and more particularly the GSTC jurisdictional area, still faces a moderate environmental risk derived from the lack of adequate treatment of sludge. Therefore there is a need to find a more sustainable and integral solution to treat the sludge produced by GSTC, in terms of increasing energy efficiency and minimizing environmental impact.

## 5. Assessment of Bank and Borrower Performance

### 5.1 Bank

#### *(a) Bank Performance in Ensuring Quality at Entry*

**Rating: Moderately Unsatisfactory**

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<sup>4</sup> For instance, the Bank funded PRD2 project includes the construction of a 400 tons/day capacity centralized sludge treatment and disposal facility at Nanzhuang to treat sludge from five wastewater treatment plants in Foshan

As already discussed in Section 2.1, the project was well justified, and its objectives were closely aligned with the CAS of January 2003 and the Borrower's policy instruments such as the PRDCP and the IPCAP to address the environmental deterioration of the PRD. A number of actions, such as engaging a private operator for the hazardous waste facility, were quite innovative and carried considerable leveraging power.

The Bank preparation team was managed by one very senior staff member and included a well-rounded team comprising expertise in sanitary engineering, social and environmental safeguards, procurement and financial management. The project was prepared over 24 months with a total budget of US\$548,490. The team was based in the Beijing office, which facilitated communications.

Nevertheless, there were some notable shortcomings. The project design over-emphasized the "hardware" components and **under-estimated the challenges posed by the development of new institutional frameworks or the transformation of existing ones**. The priority given to institutional strengthening measures during design of these reforms and innovations, in terms of the resources allocated to address them, was insufficient.

Another problem was the lack of clarity in defining the **results framework** and M&E indicators, where there were inconsistencies between the objectives and the indicators and unclear baselines and target values. The Bank should have devoted more time and resources to define a more precise and effective results framework and monitoring system that would have facilitated monitoring during implementation and evaluation of project achievements at completion.

Lastly, the Bank should have evaluated more realistically a number of project **risks**, particularly those linked to the fiduciary management capacity of the implementing units, and allocated necessary resources to provide better and more continuous training on Bank fiduciary procedures. The challenges related to resettlement in densely populated urban areas could have also been better anticipated given the Bank's long history of working in other mega cities in China and other East Asian countries. Finally the institutional risks of moving toward an inter-municipal development approach were underappreciated. Had the risks been more thoughtfully assessed, the risk rating probably would have been "substantial" and the project might have received more than the usual supervision coefficient budget, which QAG agreed was too low for a project of this scope and complexity.

#### *(b) Quality of Supervision*

##### **Rating: Moderately Satisfactory**

Early in implementation, project supervision was planned and carried out adequately. Supervision teams were appropriately staffed to address and report on implementation issues as they emerged, although it would have been more beneficial if all the team members had gone on mission together once a year to discuss overlapping problem areas instead of employing a piecemeal approach where a technical mission would be followed by a fiduciary mission, followed by a safeguards mission.

Although the project did not fund any activities geared toward complying with it, the IPCAP was included in the results framework and was a covenant in the Project Agreement. The client

communicated early during implementation that the IPCAP had been completed with the most heavily polluting industries relocated. However, these assertions were never independently verified by the task team.

In the latter half of 2007, when problems began to arise, the Bank team shifted its focus to resolving issues causing delays such as procurement irregularities, financial management weaknesses, counterpart funding shortages and resettlement problems. Technical experts keyed in on issues such as reviewing new design proposals for the hazardous waste facility; financial experts focused on GSTC's compliance with financial covenants. All these issues were on the critical path to successful implementation during this period, and the issues are candidly reported in bi-annual Implementation Status Reports (ISRs).

In light of the problems and subsequent delays cited above, it became obvious that the Loan closing date of December 31, 2009 would not allow the PDO and GEO to be met, and the Borrower requested a two year extension. However, with the project rated Unsatisfactory, granting the extra 24 months was ill-advised. Bank management wisely took a two-pronged approach. First it granted a nine-month extension to enable the Borrower to carry out an Action Plan including: (a) refunding ineligible disbursements from 2007 (US\$284,180) and 2008 (US\$226,338); (b) explaining irregularities in procurement processing for domestic training; (c) implementing new regulations to improve internal controls; (d) resolving all other accounting issues; and (e) completing land acquisition and resolving counterpart funding issues for the hazardous waste component. Once the Bank was satisfied with progress on the Action Plan, the second extension to December 31, 2011 was accorded. The Bank also extended the Grant closing date to keep the both closing dates in sync. The Borrower requested another extension of the Grant closing date to December 31, 2012 in order to complete the Luoxi Island WWS but it was rightly rejected by Bank management on the grounds that the repeated procurement failures were mostly due to weak procurement capacity of the PIU, and a fourth bidding was not likely to yield successful results.

Overall the Bank showed proactivity and flexibility by amending the legal agreements (four times) and restructuring the project to increase its disbursement percentage for financing of works and to extend the Loan/Grant closing dates to allow for the completion of project activities in order to meet the PDO and GEO to the greatest extent possible. During the supervision, the Bank focus on solving the implementation issues discussed above. Ideally, the PDO and results framework would have been improved during a project restructuring; however, this was not possible because the Borrower never formally requested the amendment needed for the Bank to pursue a Level I restructuring for this purpose.

After the majority of these issues were resolved, the Bank continued to monitor the various technical challenges related to quality of construction, installation, testing and commissioning of key works, and kept close tabs on remedial actions taken by suppliers and contractors. In particular, for the hazardous waste component, the team provided technical support at appropriate times for the preparation of bid documents for public/private participation for the management and operation of the facility and secured landfill, including the collection and transportation of hazardous wastes. It also provided advice on the strategy and implementation plan for the plant's full cost recovery objective, including the survey and registration of industries generating hazardous waste. However, the expert consultant who helped prepare this component was not present during implementation.

Such support might have provided the continuity necessary to overcome the difficulties that such a new activity entailed.

The team's safeguards experts continuously followed up on implementation of the EMP and RAP, with particular focus on implementation of the RAP for Chebei Village. The Bank conducted regular supervision missions in this area twice a year. However, given the seriousness of the land compensation and resettlement related challenges in this project, the Bank could have devoted more supervision resources to work closer with the client in solving these issues.

Two other weaknesses detected during implementation were the lack of attention paid to the institutional set-up for the operational phase of the inter-municipal subprojects and the Bank's failure to convince the PRD municipalities of the importance of employing a regional approach to planning, data-sharing and operation of shared infrastructure. However, it must also be noted that with the project's already complex design involving five components, and with the serious fiduciary issues starting in 2007, the team's supervision budget quickly came under pressure. The team was able to obtain some extra resources while the project was in problem status, but still, the team was forced to focus on key technical issues to ensure the achievement of the water quality improvement objective, and on ensuring proper implementation of safeguards and fiduciary policies, unfortunately at the expense of supporting the implementation of institutional challenges.

*(c) Justification of Rating for Overall Bank Performance:*

**Rating: Moderately Satisfactory**

Bank's performance at quality at entry was moderately unsatisfactory, and its performance in supervision is moderately satisfactory. Considering the project's moderately satisfactory overall outcome, the overall moderately satisfactory rating is justified.

## **5.2 Borrower Performance**

*(a) Government Performance (Guangdong Provincial Government and Guangzhou Municipal Government):*

**Rating: Moderately Satisfactory**

The Bank prepared and designed this project because it saw the opportunity to support the PRD government's ongoing solid initiatives, such as the PRDCP and the IPCAP, to address its serious environmental problems. Regional and local authorities showed strong commitment and leadership by making the necessary institutional reforms such as the establishment of GSTC as an autonomous enterprise or allowing the hazardous waste facility to be operated by the private sector. The government did provide counterpart funding estimated at \$438.6 million or 144% above the appraisal estimate of \$304.4 million, in order to continue making sustainable progress in providing sound environmental services. The government's good performance in these areas was compromised by its lack of success in moving toward a more integrative regional approach, which was part of the PDO. This objective would have met with greater success if the governments had displayed stronger commitment to: (a) forcing the PRD municipalities to use the updated wastewater master plan as a planning tool, (b) encouraging

shared operational responsibilities for the Nangang WWTP, and (c) disseminating data on water quality monitoring. As noted, specific issues also arose regarding land compensation or lack of counterpart funds to cover land acquisition that greatly exceeded initial estimates. These evidenced only moderately satisfactory focus on resolution by regional and local activities.

*(b) Implementing Agency or Agencies Performance:*

Rating: **Moderately Satisfactory**. (GDPMO, GZPMO, GZEPB, Guangdong Provincial Department of Construction, GDEIC, GZEDZ, Jiangmen and Foshan PIUs: Moderately Satisfactory. GSTC, GSWMC: Moderately Unsatisfactory. PIU in Panyu District: Unsatisfactory)

In general, the performance of implementing agencies in completing detailed designs, conducting design reviews, and implementing of environmental safeguards measures, is considered **moderately satisfactory**. The quality of monitoring and reporting on the project outcomes and output indicators was sometimes poor; however, many implementing agencies maintained strong commitment to achieving the PDO despite their weak capacity, which led to delays in carrying out their respective tasks and addressing obstacles as required, mainly for lengthy land acquisition.

The Bank detected several weaknesses in the PIUs that were causes of delays. First, the assignment of GDPMO to the Finance Bureau was not the best choice and other institutions more closely related to environmental infrastructure would have been a better candidate. Their staffs were not familiar with Bank procedures and evident shortcomings were found in financial management and procurement practices.

**GSTC** was responsible for the cases of improper fiduciary practices and pending resettlement issues in Chebei village. The slow construction progress caused by the resettlement problems could have been addressed had this institution been more proactive in requesting municipal government intermediation with the PAPs or in promoting coordination among district government agencies in realigning the collection pipelines in or nearer the streams and canals in order to reduce the impacts of resettlement.

This PIU was also responsible for the procurement and financial management problems raised in Section 2.4. The Bank had to provide extra training towards the end of the project to build capacity in these areas. However, the efforts made by GSTC to become a corporatized utility, to train its staff, to comply with the agreed covenants (except the financial ones which were somewhat out of its control), and to overcome the afore-mentioned challenges in order to take the project to a successful end, need to be recognized.

**GSWMC under GZEPB**, responsible for the implementation of the hazardous waste facility, were not able to facilitate the resolution of the land compensation problem where the municipal government took three years to purchase the land needed. Weaknesses were also found in the supervision of the market study report and on understanding the proposed management framework, resulting in delays in preparing the regulatory framework and hiring the private operator.

The PIUs in charge of **the inter-municipal component** (Foshan, GZEDZ and Panyu District), proved to be considerably slow, with the exception of GZEDZ, and PIU in Panyu District is lack of



adequate understanding of Bank procedures. This consequently caused delays in the preparation of bidding documents and other management and supervision activities. In particular the PIU in Panyu District failed three times in the bidding process for the main works of the Luoxi Island inter-municipal component that was finally dropped.

