

添付資料 3 質問票収集結果

GW I Headquarters' Response to JICA Questionnaire

DRAFT RESPONSE

1 General Information

1.1 Background Data

1.1.1 Population Data

Preliminary population data was submitted by Division 5. This data is an estimate of the amount of customers in the project area. Occupancy of 4 will be used to estimate the population until more detailed information is obtained from the 2002 population census.

1.1.2 District Map

See project area map.

1.1.3 Surface Area of Each District

Division 5 has an approximate surface area of 3000km².

1.1.4 Occupancy

Information will be determined from the 2002 population census. In the interim, an occupancy of 4 will be assumed.

1.2 Meteorological Data

Rainfall Data (mm)

Year	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2000					346.8	348.5	337.1	88.2	90.8	127.4	130.7	114.4
2001	89.4	42.2	33.5	44.7	194.5	195.7	144.3	131.8	211.6	48	90.2	115.5
2002	90.9	39.4	193.3	228.6	284.7	206.1	205.8	96.9		110.1	147	132.8
2003	30.1	25.2	45.8	39.3	246.3	203.6	259.1	103.3	110.2	104	166.2	96.1
2004	111.5	37.9	98.1	199.3	276.1	185.3	187.8	45.7	66.3	170.4	84.5	167.3
2005	218.5	145.9	119.8	132.7	239							

1.3 Socio-Economic Data

Data Unavailable.

1.4 Economic Data

Need to contact Ministry of Finance to gather information regarding inflation ratios or consumer price indices over the past 5 years.

1.5 Choice of Project Area

The project is intended to provide access to potable water to customers in Region 6 that currently do not receive a treated supply. This is in line with one of the principles of the Poverty Reduction Strategy Paper of investing in physical capital with emphasis on better and broader provision of safe water and sanitation. Access to potable water is one of the most important indicators of poverty in Guyana, and in light of this fact, Guyana Water Incorporated (GWI) has an important role to play in reducing poverty throughout Guyana.

Guyana Water Incorporated has secured funding for three treatment plants in Divisions 1,2 and 4 from the World Bank. This intervention by the World Bank represents a significant contribution towards achieving GWI's license target of 90% coverage to the coastal population. However, no funding has been secured for the construction of a treatment plant in Division 5.

Interventions¹ in Bushlot and Corriverton were identified during the GUYWA administration valued at USD 6M and USD 7.7M respectively and were scheduled for completion in 2005. This however was not possible but was incorporated into the ten year development plan of Guyana Water Incorporated. This project will assist in GWI achieving its licensed targets of 90% coverage by 2007 as upon the completion of the project it is envisaged that 75% of the coastal population for region 6 will have access to potable water.

¹ KPMG, *Guyana Water and Sanitation Sector Studies, Volume 2, Part 2, December 1999*

2 National Water Supply Sector

2.1 Organizations

2.1.1 Water Supply Regulation

The Hydrometeorological Department of the Ministry of Agriculture is empowered under Part 3 of the Water and Sewerage Act of 2002 to establish, manage and operate licensing systems for the use of ground and surface water.

The Guyana Water Incorporated which was created in accordance with Part 8 of the Water and Sewerage Act 2002 and operates under a license granted by the Minister of Housing and Water is not exempted from the borehole licensing procedure and must make applications to the Department of Hydrometeorological Department for the user of ground and surface water.

2.1.2 Organizational Chart

GWI's organizational chart obtained from Human Resources.

2.1.3 Annual Budgets

Need to check with Finance department for the annual budget for the last three years. Grant system between central government and regional administration needs to be researched.

2.2 Sector Legal Framework

As outlined in Part 4, Section 18, of the Water and Sewerage Act, 2002, the ownership of all water resources in the country and the rights to use, abstract, manage and control flow are vested in the state. The public is entitled to a supply of potable water for domestic purposes and satisfactory supply of water for commercial and industrial purposes from a public supplier appointed by the Minister.