The Guangdong Provincial Department of Construction, in charge of the review and update of Wastewater Master Plan, started the task unconscionably late due to poor contract management of an international firm who only completed the study more than one year later than the contracted delivery schedule, leaving little time to prove its value during the life of the project.

**GDEIC under GDEPB** responsible for the implementation of the **Water Quality Monitoring and Information System** component, with a slow start until 2009 due to lack of ownership, completed the **Water Quality Monitoring and Information System** within two years.

**Jiangmen**, responsible for the implementation of the PSP study, selected the consultant only in 2009 after the drop-out of Dongguan, and completed the PSP study within two years.

*(c) Justification of Rating for Overall Borrower Performance:*

**Rating: Moderately Satisfactory**

As the performance of the government and implementing agencies are both rated moderately satisfactory and the project outcome is moderately satisfactory, the overall borrower performance is also moderately satisfactory.

**6. Lessons Learned**

1. **PMO's functions should be delegated to an entity which is relatively robust and has the capacity to coordinate with related government entities.** The PMO should be well staffed and provided with sufficient financial support. Whenever PIUs delegate their owners' responsibility to other entities, they need to strengthen supervision on the work conducted by the delegated entities. Hiring a well-known international firm does not mean that PIUs can abdicate responsibility for overseeing their work. PIUs need to set up a solid internal control system to ensure the performance of the consulting firms is supervised efficiently. Meanwhile, sanction clauses should be carefully considered, added in the respective contracts and enforced to protect the interests of project owners.
2. Two lessons learned arose from implementation of the hazardous waste component:
  - a) The cost of land acquisition and ability to mount adequate, timely counterpart funding should be very realistically assessed during the site selection process in order to avoid lengthy, costly delays. This lesson is widely applicable for similar projects in the waste management sector.
  - b) The challenges of setting up a successful and effective institutional framework for the management and operation of the new facilities depends on possessing a broad knowledge of the market. To ascertain such knowledge, it is necessary to conduct a sound cost recovery

analysis and to design realistic terms of reference for the private operator, if that route is chosen.

3. **In the wastewater sector, institutional changes take time, and the support provided needs to adequately capture the local context.** For instance, the introduction of PSP requires a careful analysis of the various PSP modalities. In this context, pure BOT models might not be the optimum solution for the wastewater sector due to the high tariff level needed to recover the private operator investment; DBO/T-type solutions might prove to be more appropriate. Also, mere corporatization of a public service like in the case of Guangzhou might work as well given the establishment of performance management contracts to guarantee accountability in the provision of the service, together with the right tariff policies to ensure cost recovery and efficiency. It may be necessary to test some options in order to continue improving the quality of the service in an efficient way.
4. From the technical point of view, it is important to carefully analyze influent wastewater characteristics and conduct accurate flow projections in order to optimize the design and technologies of WWTPs. Likewise, the selection of appropriate technologies to treat the receiving wastewater from the outset of plant operations should be carefully analyzed. Conducting basic loading-balance using the projected flows and wastewater characteristics is critical at the design stage. For these purposes, **a sound wastewater master plan is important to capture all these factors to establish a sound basis for work during the feasibility study stage.**
5. **When planning sewer networks construction, the budget, schedule and potential obstacles need to be realistically assessed, to ensure the entire wastewater treatment system can be completed in a timely manner.** Being able to foresee and mitigate the main obstacles during construction of a sewer network is necessary to minimize public objection to construction and to secure temporary land use rights. **Open-cut construction is most likely not a feasible option for sewer construction in densely populated urban areas.** Tunneling (including micro-tunneling) construction should be considered, even though the associated engineering costs could be high, as this method could have helped minimize the land acquisition problems and consequent delays experienced in this project.
6. **Sludge management strategies should be developed according to the influent wastewater characteristics and potential reuse market or its final disposal method and locations.** This will not only provide the plant operation more flexibility but it will also reduce operating costs. In doing so, adequate equipment selection and system operation including odor control should be planned early in project design. Sludge digestion may not be a viable option for GSTC at this stage, yet a long-term sludge management strategy should be considered when wastewater characteristics eventually improve due to the construction of more separate sewer networks.
7. Sharing facilities between two or more local entities has proved to save money in terms of capital expenditures. However, the viability and cost efficiency of such operation as a win-win situation for both entities remains to be proven. **Hence, it is essential to carefully evaluate the local context for each specific case, as well as all the administrative constraints that may influence the success of the operation, and to tailor solutions on a case by case basis.**

Moreover, as shown by the case of Nangang, **strong political leadership at the right level is required** to overcome the specific difficulties that constrain the optimal operation strategy.

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

### (a) Borrower/implementing agencies:

The Borrower raised the following issues:

- **Project Outcome Rating:** The ICR should be written based on the comprehensive and fair review of the project outcome and the overall project rating should be considered as “Satisfactory”.
- **Pending Resettlement Issues in Chebei Village:** According to Chinese Contract Law, Guangdong and Guangzhou have fulfilled all the related duties and obligations of the Chebei Village resettlement issue, and the land acquisition has been completed, so there is no pending resettlement issue. There is still serious dispute between two parties, and the assessment made by the Bank solely from the Bank’s perspective in the ICR is not fair and Guangdong PMO requested to delete all the related Chebei Village resettlement issue from the ICR.
- **Project Implementation Arrangements:** GDPMO considers the statement of “... GDPMO... staff were not familiar with Bank procedures and evident shortcomings were found in financial management and procurement practices” is not appropriate as GDPMO regard itself as the supervising agency, not the implementing agency of the project, but GDPMO agrees with the assessment that the assignment of GDPMO to the Finance Bureau was not the most appropriate.

### (b) Cofinanciers: n.a.

### (c) Other partners and stakeholders (e.g. NGOs/private sector/civil society): n.a.

## ANNEXES

### Annex 1. Project Costs and Financing

#### (a) Project Cost by Component (in US\$ million equivalent)

Components	Appraisal Estimate (US\$ million)	Actual /Latest Estimate (US\$ million)	Percentage of Appraisal
1.Wastewater Management	325.00	390.23	120%
2.Regional Hazardous Waste Management	24.00	55.65	232%
3.Inter-Municipal Environmental Infrastructure	64.90	66.80	103%
4.Water Quality Monitoring and Information System	11.60	5.49	47%
5.Institutional Strengthen & Training	6.40	2.57	40%
<b>Total Baseline Cost</b>	<b>431.90</b>	<b>520.74</b>	<b>121%</b>
Physical Contingencies	0		
Price Contingencies	0		
<b>Total Project Costs</b>	<b>431.90</b>	<b>520.74</b>	<b>121%</b>
Interest during construction (IDC)	9.20	54.99	<b>598%</b>
Front-end fee (IBRD only)	1.28	0.64	50%
<b>Total Financing Required</b>	<b>442.38</b>	<b>576.37</b>	<b>130%</b>

#### (b) Financing

Source of Funds	Type of Financing	Appraisal Estimate (US\$ million)	Actual/Latest Estimate (US\$ million)	Percentage of Appraisal
Government		304.38	438.66	144%
IBRD		128.00	127.72	100%
GEF	WB-administered TF	10.00	9.99	100%
<b>Total</b>		<b>442.38</b>	<b>576.37</b>	<b>130%</b>

## Annex 2. Outputs by Component

### Component 1: Wastewater Management

The project constructed two municipal wastewater treatment plants (WWTP) and about 371 kilometers of sewer networks in Guangzhou, of which approximately 217 km were financed by the Bank and about 154 km by the local government. Dashadi WWTP has a capacity of 200,000 m<sup>3</sup>/day and Phase III of Liede WWTP also has a capacity of 200,000 m<sup>3</sup>/day and both are in operation. Planned and actual facilities constructed for both WWTP systems are as follows:

**Table 1. WWTP characteristics and corresponding networks**

Facilities	Planned	Constructed	Notes
<b>Dashadi System</b>			
WWTP, m <sup>3</sup> /day	200,000	200,000	
Sewer Networks, km	120.5	80.5	less branch sewers of 40 km
Pumping Stations	2	2	
<b>Liede Phase III System</b>			
WWTP, m <sup>3</sup> /day	200,000	200,000	
Sewer Networks, km	144.7	99.0	less branch sewers of 45.7 km

As shown in table 1, branch sewers for both Liede III and Dashadi WWTPs were not constructed mainly due to difficulties related to operating in dense urban environment and existing road encroachment, longer schedule than planned, higher costs for construction and land acquisition and temporary land requirements that were encountered during construction. It is expected that, in the case of Dashadi, the development of the network will continue until the plant reaches 100% capacity. Moreover, GSTC also has in mind to gradually continue upgrading the network, expanding the extension of the separate network where possible.

The project also financed the extension of the network of other three catchment areas, based on the Guangzhou Municipal Wastewater Treatment Master Plan and Guangzhou City “Blue Sky and Clean Water” Action Plan, which required to increase the treatment rate. As for the networks of Dashadi and Liede, the initial amounts included in the feasibility studies were reduced due to the afore-mentioned problems. Table 2 below summarizes the work done.

**Table 2. Extension of the four sewer networks financed by the project**

	Sub-District	Sewer	Networks	System	
	Original	WB funded	Local funded	Constructed Sub-total	
Datansha, km	100.84	5.18	39.81	44.99	Including 2 pumping stations
Liede, km	5.03	6.47	1.58	8.05	
Xilang, km	29.71	0	24.28	24.28	
Lijiao, km	96.52	26.07	88.26	114.33	
Total	232.10	37.72	153.93	191.65	

**(1) Dashadi WWTP:**

Construction of the Dashadi WWTP, including interceptors, trunk sewers and two booster pumping stations to convey the collected wastewater to the plant, was completed in 2009. The total service area for Dashadi WWTP is about 55.5 km<sup>2</sup>. Its biological treatment process is the modified A<sup>2</sup>O process which can provide nutrient removal for better results of phosphorus and nitrogen. Currently, it is operating at **75% of hydraulic design capacity**. Additional sewer networks need to be constructed for it to meet its full capacity. In accordance with the Twelfth Five-Year Plan of Dashadi Wastewater Treatment System Construction Plan, more sewers will be constructed including conversion of the combined sewers to separate sewers. These additional sewers will increase the collection rate and improve influent wastewater strength as well. Dashadi WWTP has been in service since late 2009 and has met all required effluent standards. Actual monitoring data of influent and effluent for the Dashadi WWTP for 2011 are tabulated below:

**Table 3. Characteristics of raw and treated water at the Dashadi WWTP**

Indicators, (mg/L)	COD <sub>cr</sub>	BOD <sub>5</sub>	SS	T-P	NH <sub>3</sub> -N
<b>Influent, actual</b>	132.3	68.0	128.1	2.6	22.6
<b>Effluent, required</b>	60	30	30	1	15
<b>Effluent, actual</b>	18.6	4.1	10.1	0.7	1.2

**(2) Liede WWTP Phase III:**

Liede WWTP has been in service since 1999 and now has a total capacity of 1.2 million m<sup>3</sup>/day including additional Phase III and IV expansion of 200,000 and 560,000 m<sup>3</sup>/day, respectively. It has three different biological treatment processes: i) Phase I (A/B process); ii) Phase II (UNITANK); and iii) Phase III and IV both use modified A<sup>2</sup>O process. The service area for Liede WWTP Phase III is about 43.9 km<sup>2</sup>. Liede WWTP Phase III was constructed in 2006 and has been operating at full capacity treating mostly domestic wastewater. It has been in service since 2007 and has met all required effluent standards. Actual monitoring data of influent and effluent for Liede WWTP Phase III for 2011 are tabulated below:

**Table 4. Characteristics of the raw and treated water at the Liede WWTP**

<b>Indicators, (mg/L)</b>	<b>COD<sub>cr</sub></b>	<b>BOD<sub>5</sub></b>	<b>SS</b>	<b>T-P</b>	<b>NH<sub>3</sub>- N</b>
<b>Influent, actual</b>	213.3	138.7	152.4	3.3	20.5
<b>Effluent, required</b>	40	20	20	0.5	10
<b>Effluent, actual</b>	16.2	3.0	7.9	0.3	0.6

## **Component 2: Hazardous Waste Management**

Specific components of the completed Hazardous Waste Treatment and Disposal Facility include:

1. A waste receiving, sorting, and transfer facility with a design capacity of 45,000 tons per year, consistent with the original design;
2. A physical/chemical treatment facility with a design capacity of 4,000 tons per year, doubling the original design of 2,000 tons per year;
3. A stabilization and solidification facility with a design capacity of 20,000 tons per year, slightly under the original design capacity of 21,000 tons per year;
4. A trans-shipment capacity of 21,000 tons per year, slight below the original estimate of 22,000 tons per year; and
5. A secure landfill site with a total capacity of 290,000 cubic meters in phase 1 development, as opposed to the original design of 150,000 cubic meters. This significant increase of the secure landfill capacity is primarily due to the realization during the detailed design phase that the topographic setting of the site allowed for a significant increase in the landfill volume without an increase of the area.
6. Total investment is US\$ 46.78 million, as opposed to the original budget of US\$24 million with a Bank loan allocation of US\$ 10 million. The primary causes for the cost increase are significantly higher land acquisition and resettlement costs and the significant changes in the RMB/US Dollar exchange rate.

The following technical assistance outputs were financed by the GEF Grant:

1. Hazardous Waste Market Survey and Assessment
2. Regulatory and Institutional Framework
3. Bid document for the selection of a private sector facility operator.

With the implementation of GEF supported projects, Guangzhou EPB and Guangzhou Solid Waste Management Center (GSWMC) implemented the following specific regulatory reforms and capacity development activities:

1. An annual reporting and registration program for hazardous waste generators was instituted to allow Guangzhou EPB and GSWMC to gather and compile data on the amount of annual hazardous waste generation, treatment and disposal.
2. Permits for hazardous waste transactions will be issued prior to shipment.

3. Manifests will be used to control and monitor hazardous waste shipments, and conduct selective inspections.
4. Permits and licenses will be issued for hazardous waste treatment and disposal companies, as well as transportation companies and vehicles involved in hazardous waste shipments, including the use of a GPS system on waste transport vehicles for enhanced monitoring.
5. Study tours were conducted to other cities (Shenzhen, Huizhou, Fuzhou, Shanghai, Tianjin, Hangzhou and Suzhou) to gain a broader perspective and review experiences in hazardous waste management.

### **Component 3: Inter-Municipal Environmental Infrastructure**

As a pilot activity, two or more municipalities and districts were to construct shared environmental infrastructure facilities using GEF funds. At Loan closing, two sub-projects had been completed: Nangang WWTP and Foshan sewer networks.

#### **Nangang WWTP**

The project financed the capacity expansion of the Nangang WWTP from 25,000 m<sup>3</sup>/day to 75,000 m<sup>3</sup>/day including 22 km of sewer networks and one booster pumping station. The total service area for Nangang WWTP is about 45 km<sup>2</sup>. Guangzhou Municipal Environmental Monitoring Center has conducted monitoring of the influent and effluent of the WWTP and data present that Nangang WWTP is meeting its discharge requirements. Nangang WWTP has been in service since mid 2010 and is meeting all required effluent standards. Actual monitoring data of influent and effluent of Nangang WWTP are tabulated below:

**Table 5. Characteristics of raw and treated water at the Nangang WWTP**

Indicators, (mg/L)	COD <sub>cr</sub>	BOD <sub>5</sub>	SS	T-P	NH <sub>3</sub> -N
Influent, actual	291	117	233	4.5	16.7
Effluent, required	60	20	20	1	15
Effluent, actual	19	2	12	0.1	0.2

**Foshan Sewer Networks:** The project financed the sewer networks and pumping facilities to convey 100, 000 m<sup>3</sup>/day wastewater to connect with the Foshan Zhen'an WWTP Phase III sewer network system expansion being financed by PRD2. The system includes 11 km of sewer networks, two new booster pumping stations, and one existing pumping station expansion.

### **Component 4: Water Quality**

The project financed the development of the water quality database and information system in the PRD region, while provincial and other local governments within the PRD financed automatic water monitoring stations (AMS) along with water sampling and analytical equipment. By 2011, there were a total of 57 automatic water quality monitoring stations in the PRD, of which 25 were located within the City of Guangzhou. The Province provides an annual budget of RMB 7.7 million as the operating budget of the water quality monitoring network. Total staff engaged in water quality monitoring activities in the PRD area reached 1,511 in 2010.



The water quality database and information system, developed under the project, contains monitoring data from the 32 automatic monitoring stations in Guangdong Province, regular manual sampling locations, as well as historic data from nine key areas of the PRD watershed, including river and surface water bodies, water supply sources, water reservoirs and lakes, river discharge points to ocean, direct discharges to oceans, etc. The water quality database has the capacity of supporting the timely identification of potential pollution sources, based on real-time data, should pollution incidents occur. Below is a summary of the water quality monitoring and information system.

ITEMS	DESCRIPTION	COST (RMB 10 <sup>6</sup> )	SOURCE OF FUNDS
3 AMS at Provincial Boundaries & 4 AMS at River Discharges	Sampling & monitoring equipment, transport, control room & data assembly staff development and certification of completion	17.50	Guangdong Province
Renovate 3 ATM at Xingdong River	Building renovation, quality control equipment, sampling and monitoring equipment, training & certification	6.75	Guangdong Province
QA/QC equipment & Transport equipment	Operational manual to ensure QA/QC for water quality monitoring & associated equipment and transport equipment	1.45	Guangdong Province
Water Quality monitoring & information system	Equipment & network development & system testing	4.71	Guangdong Province
	Software development	15.10	GEF Grant
Project preparation and project completion certification costs	Costs for project preparation (Guangdong Province AMS system), and project completion certification and staff training.	0.86	Guangdong Province
<b>Total: 46.37 million RMB (Guangdong Province Portion 31.27 million RMB, GEF Grant 5.10 million equivalent RMB)</b>			

## Component 5: Institutional Strengthening and Training

This component was composed of four parts: (a) financial, institutional and project management support; (b) public hygiene promotion; (c) strategic studies for regional planning and urban development; and (d) training and study tours. The PAD did not provide any further detailed information on the content of these technical assistance packages for comparison with actual.

Under Part (a), the institutional strengthening activities focused on building the capacity of the newly established GSTC. The GSTC Five Year Training (2006 to 2010) objectives and accomplishments were:

- GSTC staff have the skills to carry out their current jobs efficiently and effectively.
- GSTC staff are actively learning new skills to prepare themselves both for future challenges in their current jobs as well as for new roles and responsibilities within the Company.
- GSTC staff have comprehensive knowledge of relevant national and international best practices and know how to apply them in their day-to-day work.
- An effective process for succession management is in place for all key positions in the Company.

The following key methods were used to deliver the necessary training: International Study Tour (IST), domestic study tour (DST), on site training (OT), off site training (OST), and courses.

The scope of training included:

- Wastewater Sector Management: sector policy, planning, regulation, funding, tariff setting and collection, construction management, technologies, and O&M practices.
- Corporate Management: strategic and business planning, performance management, life cycle management including life cycle costing; demand forecasting, project appraisal, decision support, communications, and time management.
- Project Management: managing project scope, scheduling and budgeting; value engineering; project procurement; project accounting and cost control; construction management; and post project audits.
- Financial Management: financial planning; budgeting; accounting; life cycle management including life cycle costing; cost management; cash management; revenue forecasting; tariff setting and collection; auditing; and financial reporting; risk analysis and management methods; scenario analysis over a time cycle with varying conditions.
- Operations Management: operations planning and management; maintenance planning and management; system monitoring; process control; laboratory services – sampling and analysis; sludge management; stores and parts management; condition assessment; service life assessments; safety management; and energy management.
- Business Support: information management; document management; human resources management; purchasing, MIS, GIS, and office systems.

As part of the implementation of the training component, a formal M&E process was instituted (training assessment, refinement and reporting) for feedback from participants on the quality and relevance of specific training initiatives.

It should be noted that, by agreement between the consultancy firm MWH and GSTC at the end of March 2008, and with the new Water Bureau in place, further work planned on the Dashadi management contract was no longer required. The management contract for Dashadi WWTP operations was not implemented.

The remaining time for Dashadi was re-allocated to (i) supporting the requested sludge dewatering studies, (ii) improving GSTC's O&M budgets, (iii) assisting GSTC with monitoring and refining the training plan, and (iv) developing an HR-IS proposal to the World Bank and updating the GSTC's HR strategy including updating priorities and key tasks.

Under Part (b) Hygiene promotion. The activity was to upgrade public toilets in Guangzhou city which served many low-income neighborhoods in various parts of the city. Guangzhou ended up launching its own program to upgrade public toilets and provided own funds, deciding to concentrate on the institutional strengthening activities in building capacity for GSTC, promoting PSP and updating the Wastewater Master Plan.

Under Part (c) the following activities were carried out.

#### Private Sector Participation in Jiangmen

A service contract was established between Jiangmen Municipality together with the Public Utilities Bureau (now the Jiangmen Integrated Urban Management Bureau) and the consultant in July 2009 to organize a study tour to three European countries and to prepare the bidding documents of Duran WWTP (including the BOT contract documents).