The Hydrometeorological Department of the Ministry of Agriculture is empowered by the Water and Sewerage Act 2002 to establish, monitor and maintain licensing systems for the construction of boreholes, abstraction of ground water, construction of works affecting the flow in water courses and diversion or abstraction of surface water.

As part of the licensing procedure, any application for extraction of water that may significantly degrade the environment must be forwarded to the Environmental Protection Agency for an environmental permit. A license will be granted only after an environmental permit is issued and in accordance with the conditions of the permit.

In cases where the impacts on the environment are unclear, the applicant and the Department must provide the EPA with all relevant information to ascertain the environmental impacts of the extraction.

GWI has developed environmental guidelines suitable to water supply projects with a value in excess of G\$5M(US\$25,000). The guidelines assist in the development of the Environmental Management Plan for the project. As part of the guidelines, a preliminary environmental screening checklist was developed to assist in the development of an environmental impact assessment.

2.3 Sector Development Strategy

The latest National Development Strategy available online at www.guyana.org

2.4 Sector Study

The following reports done by KPMG are available:

- Guyana Water and Sanitation Sector Studies – Volume 2, Part 1
- Guyana Water and Sanitation Sector Studies – Volume 2, Part 2

2.5 Water Quality Standards

GWI subscribes to the World Health Organization guidelines.

The following are adopted from the world health organization guidelines.

- Iron < 0.5mg/l
- Turbidity < 5NTU
- pH - 6.5 to 8.5
- Total Coliform – 0-CFU/100ml
- Chlorine Residual – 0.2 to 0.5mg/l

2.6 Water Supply Management

The conditions of the contract between GWI and STWI are available.

All major projects are subjected to an open tender process. GWI does not select contractors from a preconceived list. There are no plans for the privatization of GWI.

2.7 Administration and Organization

2.7.1 National Level Administrations

- **Ministry of Agriculture – Hydrometeorological Department.** As it relates to the country's water resources, the principle objective of the Hydrometeorological Department is to gather, store and provide data and information for the protection, sustainable use and management of water resources.
- **Ministry of Housing and Water – Guyana Water Incorporated.** GWI operates under a license granted in accordance with Water and Sewerage Act 2002 in which it is charged with provision of safe water to 90% of the coastal population and 80% of hinterland settlements by 2007.

2.7.2 Local Level Administration

GWI is a company formed under the Company's Act of Guyana and requires a Chairman and Board of directors to perform high level managerial tasks. The Minister of Housing and Water is empowered by the Water and Sewerage Act to appoint the Chairman and the Board of Directors. The obvious link between GWI and Ministry Of Housing is through the Minister.

The Ministry in fact has two functioning arms, The Central Housing and Planning Authority and Guyana Water Incorporated. There exists a functional relationship between GWI and CHPA as GWI is responsible for the provision of potable water to the housing developments administered by GWI.

2.7.3 Subsidiary System

Subsidiary Systems exist only in a few areas along the coast. These areas include two coastal systems operated by Sugar Industry Labour Welfare Fund (SILWF) and a hinterland system in Kwakwani which is operated by the mining company. These systems are not included in GWI's operating license. The only other system that is currently not operated by GWI is that of Mathew's Ridge. This system is controlled by the NDC.

3 Water Supply Sector of Corriverton

3.1 Current State of Drinking Water

3.1.1 System Description

The intended project area stretches from Good Hope (#44 Village) in the North to Jackson creek in the South, a distance of approximately 35km. The system is serviced by nine boreholes that extract water from the A-sand aquifer. Water from the A-sands aquifer has high concentration of dissolved solids and gasses. Iron concentration varies from 0.6 to above 1.5 mg/l at the source. The operating periods for the boreholes ranges from 11 to 14 hours within the project area with typical service levels of less than 2m in some villages to above 8m in other sections of the system.

Water supplied by the distribution is not recommended for drinking purposes owing to the relatively poor raw water quality and the fact that the supply lines are not continuously pressurized.