Due to a variety of reasons, in March 2010, Jiangmen Municipal Government asked Jiangmen Urban Development Group to invest in and develop the Duran WWTP, instead of entering into a BOT contract for the construction and operation of the facility, as was originally planned. Therefore the scope of this activity needed to be modified. After discussions among the PMO, the consultant and the Bank, it was agreed that, instead, a **mid-term review** would be carried out on the existing BOTs in other wastewater systems in Jiangmen, and to assist Jiangmen to develop a regulatory framework on concessional operation.

Under the technical assistance, the regulatory framework, the content of the existing BOT contract and the performance of the concession of wastewater services were reviewed. A regulatory manual was developed on the basis of the concession agreement to facilitate institutional development and a regulatory system for the concessional market of wastewater treatment services in Jiangmen.

#### Update of the Wastewater Master Plan

Deliverables of this subcomponent were divided into three main parts: (a) analysis of the current situation, (b) hydrodynamic and water quality modeling, and (c) alternative/scenario analysis. The reports respond to the TOR in terms of format and content. The existing analysis presented and analyzed the water qualities of the PRD rivers, compared the pollution control targets proposed in the master plan with the existing water pollution, raised water pollution issues in the PRD, and gaps in the current plan. The report on hydrodynamic and water quality modeling developed proper hydrodynamic and water quality models for the PRD, which are being used to forecast trends of changes in hydrodynamic and water quality conditions, and how pollutants of the PRD would affect water quality. The report on alternatives proposed guidance and suggestions to improve the PRD plan based on cost-efficiency criteria.

#### Part (d) Training and Study Tours

Field visits were made to a WWTP in Berne, Switzerland, wastewater facilities in Hungary, IZSU (the water resources management committee) and its subsidiary WWTP in Izmir, Turkey, which provided good references to Jiangmen on management issues of existing state-owned WWTPs, financing for facility upgrading and other operation and sewer maintenance challenges. In the study tour to Brazil (IPPUC Institute for Research and Urban Planning of Curitiba, and URBS of Curitiba, and the Technical and Environmental Ministry of Brazil), discussions were held with the management and technical staff, on applying centralized operation of quality assets to facilitate development of state-owned enterprises; potential technical upgrading on existing WWTPs for better environmental effects; and delegating sludge disposal to a contractor.

### Annex 3. Economic and Financial Analysis

#### *Pearl River Delta Region*

The PRD region is formed by Xi Jiang, Bei Jiang, and Dong Jiang which are major branches of Pearl River that discharges in to the South China Sea through eight provincial tributaries. PRD consists of the cities of Guangzhou, Shenzhen, Zhuhai, Foshan, Jiangmen, Dongguan, Zhongshan, Huizhou, and Zhaoqing all in Guangdong Province.

Guangdong Province is one of the most developed provinces in China. In 2001, the provincial GDP of Guangdong Province was RMB1065 billion which was 11.3% of the national GDP of China, while the provincial GDP of Guangdong Province in 2010 was RMB4601 billion which accounted for 11.6% of the national GDP of China. Guangdong Province is the biggest contributor of the national GDP of China.

The PRD region is the most important region in Guangdong Province. The PRD region is home to half the total population of the province and produces about 80% of total provincial GDP of Guangdong Province. The population and GDP of the PRD region are presented in the following tables.

**Table 3A-1a: Population and Income Data of PRD in 2000**

	Area (km <sup>2</sup> )	Population (million)	Population Density (person/km <sup>2</sup> )	GDP (RMB billion)	GDP per capita
Total Guangdong	179,813	86.50	481	1,074.13	12,418
Total PRD	54,733	42.90	784	842.22	19,633
% of Total Guangdong	30%	50%	163%	78%	158%

**Table 3A-1b: Population and Income Data of PRD in 2010**

	Area (km <sup>2</sup> )	Population (million)	Population Density (person/km <sup>2</sup> )	GDP (RMB billion)	GDP per capita
Total Guangdong	179,813	104.41	581	4,601.31	44,070
Total PRD	54,733	56.16	1,026	3,767.31	67,077
% of Total Guangdong	30%	54%	177%	82%	152%

However, the economic development in PRD region had come at a heavy environment cost. In 2000, the PRD region produced 4,197.5 million tons of wastewater. As investments in environmental protection could not keep pace with the region's rapid economic development, the river's water quality seriously deteriorated. In 2000, the wastewater treatment capacity in the PRD region was only 2.6 million tons per day, equivalent to 22% of total wastewater generated. According to China's 2002 Environment Statement, the water quality at nine of 49 monitoring stations scattered along the entire Pearl River was at Class IV or V and four others were even worse than Class V. Many urban sections of the Pearl River were at Class V or worse. Realizing the serious water situation, Guangdong Provincial Government decided to implement the PRD Clean-up Plan in November 2002.

#### *GPG Environmental Programs – PRD Clean-up Plan*

The main objectives of the PRD Clean-up Plan were to achieve Class III for water quality in the Pearl River by 2010, and the water quality of urban sections of the Pearl River should be better than Class IV (See Annex 8 for Chinese water quality standards). During the PRDCP implementation period (2002 to 2010), the local governments in the PRD invested over RMB55.7 billion to build environmental protection facilities. These facilities included 138 wastewater treatment facilities, seven solid waste treatment facilities, two ecological protection facilities, and they carried out four capacity building activities for environmental management. There were eight additional facilities under construction. The following table summarizes the information relating to PRD, adapted from China's Environment Statements issued by the Ministry of Environmental Protection:

**Table 3A-2: Water Quality of PRD**

	2002	2010
No. of National Monitoring Sections	49	57
Water Quality Standard		
Grade I ~ III	73.5%	84.9%
Grade IV and V	18.3%	12.1%
Worsen than Grade V	8.2%	3.0%
Overall Water Quality	Good	Good
Major Pollutants	Petroleum, Permanganate Index, BOD	Dissolved Oxygen, Petroleum, Permanganate Index, Ammonia Nitrogen, BOD5

From the data and information listed in the above table, the water quality of PRD in 2010 was better than that in 2002, or at least it did not worsen. This project undoubtedly contributed to these improvements in PRD's water quality, although the investment of the project is only 2% of total investment in PRD mobilized by local governments to implement the PRD Clean-up Plan.

#### *Summary of Project Benefits and Costs*

This project included five components:

- **Wastewater Management:** Under this component, the project constructed a new treatment plant at Dashadi with a capacity of 200,000 m<sup>3</sup>/d, expanded the existing Liede plant by 200,000 m<sup>3</sup>/d (Liede III), and constructed about 371 km of truck sewers to convey wastewater from the drainage catchments of Dashadi, Liede III, and other four drainage catchments (i.e., Xilang, Lijiao, Datansha, and Liede II), reducing about 129 km of sewers appraised.
- **Regional Hazardous Waste Management:** Under this component, the project constructed a secure landfill with capacity of 290,000 m<sup>3</sup> which doubled the capacity appraised. This component also constructed a transferring area, a physical and chemical workshop, stabilization and solidification workshop. This facility is to serve Guangzhou and neighboring cities to treat hazardous wastes and incinerator ash.

- **Inter-municipal Environmental Infrastructure:** Under this component, the project expanded the capacity of the wastewater treatment facility in Nangang from 25,000 to 100,000 m<sup>3</sup>/d and a wastewater collection system in Foshan for the Zhen'an III WWTP with capacity of 100,000 m<sup>3</sup>/d.
- **Water Quality Monitoring and Information System:** Under this component, the project (a) constructed three monitoring stations at provincial boundaries and four monitoring stations at river estuaries, (b) updated three provincial automatic monitoring stations, (c) provided equipment for the quality assurance of the automatic monitoring stations and vehicles, and (d) constructed a MIS for the automatic monitoring system for water quality.
- **Institutional Strengthening and Training.**

The wastewater and hazardous waste management components are major investments financed by the Bank loan. The other three components, partially financed by the GEF grant, are strong complements to these two, and also crucial to the implementation and the success of the entire project.

The benefits of the project include reduction in water supply and public health costs, and results in positive impacts on amenities, tourism, land values (especially those on the water front), agriculture, and fisheries. However, since it was difficult at appraisal to value those benefits in monetary terms due to the limited data available, the complexity of the causes of pollution, and uncertainties related to the linkage between pollution reduction and the benefits, a cost-effectiveness approach was adopted in the analysis.

At appraisal, the following factors were considered when the cost-effectiveness analysis was conducted:

- Pollution control targets;
- Net present value of total investment cost (NPV);
- Average incremental cost (AIC);
- Financial internal rate of return (FIRR);
- Tariffs; and
- Affordability.

#### *Cost-effectiveness Analysis*

### **Wastewater Management Component**

*Project alternatives.* At appraisal, there were three options (one base scheme and two alternatives) analyzed. The selected option for funding under this project comprised: (a) construction of the Dashadi WWTP with a capacity of 200,000 m<sup>3</sup>/d, (b) expansion of the existing Liede (Liede III) with a capacity of 200,000 m<sup>3</sup>/d, and (c) construction of 500 km of trunk sewers in six drainage catchments of Dashadi, Liede III, Xilang, Lijiao, Datansha, and Liede II. The total investment was estimated about RMB2,641.8 million.

During implementation, the Dashadi and Liede III WWTPs were built following the selected option. However construction of trunk sewers was optimized, and the final sewers built was 371 km. Total expenditures for this component were about RMB2,777.4 million, or 5% higher than the cost estimate at appraisal. The cost increase was mainly due to rising resettlement costs. The selected alternative is still cost-effective because the alternatives at appraisal focused on the amalgamation of other WWTPs with the Dashadi WWTP. The increased resettlement costs would have had the same impact on a different alternative.

*Water quality improvement and economic benefits.* At appraisal, it was estimated that the dissolved oxygen concentrations would increase, on average by 3.5 mg/l over the section receiving discharges from the Liede and Dashidi WWTPs. However, this target was not realized. According to data provided by Changzhou AMS, the DO in the Guangzhou Section of the Pearl River was only 2.74 mg/l representing Class IV water quality, much lower than 5 mg/l which is the standard for Class III of water quality. The actual monitoring data of influent and effluent of Liede III and Dashadi WWTPs for 2011 presented in Annex 2 shows that the wastewater treated and discharged into the Pearl River has met all required effluent standards. The reasons for not improving the water quality as appraised are likely due to factors external to the project. Compared to the average annual runoff of the Pearl River which is 336 billion cubic meters, the treatment capacities installed under this project are very limited.

The economic benefit of water quality improvement analyzed at appraisal to illustrate the magnitude of the potential benefits was proxy of the amount of money Guangzhou residents spent on bottled water. This is one of avoidable costs. At appraisal, it was concluded that about 31% of households in Guangzhou consumed bottled water and the average expenditure per family using bottled drinking water was RMB31 per month.

During implementation, a market survey on bottled water was conducted. The results of this survey show that 86% of Guangzhou households were consuming bottled water. Assuming 60% of households are middle income and above families which could consume bottled water, only 51% of Guangzhou households would consume bottled water. Of that number, 64% of these households consumed one bottle each week, 24% consumed half a bottle each week, and 12% consumed two bottles each week, based on the results of that market survey. Therefore, in 2010 the average consumption of bottled water per family in Guangzhou would be estimated at RMB63.83 per month, which doubles the expenditure of bottled water per family consumed at appraisal. However, there are doubts about the extent to which this survey should be used as an indicator to measure the economic benefit of water quality, since the same market survey also indicated that the residents in Guangzhou, even in Beijing and Shanghai, select bottled water for drinking, not only because bottled water is safer, but also because it is more convenient.

As mentioned above, the water quality of Pearl River has not improved significantly due to various reasons. Since 2008, Guangzhou Municipal Government has spent RMB9.8 billion to introduce water from Xijiang Province to improve the quality of water supply to Guangzhou. This investment implies from another angle that the water quality of the Pearl River has not materially improved and the economic benefit of the project expected at appraisal – reducing expenditures on bottled water – has not been realized.



*Tariff increase.* The current average wastewater tariff is RMB1.06/m<sup>3</sup> which was increased in July 2009 from RMB0.70/m<sup>3</sup>. At appraisal, it was forecasted that the wastewater tariff in Guangzhou should be increased to RMB2.43/m<sup>3</sup>. However, in order to satisfy the financial covenants requiring covering O&M and depreciation costs, the tariff should be raised to RMB 2.94 in 2012. The financial projections carried out by GSTC considered raising the average wastewater tariff to higher levels, i.e., between RMB3.6 and RMB 3.7. The current wastewater tariff cannot meet the requirements of operating<sup>5</sup> the wastewater facilities in Guangzhou.

*Affordability.* Before the wastewater tariff increase in 2009, a public hearing was held in Guangzhou. There were 11 participants in the public hearing and they all in general supported the tariff increase. According to statistical data, about 78% of households in Guangzhou consumed 22 tons of water per month. The wastewater tariff for residents increased to RMB0.90/m<sup>3</sup> from RMB0.70/m<sup>3</sup>. This increase of wastewater tariff caused 78% of households in Guangzhou to pay about RMB4.00 more per month for the wastewater they generated, which only accounted for 0.01% of the disposable income of each family.

Due to the introduction of quality water from Xijiang to Guangzhou, a public hearing was held in February 2012 for increasing the water tariff to compensate for the investment. According to the analysis, the increased water tariff will account for 0.435% of the disposable income of each family. Based on this analysis, if the wastewater tariff is increased to RMB2.94/m<sup>3</sup> as projected in the Financial Section below, the average wastewater tariff for each family will be RMB68.82 based on 90% of water consumed, which accounts for 0.380% of disposable income. So the projected wastewater tariff projected below is affordable.

*Poverty aspects.* In 2009, only 1% of the total population lived in low-income households. According to Guangzhou Municipality's policy, these families have certificates issued by the government. The families holding these low-income certificates are exempt from the wastewater tariff, so the increased wastewater tariff in 2009 had no impact on them. This policy will be applicable to future tariff increases as well.

## **Hazardous Waste Management**

*Project alternatives.* At appraisal, there were three alternatives analyzed. The final alternative selected for funding was to build a landfill in Liangtian with a capacity of 150,000 m<sup>3</sup> and other auxiliary facilities such as a physical-chemical treatment plant with a capacity of 5,000 tons per year, and a stabilization and solidification plant with a capacity of 50,000 tons per year. The total investment was estimated at appraisal about US\$24 million. The unit cost of the proposed landfill was about US\$160.

It took seven years (from November 2004 to December 2011) to finish construction of landfill with a capacity of 290,000 m<sup>3</sup> and its auxiliary facilities. The total expenditure for the landfill was US\$46.78 million. The unit cost of the constructed landfill is about US\$161, which means that the initial analysis on alternatives remains valid.

*Market analysis.* This landfill can treat all hazardous waste generated by industries in Guangzhou, and surrounding cities as well. In 2004, the total industrial solid waste generated in Guangzhou was 5.66

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<sup>5</sup> Including O&M and depreciation

million tons including 0.23 million tons of hazardous waste. About 0.15 million tons of hazardous were treated while the other 0.08 million tons were reused. In 2010, the total industrial solid waste increased to 6.92 million tons including 0.25 million tons of hazardous waste. All hazardous waste generated in 2010 was treated. The average increase of hazardous waste from 2004 to 2010 was 1.4%. Therefore, it is estimated that by 2020 the hazardous waste generated in Guangzhou will be about 0.29 million tons.

*Hazardous waste treatment tariff.* The current hazardous waste treatment tariff was set by the Guangdong Provincial Price Bureau:

- RMB1,800 per ton for pH $\geq$ 6; and
- RMB2,000 per ton for pH $<$ 6.

Since landfill construction was just completed at the end of 2011, there are no records for operation. A reasonable tariff cannot be determined.

## **B. Financial Analysis**

A financial analysis was carried out for the wastewater management component and focused on the financial viability of GSTC.

*Guangzhou Sewage Treatment Company – GSTC*

At project appraisal in 2003, wastewater collection, treatment and disposal were the responsibility of the Guangzhou Municipal Gardens Bureau (GMGB). Budgetary allocations were made to fund the service.

During appraisal, as required by the Bank, Guangzhou Municipal Government (GMG) established Guangzhou Sewage Treatment Company (GSTC) in November 2003.

During implementation, in line with the decision on investment and financing system reform for Guangzhou urban construction, Guangzhou Water Investment Group Co., Ltd. (GWIC) was established in August 2008. From then on, GSTC became a subsidiary of GWIC. Currently, GSTC materially controls and operates nine wastewater treatment plants in Guangzhou City comprising Datansha I, II and III, Liede I, II, III, and IV, Lijiao I and II, Dashadi, and Xilang and the total treatment capacity is about 2.98 million tons per day. It also runs 45 pumping stations and maintains 1,414 km of network.

*Wastewater Tariff in Guangzhou City*

Since 2003 GMG has adjusted the wastewater tariff applicable in Guangzhou City twice. The following table lists the actual and projected wastewater tariff by GSTC over the project implementation period.

**Table 3B-1: Actual and Projected Tariffs (RMB/m<sup>3</sup>)**

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	<i>Actual</i>		<i>Projected at appraisal</i>										
Average	0.30	0.70	0.70	0.77	0.85	1.02	1.42	1.71	2.22	2.22	2.67	3.60	3.60
	<i>Actual</i>										<i>Projected in project implementation</i>		
Average	0.30	0.70	0.70	0.70	0.70	0.70	0.70	0.70/1.07	1.07	1.07	3.67	3.60	3.70
Residential	0.30	0.70	0.70	0.70	0.70	0.70	0.70	0.70/0.90	0.90	0.90			
Industrial	0.30	0.70	0.70	0.70	0.70	0.70	0.70	0.70/1.40	1.40	1.40			
Administrative	0.30	0.70	0.70	0.70	0.70	0.70	0.70	0.70/1.20	1.20	1.20			
Commercial	0.30	0.70	0.70	0.70	0.70	0.70	0.70	0.70/1.40	1.40	1.40			
Special	0.30	0.70	0.70	0.70	0.70	0.70	0.70	0.70/2.00	2.00	2.00			

Currently, the wastewater tariff is collected by Guangzhou Water Supply Company (GWSC) based on 90% of water consumption and then passed to GSTC directly.

### *Financial Covenants*

To ensure GSTC has a healthy financial situation, the Guangdong Provincial Government (GPG) and the Bank agreed upon certain financial covenants which are stipulated in the Project Agreement dated July 5, 2004. These financial covenants require GPG shall, through GMG, to cause GSTC to undertake, commencing in 2005:

- (a) To produce for each year total revenues equivalent to not less than the sum of (i) its total operating expenses<sup>6</sup> (including for maintenance) and (ii) the amount by which debt service requirements exceeds the provision for depreciation.
- (b) Not to incur any debt unless a reasonable forecast of its revenues and expenditures shows that its estimated net revenues for each year during the term of the debt to be incurred shall be at least 1.3 times its estimated debt service requirements in such year on all of its debt including the debt to be incurred;
- (c) (i) To review by September 30 of each year, on the basis of forecasts prepared in a manner satisfactory to the Bank, whether it would meet the requirements set forth in sub-paragraphs (a) and (b) above, in respect of such year and the next following year and furnish to the Bank the results of such review upon its completion; and (ii) if any such review shows that it would not meet such requirements for the years covered by such review, promptly take all necessary measures (including, without limitation, adjustments of the structure or levels of its tariffs and charges) in order to meet such requirements.

GSTC started reviewing compliance with financial covenants in 2009 and provided the Bank with its results. The latest review was conducted in March 2012. The financial projection shows that GSTC needs to require GMG to increase its wastewater tariff from current RMB1.06/m<sup>3</sup> to RMB2.94/m<sup>3</sup> in 2012 so that the financial covenants can be complied with. The following table presents the results of such reviews by comparing them with the projections made at project appraisal.

<sup>6</sup> All expenses related to operations, including administration, adequate maintenance, taxes and payments in lieu of taxes, and provision for depreciation but excluding interests and other charges on debt.

**Table 3B-2: Key Operational and Financial Indicators**

		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Water Sales (mil. m <sup>3</sup> )	AA*	403	481	486	492	497	502	508				
	AI**								894			
Sewage Quantity (mil. m <sup>3</sup> )	AA	322	385	389	393	398	402	408				
	AI								804			
Sewage Tr. Capacity (mil. M <sup>3</sup> )	AA	200	200	200	470	470	533	544				
	AI								1043			
Sewage Treated (%)	AA	35	35	81	81	81	90	90				
	AI											
Net Income***	AA	18.6	67.7	92.0	26.3	9.6	61.5	-40.2				
	AI							-293	-2006	-586	-621	-658
Average Tariff (RMB/m <sup>3</sup> )	AA	0.70	0.77	0.85	1.02	1.42	1.71	2.22				
	AI	0.70	0.70	0.70	0.70	0.70	0.88	1.06	1.06	2.94	2.85	2.91
Capital Expenditures	AA	373	332	508	549	264	120					
	AI							9491	120	3292	3302	3302
<b>Financial Covenant****</b>												
Revenue	AA	297	330	400	566	687	772	783				
	AI							927	881	2402	2446	2492
Op. Exp +> of Depreciation or Debt Service	AA	217	220	223	399	565	612	762				
	AI							918	2315	2402	2446	2492
Debt Service Coverage (times)	AA	n/a	n/a	16.2	10.0	6.4	5.4	5.2				
	AI							1.5	0.6	13.3	26.7	1.5

\*AA = At Appraisal

\*\*AI = At Implementation

\*\*\*Takes into account both depreciation and financial costs

\*\*\*\* Required Revenues equal or greater than the sum of operating expenses and the amount by which debt service exceeds depreciation

Since 2009 GMG has indicated no intention of adjusting the wastewater tariff due to social stability concerns. Therefore GSTC is not able to comply with financial covenants although some measures were taken to reduce debt service for the construction of pumping stations and networks.