3.1.2 Non Revenue Water and Leakage

1	Total Population in Project Area	Approximately 45,000
2	Population in Region 6	Approximately 120,000
3	Served population	>108,0000
4	Service population ratio	>90%
5	Service Area for project	App. 700km ²
6	Theoretical Consumption	135 l/capita/day
7	Leakage ratio	61%
8	Non revenue water ratio	69%
9	Total potential water demand	8100m ³ /day

Leakage Estimation

Leakage was estimated based on the assumption that the total production is constituted by the following:

A	B	C	D	E
System input (m ³ /month)	Authorized consumption	Billed Authorized consumption	Billed metered consumption	Revenue Water
			Billed unmetered consumption	
		Unbilled authorized consumption	Unbilled metered consumption	Non revenue water
			Unbilled unmetered consumption	
	Water losses	Apparent losses	Unauthorized consumption	
			Metering inaccuracies	
		Real losses	Leakage on transmission and distribution	
			Leakage and overflows at storage tanks	
			Leakage on service connection	

The following assumptions were made in determining the leakage

- Occupancy = 4 persons/household
- Cost per m³ = G\$58
- Per capita consumption = 0.135m³/day

Monthly Production (m ³)	Category	Estimated Customers	Value (G\$)	Volume (m ³)
1,547,299	Billed metered consumption	2835	\$6,541,047	112,777
	Billed unmetered consumption	22945	\$18,890,463	371,709
	Unbilled unmetered consumption	455		7,371
	Unbilled metered consumption	5155		83,511
	Unauthorized Consumption	1% of production		15,473
	Metering inaccuracies	5% of metered consumption		5,639
	Leakage			950,819