### *Assumptions to Utility Financial Projections*

There is about a 5% increase for O&M considered in the projections conducted by GSTC. This 5% increase includes inflation and other contingencies.

### **Income Statement**

The projected wastewater tariff revenue was calculated on the basis of volume of wastewater generation and the projected wastewater tariff. The volume of wastewater used for the projections was calculated based on the real volume of wastewater in 2011 and then increased 5% each year.

The projected operating costs include variable costs (chemicals, water, electricity, sludge treatment) and fixed costs (salary, equipment and sewer maintenance, depreciation). Both costs were projected on the basis of real costs in 2011 and then increased 5% each year. The depreciation was projected at 5.94% of total original costs of fixed assets.

### **Balance Sheet**

Inventories were projected on the basis of the volume of wastewater treated and then a 5% increase for inflation and contingencies. There were about 41 days of turnover on average for expenditures for chemicals. Accounts receivables were projected at 8% of total wastewater tariff revenues. There were about 27 days of turnover of total wastewater tariff revenues.

## Annex 4. Bank Lending and Implementation Support/Supervision Processes

### (a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
<b>Lending</b> <i>(The system pulls from Task Team in PAD Data Sheet, if any.)</i>			
Thomas Zearley	Lead Operations Officer and Task Manager	EASCS	Overall
A. D. C. Godavitame	Municipal Engineering Specialist	EASER	Institution
Vellet Femandes	Program Assistant & Document Production	EASIN	ACS
Dan Hoomweg	Sr. Environmental Engineering Specialist	EASIN	Solid Waste Management
Dahong Li	Consultant	EASIN	Environment
Xiaofeng Li	Program Assistant	FEUUR	ACS
Patrick McCarthy	Financial Analyst	GSDPM	Financial Analysis
Hoi-Chan Nguyen/Margaret Png	Legal Counsel	OPCIL	Legal
Robert O'Leary	Disbursement Officer	LOA	Disbursement
Bekir Onursal	Sr. Environmental Specialist	EAPCO	Environment
Chongwu Sun	Environmental Specialist	EASCS	Environment
George Taylor	Consultant	EASCS	Engineering
Chaogang Wang	Resettlement Specialist	SDV	Resettlement
Yanxiang Wang	Consultant	EASCS	Environment
Hardy Wong	Consultant	EASCS	Environment
Jian Xie	Project Economist	EASER	Economist
Dong Yi	Financial Management Specialist	EASCS	Financial Management
Chaohua Zhang	Resettlement Specialist	SASDS	Resettlement
Hao Zhang	Municipal Engineering Specialist	EASCS	Engineering
Zhun Zhang	Institutional Specialist	EASCS	Institution
Zhentu Liu	Procurement Specialist	EAPPR	Procurement
<b>Supervision</b> <i>(The system pulls from Task Team Members in all archived ISRs.)</i>			
Thomas L. Zearley	Lead Operations Officer and Task Manager	EASCS	Overall
A. D. C. Godavitarne	Consultant	EASER	Institution
Chongwu Sun	Senior Environmental Specialist	EASCS	Environment

David I	Sr Financial Management Specialist	EAPFM	Financial Management
Haiyan Wang	Senior Finance Officer	CTRLN	Disbursement
Hao Zhang	Sanitary Engineer	EASCS	Engineering
Hardy M. Wong	Consultant	EASCS	Environment
Jianjun Guo	Senior Procurement Specialist	EAPPR	Procurement
Ning Wu	Consultant	EASCS	Financial Analysis
Paul Kriss	Lead Urban Specialist	EASCS	Overall
Sing Cho	Urban Specialist	EASCS	Overall
Siu-wa Lam	Consultant	EASCS	ICT
Songling Yao	Senior Social Development Specialist	EASCS	Resettlement
Xujun Liu	Consultant	EASCS	Procurement
Yi Dong	Sr Financial Management Specialist	EAPFM	Financial Management
Yiren Feng	Senior Environmental Specialist	EASCS	Environment
Zhentu Liu	Senior Procurement Specialist	EAPPR	Procurement
Zhun Zhang	Consultant	EASCS	Institution
Xin Chen	Senior Program Assistant	EASCS	ACS
Huiying Guo	Program Assistant	EASCS	ACS

**(b) Staff Time and Cost (from SAP)**  
*(The system pulls data available for all fields)*

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of Staff Weeks	US\$ Thousands (including travel and consultant costs)
<b>Lending</b>		
FY2002	8.92	72.04
FY2003	23.31	109.47
FY2004	45	366.98
<b>TOTAL:</b>	<b>77.23</b>	<b>548.49</b>
<b>Supervision/ICR</b>		
FY2005	14.99	70.03
FY2006	12.07	58.27
FY2007	13.02	54.21
FY2008	4.13	33.79
FY2009	10.19	50.57
FY2010	15.2	57.03
FY2011	8.61	29.30
FY2012	12.39	93.74
<b>TOTAL</b>	<b>90.6</b>	<b>446.95</b>

## **Annex 5. Summary of Borrower's ICR and/or Comments on Draft ICR**

### **(i) Assessment of the operation's objective, implementation, and operational experience;**

#### ***Assessment of PDO***

The PDO was adequate as it supported the efforts to address the challenge of water pollution in the PRD and is consistent with Guangdong's policies and planning on pollution prevention and control. Guangdong had adopted a plan to accelerate wastewater management in the Pearl River Delta through the PRD Cleanup Campaign, which sets out phased targets to meet water quality standards. The PDO of this project well supported Guangdong's initiative. However, the PDO was too ambitious in consideration of the project scope.

#### ***Assessment of the Implementation***

The implementation of the project, in general, is satisfactory. The project has successfully finished all project activities and achieved expected results.

At the very beginning of the project, PMOs and PIUs were established with designated staff to manage the project. Due to the complexity of the project, there were 2 PMOs respectively at provincial and municipal levels and 7 PIUs. Extra coordination was required for such a challenging project.

The procurement, financial management, M&E and safeguards of the project were carried out in a satisfactory manner.

For procurement, there were about 80 contracts in this project; except for a few contracts, the contracts were procured and implemented strictly according to the Bank's procedure and procurement guidelines.

In terms of financial management, the Bank's proceeds were fully utilized and yield great results; but a sum of about US\$500,000 was refunded to the Bank due to overlook in the review of the supporting document.

The resettlement of the project was finished in full compliance with Bank's involuntary resettlement policy and regulations (OP 4.12 on Involuntary Resettlement). During implementation, the designed was improved to adopt advanced engineering techniques such as pipe-jacking, to reduce the influence on the neighboring population. External and internal monitoring was conducted for the resettlement.

Effective environmental mitigation measures were adopted during implementation to reduce the adverse effects on the environment to the greatest extent. During construction, no complaint was received.

Though the project was implemented with successful results, there are still some key implementation issues:

On the wastewater sector, the project financed the construction of 80 km in the Dashadi service catchment area, 40 less than originally planned. The total length of the wastewater collection network of the Liede WWTP (phase III) service catchment at design was 145km, of which finally 99 km were constructed. Also, 46 km of tertiary separated storm/sewage sewers were dropped.

The construction of the Nangang WWTP encountered several difficulties and consequently this component suffered serious delays. One of the major issues was the difficulty in land acquisition. Other challenges during the implementation of this component were the excessive delays in finalizing contract arrangements and the low quality of the main suppliers. One of the causes of these problems was the contract awarding mechanism of selecting the lowest cost bid.

In the Foshan sub-component, the design was modified to adapt the sewer network to the plant being constructed under PRD2. These changes caused subsequent delays.

On the PSP Technical Assistance, delays were caused by modifications in the TORs by the PIU after agreed with the Bank. Regardless of these changes, the component was back on track through collaboration among all the parties. Savings derived from this change allowed the inclusion of additional domestic study tours to four cities in east China and Beijing, which increased the value added of this activity and provided good references to Jiangmen on PPP regulation and management models.

## **(ii) Assessment of the outcomes**

The outcomes of the project are satisfactory.

### *Wastewater component.*

By supporting Guangdong Government's efforts to clean up the Pearl River, this project has contributed an expanded and renewed network of sewers and new wastewater treatment facilities that are able to match the demand for wastewater generation.

GSTC is now a corporate utility which strategy focuses on increasing wastewater interception and COD reduction through improved catchment-based wastewater collection and modern treatment systems that will allow increasing coverage of municipal wastewater sewerage network and treatment.

An important step forward in strengthening the institutional wastewater management framework was achieved after GSTC was restructured in March 2010 based on corporate management concepts. The company's headquarter divisions and subsidiary entities were reorganized with clearly defined authorities and responsibilities. A solid financial audit system is now in place, the company has a robust HR structure and technical skills of key staff have been strengthened and incentives are based on evaluated performances.

Training was carried out at the time that GSTC was preparing its institutional reforms. Training on HR management, financial management and other aspects provided medium to high levels of management staff with corporate management knowledge and familiarized them with commercial



operation models, which improved GSTC's operation capacity and laid a foundation for development and implementation of corporate development plans.

#### *Hazardous waste component*

A hazardous waste landfill of 290,000m<sup>3</sup>, a pre-processing center, a physical/chemical treatment workshop, and stabilization and solidification workshop were built. These facilities will meet Guangzhou's need of safety disposal of non-reusable hazardous waste. Hazardous waste from industries in Guangzhou will be entirely treated at the new facility. Moreover, sufficient capacity is available to provide services to surrounding towns in the PRD area. This new facility forms part of the essential environmental infrastructure in Guangzhou and PRD region and will respond to the rapid growth of the metropolitan area of Guangzhou, also providing the city with sufficient emergency responsive capacity.

#### *Inter-municipal component*

This component broke the concept that environmental infrastructures have to be developed within the district jurisdictional borders. This was achieved by promoting collaboration of neighbor districts in developing environmental infrastructure. These pilots maximized the environmental and economic benefits at minimum capital cost. The two facilities at Nangang and Foshan will reduce pollution load in the receiving water bodies and reduce the stress to drinking water sources, and can be considered to be a model to be replicated nation-wide.

In the case of Foshan, this intervention, together with the ones financed under phase two, will foster investment, trade and tourism.

#### *Water quality*

With application of modern telecommunication technologies, a powerful professional information network has been developed to monitor the environmental quality of the PRD. This was achieved by upgrading and expanding the number of automatic monitoring stations and developing a platform for data visualization and management.

Development and operation of the system will bring significant social and economic benefits. Real-time and continuous water quality data of the river's critical sections will show the temporal and spatial dynamics of the water quality in an accurate manner. The new system allows detecting illegal water pollutant discharges, providing effective early warning and projection of affected waters.

The WQM information system is also providing data support for the adequate appraisal of future environmental improvement projects at the Pearl River. Conservation of the drinking water sources is strategic to the socioeconomic development of the river basin. Real time monitoring data continuously available and periodically updated in the online monitoring platform is publically available so citizens will improve their knowledge and awareness of environmental conditions of the PRD.

Another expected positive impact of this component is the contribution to strengthening pollution control at the South China Sea by helping to enforce the limitation of the amount of pollutants being discharged in the Delta and otherwise entering the South China Sea.

#### *Update of PRD Wastewater Management Plan*

This exercise highlighted the main gaps of the former plan and allowed the comparison of different pollution targets and means to achieve them under different development scenarios. This tool makes now possible to forecast future trends of changes in water conditions, and to visualize how different pollutant levels would affect recipient water bodies.

#### *PSP study*

This study produced a systematic analysis of BOT modalities applicable for developing WWT facilities in Guangdong and China. It also analyzed associated PSP laws and proposed a regulatory context, conducted a market analysis, investment and financing options, taxation issues, implementation (building, operating, regulating and transferring), and resolution of disputes. The report identified the main challenges in existing concessional operation agreements (Longquan WWTP) that were inappropriate given the existing conditions and gaps in the regulatory system. It provided good guidelines on regulations related to service improvement of the two WWTPs in Jiangmen. The study provides sound references for developing and improving the regulatory system of concession options in Jiangmen. In particular it gives useful recommendations for the BOT tender of the Jianghai WWTP which is to be started soon and for the operation of other state-owned WWTPs in the near future.

### **(iii) Borrower's own performance during the preparation and implementation of the operation, with special emphasis on lessons learned that may be helpful in the future**

#### *Borrower's own performance*

The local government has showed strong commitment to address the serious environmental problems. On one hand, the local government has provided necessary counterpart funding to the project; the government also injected a great amount into the PRD Clean-up Campaign initiated on its own. On the other hand, the local government adopts institutional reforms, including the establishment of GSTC as an autonomous company and introduction of PSP into solid waste management, to encourage marketization of the environmental infrastructure and ensure sustainable development.

The implementing agencies were committed to successfully complete the project and achieve the development objectives. A lot of efforts were made to overcome the difficulties during the implementing, such as land requisition and insufficient funding. Despite some fiduciary issues in the process, active response was made and the institutional capacity was constantly improved to avoid future problems.

#### *Lessons Learned*

The PDO, though addressing to the urgent need of the province, is too ambitious for such a project of this scope. The unrealistic PDO has affected the following assessment of the project.

The design of the project is very complex, with too many components and involving too many institutions. The coordination under this project was overwhelming. Besides, the inter-municipal component was not sufficiently assessed, which led to the delay of implementation. Adequate consideration during project design is very critical.

The procurement plan initially prepared was not rational in terms of packaging. Being a highly difficult and technically challenging project, if alternate procurement method could have been

approached for the development, the entire project progress would have been facilitated with lower risks of procurement, execution and supervision.

More attention should have been paid to the design and preparation of bidding documents to prevent irregularities in the competition process and to improve the cost efficiency of the investment. The commercial, technical parts and bills of quantities of the bidding documents should have been better tailored to the project characteristics, and carefully defined. Special contract conditions should have been refined according to project characteristics, where rights and obligations of the parties should have been defined to minimize disputes during execution.

Communication problems between the international consultant firm and the project owner and the consultant team were frequent during the implementation. This firm could not provide the best services and assistance to the project owner despite its familiarity with the Bank procurement guidelines and requirement. This was because it had no local office and knew little of local situation and conditions. Local consultant firms should have been encouraged and supported to improve its familiarity with Bank-financed projects to gain local experience and perform better.

**(iv) Evaluation of the performance of the Bank, any co financiers, or of other partners during the preparation and implementation of the operation, including the effectiveness of their relationships, with special emphasis on lessons learned**

The Bank provided great support to the implementing agencies, enabling the assimilation of the new procedures. The Bank has played a very positive role in facilitating institutional innovations. However, attentions must be drawn to the following aspects:

The stability of the task team needs to be maintained. The task team leader and members were changed frequently under this project, which had to some extent led to the low efficiency in communications and somewhat affected the project progress.

The supervision mission was not well planned. In some years, there were 4-5missions yearly, including 2 supervision mission, a technical mission, a fiduciary mission, and a safeguards mission. The frequent missions placed heavy burden on the implementing agencies.

**Annex 6. Comments of Cofinanciers and Other Partners/Stakeholders**

N/A

## Annex 7. Resettlement

The Project triggered OP 4.12 and so a RAP was prepared as part of project preparation. RAP implementation started in 2004 and was mostly completed, with except for one village, by the end of 2011. RAP implementation was coordinated by GZPMO, and with external monitoring carried out by three external resettlement consultants. A summary report of resettlement implementation was completed by the PMO.

### A. Resettlement Implementation

Resettlement occurred under three components: Wastewater, Solid Waste and Inter-municipal Infrastructure.

- a. Wastewater:** Guangzhou municipal sewage treatment project comprised: i) Dashadi Wastewater Treatment System; ii) Guangzhou Liede Wastewater Treatment System; iii) Reconstruction of Four Sewage Network Systems. Permanent land acquisition of 27 mu of state owned land and 1,180 mu of collective land was required, together with temporary occupation of state-owned land of 287 mu and collective land of 1,107 mu. The land acquisition affected 481 households (1,685 people). Housing demolition of 238,868 m<sup>2</sup> of housing also took place. In total 643 households with 6,780 people were relocated.
- b. Solid Waste:** The component took only collective land, totaling 500 mu of non-cultivated mountainous and hilly land collectively owned by two villages and contracted to local people for fruit trees. Demolition of about 23,865 m<sup>2</sup> of simple structures used for poultry and pig-raising that concerned seven local operators also took place.
- c. Inter-municipal Infrastructure:** The component permanently acquired 11 mu of collective land and temporarily used 24 mu of collective land. No resettlement was involved.

Compared to the RAP, the actual resettlement impacts were much reduced especially in the Wastewater component. The resettlement impacts in the wastewater component in the RAP include relocation of 6,030 households or 24,342 people, but the actual resettlement was reduced to 5,387 households or 17,562 persons. The number of PAPs was greatly reduced because effective construction measures, such as pipe jacking, pipeline layout modification, etc. were employed and more accurate surveys and investigations were prepared following RAP preparation.

Total permanent land acquisition decreased from 1,929 mu as planned in RAP to an actual of 1,180 while temporary land acquisition decreased from 3,253 mu to 1,478 mu. As showed in the table below, except for Liede 3 WWTP and the Hazardous Waste Center, the actual permanent land acquisition was reduced especially in reconstruction of the four sewage network systems. Compared with the RAP, the actual amount of building demolition decreased greatly from 958,565 m<sup>2</sup> to 262,733 m<sup>2</sup> or 73%.

### Comparison of Permanent Land Acquisition

Unit (mu)

	<b>PAD</b>	<b>RAP<sup>7</sup></b>	<b>Actual<sup>8</sup></b>
<b>Dashadi</b>	902.21	306.59	597.77
<b>Liede 3</b>	238.84	202.51	594.36
<b>Liede 1-2*</b>	9.07	25.67	N/A
<b>Datansha</b>	190.73	338.85	0
<b>Lijiao</b>	195.57	415.32	0
<b>Xilang*</b>	92.24	31.06	300.23
<b>HW Center</b>	300.40	300.40	500

\* According to the PMO, implementation of both Liede 1-2 and Xilang were not Bank supported components.

### B. Resettlement Fund Disbursement

At present, a total of RMB 2,039 million was used for resettlement implementation under the wastewater component; RMB 83 million for the Solid Waste Component; and RMB 6.4 million for the Inter-municipal component. All assets affected by the project were compensated according to contracts/agreements, not less than specified in the RAP, and prior to asset-taking.

### C. Resettlement Monitoring

Resettlement implementation in the wastewater component was monitored by Zhongshan University from 2004 to March 2010 and by Hohai University from April 2010 to December 2011. The solid waste component was monitored by the Guangdong Provincial Social Science Institute. The inter-municipal component was monitored by the Shenzhen Kexin Company. All the external monitoring reports were provided regularly.

### D. Evaluation of Livelihood Restoration

Hohai University's monitoring team conducted random investigations on livelihood restoration with 67 households over the last two years. The investigations concluded the livelihoods of the PAPs have been fully restored and their average annual income has actually increased from RMB 28,382 in 2010 to 33,544 in 2011. Their living environment, including provision of public facilities and services, has improved significantly.

<sup>7</sup> Page 61, Volume One of the 5<sup>th</sup> Edition of RP (Chinese version).

<sup>8</sup> Provided by PMO (GSTC / GHWMC).

### Average Income Structure of PAPs

<b>Income Sources</b>	<b>Income 2010 (CNY)</b>	<b>Income 2011 (CNY)</b>
<b>Rental</b>	4,435	4,875
<b>Collective dividends</b>	3,201	3,201
<b>Enterprises pay</b>	6,744	8,256
<b>Working income</b>	6,340	8,530
<b>Sideline business</b>	3,472	4,062
<b>Others</b>	4,190	4,620
<b>Total</b>	<b>28,382</b>	<b>33,544</b>

The PAPs focused on improvements in their standard of living after becoming familiar with their new living environment. Since Guangzhou Municipality is located in coastal areas, its employment opportunities are abundant and few local residents owned land, so their main income came from enterprise pay, wage income, rental income and dividends or other sources of income; therefore, land acquisition had minimal impact on them. With the development of a market economy, more employment opportunities are available, making it easier for local residents to find employment. As there is a significant floating population in Guangzhou, rental income is a major source of income for suburban PAPs.

Under the solid waste component, all land compensation was disbursed to the two villages and the seven investors received compensation for their structures through transparent procedures. The monitoring agency conducted surveys on living standards and concluded that the PAPs' livelihoods were restored. The 500 mu of land taken was collective land and compensation that the seven operators received was for orchards and simple structures for poultry and pig-raising. The monitor suggested that management of the compensation for the collective land under the village authorities should be more effective and transparent with clearer and more reasonable regulations.

The inter-municipal infrastructure component had little impact on PAPs, due to very small portion of land required. The two monitors concluded that the PAPs had their livelihoods restored, with full compensation.

#### **E. Pending Issue**

Chebei village under the wastewater component has not yet completed its construction of replacement housing for 154 households (550 people). The GZPMO is responsible for ensuring its completion as soon as possible; the Bank will supervise this work through satisfactory completion.