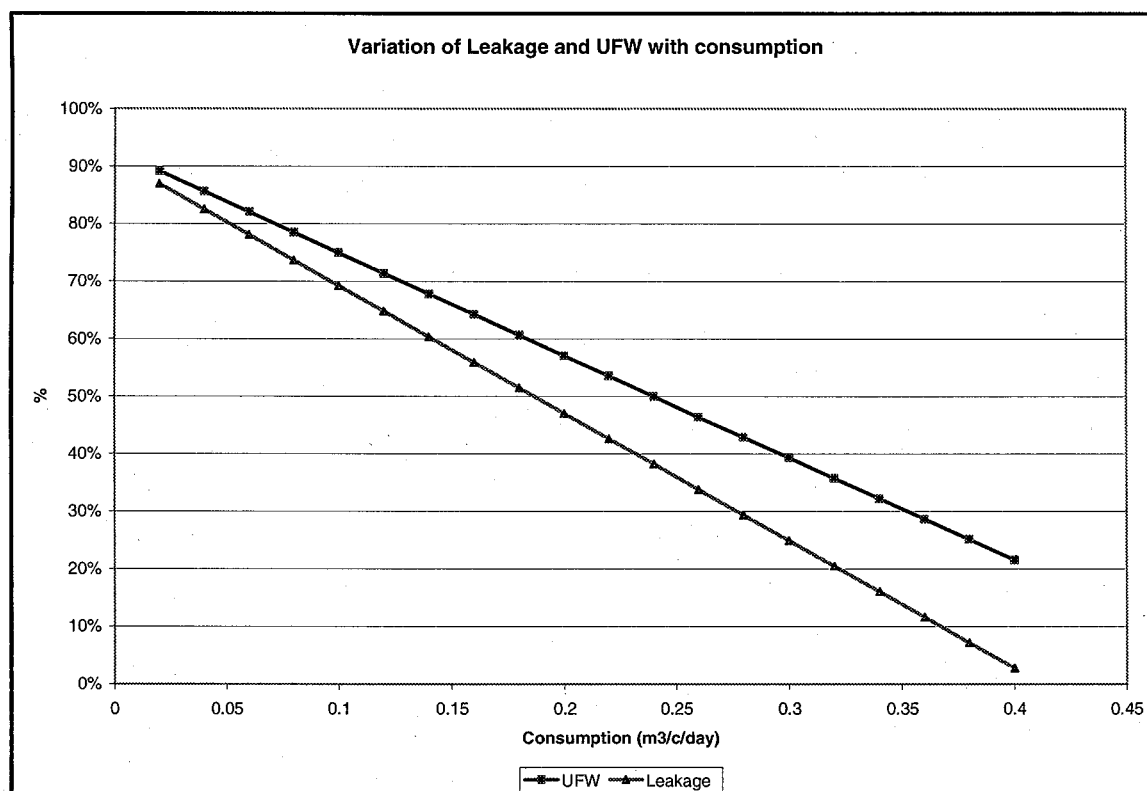
Summary

Item	Estimated Monthly (m ³)	%
Revenue Water	484486	31
Nonrevenue Water	1062813	69
Leakage	950,819	61

Overall, leakage within the division is very hard to estimate, as the number of unmetered customers is far in excess of metered customers. This issue is further complicated by the fact that billing of metered customers within the project area is very low.

The estimated leakage of 61% is extremely high for any system. Taking into account the fact that service is usually provided for 12 hours or less on a daily basis, and that customers actually receive an adequate supply, the scenario of unbilled unmetered and billed unmetered consumption being in excess of 0.135m³/c/day is entirely likely.

To obtain a better estimate of the true value of unaccounted for water in the project area, a sensitivity analysis was conducted to ascertain the variation of unaccounted for water in the project area with assumed consumption. In the calculations above, the consumptions for the unbilled customers and billed unmetered customers were estimated using the theoretical consumption of 0.135m³/person/day. In the sensitivity analysis, the effect of varying the consumption on the leakage and non-revenue water is better understood. The result of this analysis is summarised in the graph below.



Recommendations have been made, internally, to use a theoretical consumption of 0.25m³/c/day. Should this figure be incorporated into design guidelines, the actual UFW within the project area is estimated at 48% and leakage at 36%.

3.1.3 Data on Water Borne Diseases

Diseases	200	2001	2002	2003	2004
Amoebiasis	0	0	0	0	0
Bacillaer Dysentery	1	1	1	0	0
Typhoid Fever	28	31	8	0	0
Acute Diarrhoeal Diseases (under 5 years)	435	462	439	896	380
Acute Diarrhoeal Diseases (over 5 years)	309	397	476	1053	496

3.1.4 Other Systems

Within the project area, there is one system that is currently operated by the Sugar Industry Labour Welfare Fund (SILWF) located at Skeldon. The service levels in the system are similar to systems operated by GWI. GWI has plans to take over the system in 2005.

3.1.5 Privately owned systems

There are no privately owned systems in the project area except the SILWF system.

3.1.6 Service level data

See service level maps provided.

3.2 Water Demand

3.2.1 Population Data

GWI customers list will be used in the interim until 2002 population census figures are obtained. An occupancy of 4 is assumed.

3.2.2 Future Demand

This will be developed based on past and current populations. At this stage a tentative 0.75% annual growth rate will be assumed.

3.3 Financial Status

3.3.1 GWI's Financial Status

2002 and 2003 annual reports.

3.3.2 Water supply Budget

Summary of 2004 capital investment programme available.

3.3.3 Regional Financial Information

- Statement of Income – 2002 and 2003 financial reports.
- Income and expenditure account - 2002 and 2003 financial reports.
- Balance sheet - 2002 and 2003 financial reports.

3.3.4 Tariff structure

Copy Provided.

4 Water Supply Plan and Project for Corriverton

4.1 Ongoing and Planned International and Planned Donor Aided WSP

Donor Name	Scope	Status
Inter-American Development Bank	Rehabilitation of the Georgetown System	Ongoing
World Bank	Development of Treated Water Schemes in Divisions 1,2 and 4	Approval granted
Caribbean Development Bank	Flood related projects	Proposal submitted
European Union	Linden, Wakenaam, Leguan New Amsterdam WTP Rosehall WTP	Proposal submitted Project completed Project completed

5 Sewerage System for Corriverton

5.1 Current sewerage system

The project area does not have any sewers.