### Summary of Resettlement Implementation Analysis

<b>Project / Item</b>	<b>Unit</b>	<b>RP</b>	<b>Actual</b>
<b>WW</b>			
Relocated HH	HH	6030	643
Relocated persons	person	24342	6780
Land acquisition	mu	1640	1207
Affected house area	m <sup>2</sup>	958,564	238,868
Budget	10000 CNY	290300	203900
<b>HW</b>			
Relocated HH	HH	2	0
Relocated persons	person	13	0
Land acquisition	mu	300.40	500
Affected house area	m <sup>2</sup>	1,128.40	23,865
Budget	10000 CNY	6763	8015
<b>The total</b>			
Relocated HH	HH	6032	643
Relocated persons	person	24,355	6,780
Land acquisition	mu	1940.40	1706
Affected house area	m <sup>2</sup>	982,428	262,733
Budget	10000 CNY	297,063	211,915
<p>1. Number of relocated HHs was significantly reduced mainly because i) project scope was narrowed, from more than about 400 km pipeline to about 200 km; ii) advanced construction techniques were applied, like pipe jacking, to reduce structure demolition / household relocation.</p> <p>2. Resettlement cost is much higher than planned, if it is considered that resettlement is much reduced. The reason is real estate prices increased significantly over the project period.</p>			

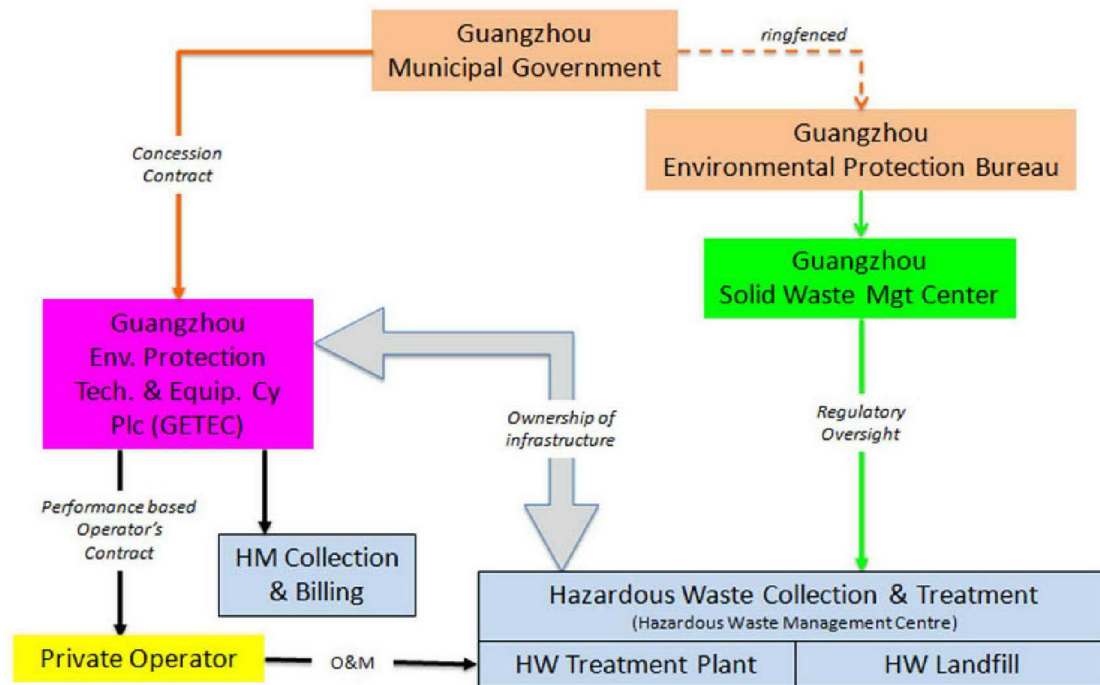


### Detailed Comparison of Actual and Planned Resettlement

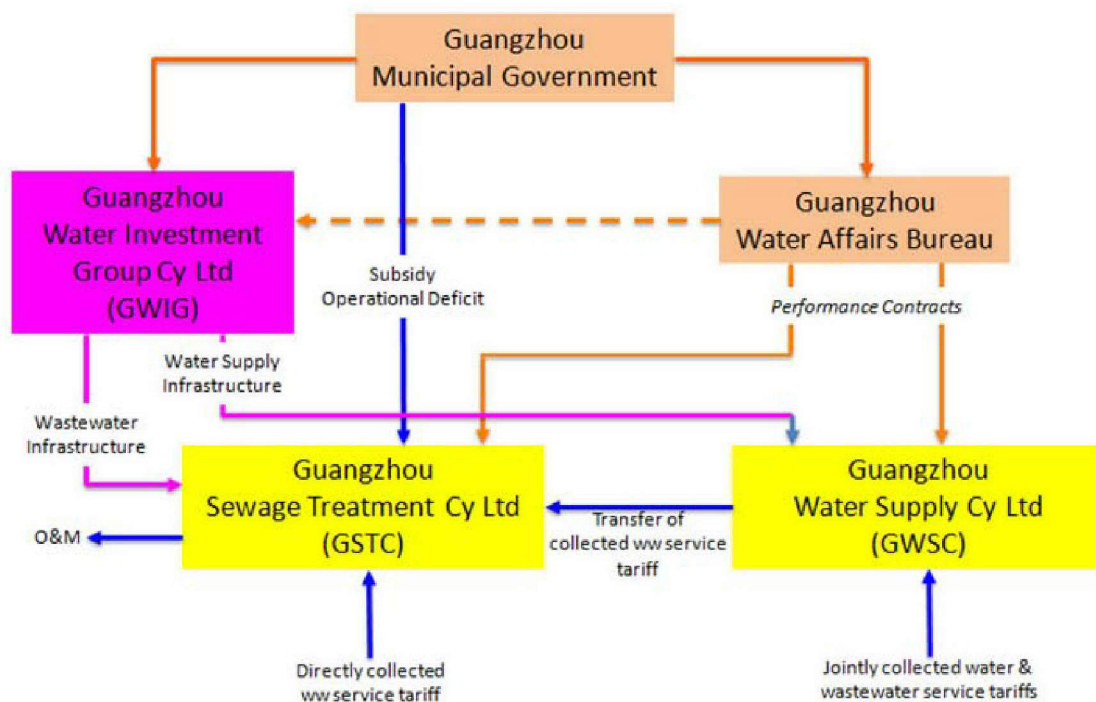
Components	Permanent Land Acquisition (mu)		Temporary Land Acquisition (mu)		Building Demolishing (m <sup>2</sup> )		Resettlement			
							Households		Population	
	P	A	P	A	P	A	P	A	P	A
Dashadi WWTP	604.22	597.77	0	97.78	75,763.00	69,777.79	42	19	820	24
Dashadi Sewer	297.99	14.31	980.96	469.04	246,314.88	18,128.66	2,986	41	10,242	47
Sub-total	902.21	612.08	980.96	566.82	322,077.88	87,906.45	3,028	60	11,062	71
Liede 3 WWTP	0	388	0	48	0	18,000	0	154	0	750
Liede 3 Sewer	238.84	206.36	763.50	365.46	113,129	26,183.4	1,454	154	6,296	550
Sub-total	238.84	594.36	763.50	413.46	113,129	44,183.4	1,454	308	6,296	1,300
Datansha Sewer	190.73	0	592.61	2.39	175,316.00	0	2,207	0	10,700	0
Liede 1-2 Sewer*	9.07	N/A	25.48	N/A	5,592.00	N/A	60	N/A	249	N/A
Xilang Sewer*	92.24	300.23	260.15	84.19	18,415.00	49,139.30	311	N/A	808	N/A
Lijiao Sewer	195.57	0	630.71	411	322,906.00	106,777.84	4,200	275	15,513	5,409
Sub-total*	487.61	0	1,508.95	413.39	522,299.00	106,777.84	6,407	275	26,213	5,409
HW Center	300.40	500	0	0	1,128.40	23,864.82	2	0	13	0
Sub-total	300.40	500	0	0	1,128.40	23,864.82	2	0	13	0
<b>Total</b>	<b>1,929.06</b>	<b>1,706.44</b>	<b>3,253.41</b>	<b>1,393.67</b>	<b>958,564.28</b>	<b>262,732.51</b>	<b>11,262</b>	<b>643</b>	<b>44,641</b>	<b>6,780</b>

\* According to GZPMO, both Liede 1-2 and Xilang were not part of the Bank-supported project and their statistics are not included.

## Annex 8. Institutional Framework for Hazardous Waste Management



## Annex 9. Institutional Framework for Hazardous Waste Management



## Annex 10. Discharge Standards for Municipal Wastewater

### Discharge Standards for Municipal Wastewater (GB18918-2002)

**Table1. Highest Allowable Discharge Concentration of Water Pollutants from Sewage Treatment Plants (Daily Average)**  
(Unit: mg/l)

Basic Controlled Indicators		Class I Standard		Class II Standard	Class III Standard
		A	B		
COD		50	60	100	120 (1)
BOD <sub>5</sub>		10	20	30	60 (1)
Suspended Solids (SS)		10	20	30	50
Animal and Plant Oil		1	3	5	20
Petroleum		1	3	5	15
Negative Ion Surface Active Agent		0.5	1	2	5
Total Nitrogen (as N)		15	20	-	-
NH <sub>3</sub> -N (as N)		5 (8)	8 (15)	25 (30)	-
Total P (as P)	Built before Dec 2005	1	1.5	3	5
	Built before Jan 1, 2006	0.5	1	3	5
Color (dilution magnitude)		30	30	40	50
PH		6-9			
Bacillus Coli (count/l)		1000	10000	10000	-

- Notes: (1) Removal rate indicators should be higher than 60% when inlet water COD is higher than 350 mg/l, higher than 50% when BOD is higher than 160 mg/l;  
 (2) Values outside brackets refer to controlled values when water temperature is  $>12^{\circ}\text{C}$ , those inside refer to controlled values when water temperature is  $\leq 12^{\circ}\text{C}$

**Table 2 Environmental Quality Standards (Main Parameters) for Surface Water  
 (GB3838-2002)  
 (Unit: mg/l)**

Classification	Class I	Class II	Class III	Class IV	Class V
Description	Mainly applicable to water sources and national nature reserve areas	Suitable for class I drinking water supplies, endangered fish reserves, and fish and shrimp breeding areas	Suitable for class II drinking water supplies, general fish reserves, and swimming areas	Mainly suitable for general industrial purposes and recreational uses that do not involve direct human contact with the water	Mainly suitable for agricultural uses and general scenic purposes
BOD <sub>5</sub>	$<3$	3	4	6	10
DO	90% (or 7.5)	6	5	3	2
Acidity (pH)	6-9	6-9	6-9	6-9	6-9
Total Phosphorus	0.02(L/R 0.01)	0.1(L/R 0.025)	0.2 (L/R 0.05)	0.3 (L/R 0.1)	0.4 (L/R 0.2)
Total Nitrogen	0.2	0.5	1.0	1.5	2.0
NH <sub>3</sub> -N	0.15	0.5	1.0	1.5	2.0
Fecal Coli form	200	2000	10000	20000	40000