5.2 Location maps of sewerage facility

Not applicable

5.3 Service population and service area

Not applicable

5.4 Method of Sewage Treatment

Septic Tanks and a few pit latrines

5.5 Discharge points of treated and untreated sewage

Septic tanks are discharged into the existing drainage and irrigation facilities.

6 Environmental and Social Impact Assessment

6.1 National Environmental Policy

The national environmental policy is based on the principle of sustainable development and incorporates this concept into legislation.

6.2 Guyana's Environmental Protection Laws

Copy of environmental protection act provided.

6.3 Necessity for gender consideration

Guyana supports equal opportunities for women in the workplace.

6.4 Domestic animals

The breeding of domestic animals is popular in the rural sections of the country, but does not occur upstream of the Corentyne river.

6.5 Water Supply Sector third important sector following education and health.

The priorities of the Poverty Reduction Strategy are as follows:

- Economic strategies to stimulate growth
- Good governance
- Investment in human capital (health and education)
- Infrastructure to support services (including water and sanitation)
- Safety nets
- Infrastructure to support growth
- Special Intervention Strategies

These strategies have been priorities based on their effect on growth of the country. Although access to potable water and sanitation is an indicator of poverty, there is not an automatic decrease in poverty when these services are provided. This is based mainly on the ability of the customers to pay for the service. Therefore, in the context of overall reduction in poverty, the strategy is focused on reducing poverty levels by increasing the economic activity and growth through the nation. Health and education are actually higher in the priorities of the poverty reduction strategy and are included in under investment in human capital initiative.

7 Existing and Proposed Facility

7.1 Existing Facility

7.1.1 Operation and Maintenance of Treatment Plant

Operational Costs (Monthly)

New Amsterdam Treatment Plant

Energy

Month	KWh	Cost (G\$)	Cost (USD)
Jan-05	61,800	\$3,213,600	\$16,068
Feb-05	53,400	\$2,776,800	\$13,884
Mar-05	62,160	\$3,232,320	\$16,162
Apr-05	61,920	\$3,219,840	\$16,099
May-05	58,920	\$3,063,840	\$15,319
Average	59,640	\$3,101,280	\$15,506

Chemicals

Chemical	Design Dose(kg/m ³)	Monthly Plant Production (m ³)	Mass needed (kg)	Chemical Cost (G\$/kg)	Monthly Cost (G\$)	Monthly Cost (USD)
Chlorine	0.003	162540	488	\$358.0	\$174,568	\$873
Lime	0.005	162540	813	\$41.0	\$33,321	\$167
Total					\$207,889	\$1,039

Labour

Labour	Number	Monthly Salary (G\$)	Monthly Cost (G\$)	Monthly Cost (USD)
Supervisor	3	80,159	\$240,477	\$1,202
Plant Operator	3	48,242	\$144,726	\$724
Electrician	1	80,159	\$80,159	\$401
Craftsman 1	1	38,629	\$38,629	\$193
Craftsman 2	1	48,242	\$48,242	\$241
Security			\$107,520	\$538
Sub Total			\$659,753	\$3,299
Add 20% for overtime, sick leave, annual leave			\$131,951	\$660
Total			\$791,704	\$3,959

Total Costs

Item	G\$	USD
Energy	\$3,101,280	\$15,506
Chemicals	\$207,889	\$1,039
Labour	\$791,704	\$3,959
Total	4,100,872	\$20,504

Rosehall Treatment PlantEnergy

Month	KWh	Cost (G\$)	Cost (USD)
Jan-05	160,000	\$8,320,000	\$41,600
Feb-05	163,320	\$8,492,640	\$42,463
Mar-05	136,800	\$7,113,600	\$35,568
Apr-05	160,680	\$8,355,360	\$41,777
May-05	139,200	\$7,238,400	\$36,192
Average	152,000	\$7,904,000	\$39,520

Chemicals

Chemical	Design Dose(kg/m3)	Monthly Plant Production (m ³)	Mass needed (kg)	Chemical Cost (g\$/kg)	Monthly Cost (G\$)	Monthly Cost (USD)
Chlorine	0.003	231000	693	\$358.0	\$248,094	\$1,240
Lime	0.005	231000	1,155	\$41.0	\$47,355	\$237
Total					\$295,449	\$1,477

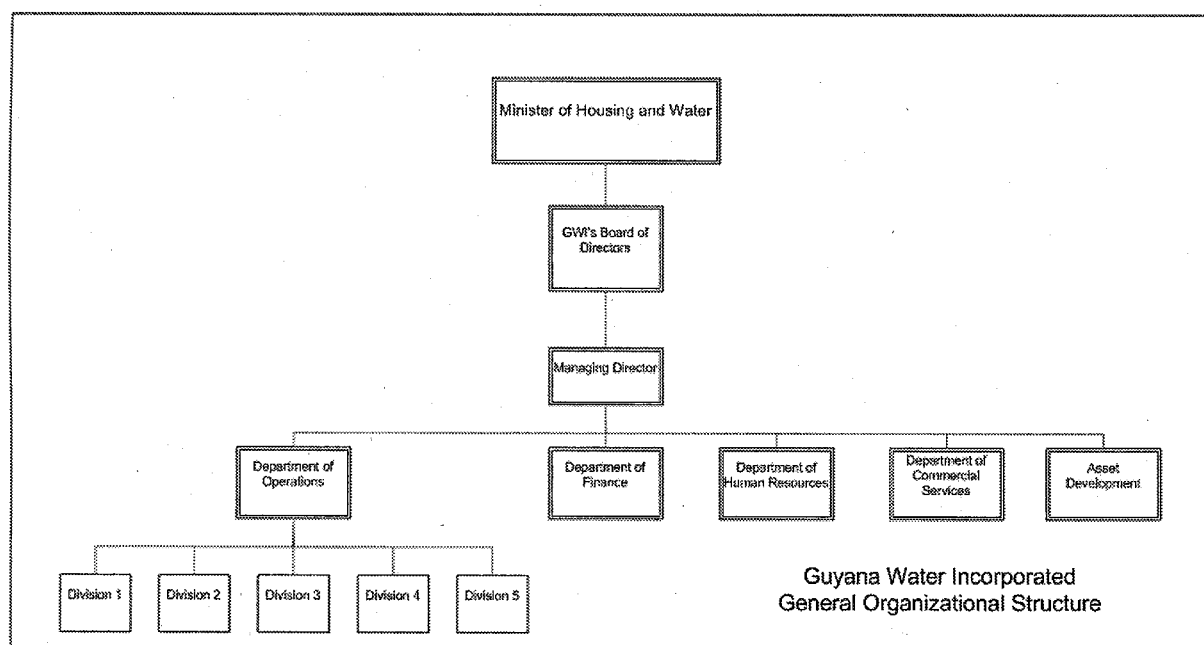
Labour

Labour	Number	Monthly Salary (G\$)	Monthly Cost (G\$)	Monthly Cost (USD)
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Security			\$107,520	\$538
Sub Total			\$659,753	\$3,299

Add 20% for overtime, sick leave, annual leave			\$131,951	\$660
Total			\$791,704	\$3,959

Total

Item	G\$	USD
Energy	\$7,904,000	\$39,520
Chemicals	\$295,449	\$1,477
Labour	\$791,704	\$3,959
Total	\$8,991,153	\$44,956

7.1.2 Current Organizational Chart

For more details on the GWI's organizational structure, check hard copies provided.

7.1.3 Raw Water and Treated Water Quality

- New Amsterdam

Parameter	Units	Raw	Treated	GWI Standards
pH		5.52	6.36	6.5 – 8.5
Turbidity	NTU	2.4	3.5	<5
Iron	mg/l	0.15	0.03	<0.5
Total Coliform	CFU	11	6	0

- Rosehall

Parameter	Units	Raw	Treated	GWI Standards
pH		5.89	6.3	6.5 – 8.5
Turbidity	NTU	10.4	6.3	<5
Iron	mg/l	0.61	0.15	<0.5
Total Coliform	CFU	5	0	0

7.1.4 Flow Charts and Drawings

- New Amsterdam
- Rosehall

No drawings are available.

7.2 Proposed Facility

7.2.1 Status of Land Acquisition

The Minister of Housing assured that land will be acquired as much of the land in the project area is state owned.

7.2.2 Soil Condition

The upper stratum is classified as weak Demarara Clay.

7.2.3 Raw Water Quality

Data is available for Division 5 as far back as 2002. This information was compiled by GWI water quality unit. The Hydro-meteorological department of the Ministry of Agriculture does not monitor groundwater quality.

7.2.4 Ground Water Levels

Data on static level up to January 2003 compiled.

7.2.5 Planned Land Use TP

Land will probably be reserved for treatment facility only.

7.2.6 Planned Land Use Boreholes

Land use may be predominantly agriculture and housing through project area.

7.2.7 Drawings of Proposed Facility

At the moment no drawings of the proposed facility are available.

7.2.8 Basis of Plant Capacity

Based on a population growth rate of 0.75% per annum over 20 years applied to the 2002 population census figures. The plants are designed to meet the 2025 maximum day demand, assuming a consumption of 180l/person/day and a maximum day factor of 1.4.

7.2.9 Cost Basis of Proposed Facility

Cost estimation based on standard cost per person for a treated water scheme. Much of the unit costs were derived from the World Bank Intervention.

7.2.10 Increase in Technical Staff

Upon completion, the project will create employment at the following positions:

Position	Number required
Supervisor	6
Plant Operator	6
Electrician	2
Craftsman 1	2
Craftsman 2	2

7.2.11 Increase in O&M Costs

Information regarding the maintenance costs within the project area is unavailable.

Current Operational Costs

The current operational cost within the project will be derived based on electrical operating costs and labour costs as shown in the table below.

Borehole	Energy							Labour		
	Energy Consumption (KWh)						Monthly Cost (G\$)	Operator	Number	Cost (G\$)
	Jan	Feb	Mar	Apr	May	Average				
#47	9232	7881	8709	8584	8693	8619.8	\$448,230	\$38,629	1	\$38,629
Dead Tree Farm #57	22442	18590	21191	22136	20222	20916.2	\$1,087,642	\$38,629	1	\$38,629
Benab #63	13564	11805	15288	13628	14047	13666.4	\$710,653	\$38,629	1	\$38,629
Friendship #69	17052	18726	13430	16158	16286	16330.4	\$849,181	\$38,629	1	\$38,629
Spring Garden #75	18537	17984	16554	17989	17956	17804	\$925,808	\$38,629	1	\$38,629
Springland	9910	10038	9222	9241	9290	9540.2	\$496,090	\$38,629	1	\$38,629
Queenstown	30000	27667	30000	31559	17878	27420.8	\$1,425,882	\$38,629	1	\$38,629
Line Path D	0	0	0	0	0	0	\$0	\$38,629	1	\$38,629
Crabwood Creek	30563	25261	26210	25710	23230	26194.8	\$1,362,130	\$38,629	1	\$38,629
Subtotals							\$7,305,615			\$347,661
Add 20% for overtime, transportation, security										\$69,532
Total							\$7,305,615			\$417,193

Estimated operational cost = G\$7,722,808

Monthly Operational Cost upon completion of project

The operational cost of the system upon completion is difficult to determine as the exact treatment process, service area and location of the plants have yet to be determined. However, figures regarding the estimated cost per m³ produced derived in the feasibility study for the World Bank Intervention will be used.

Plant Location	Production Cost per m ³
Div 1	24
Div 2	27
Div 4	29
Average	27

The project is expected to supply potable water to approximately 45,000 residents in Division 5. Assuming a consumption of 180/person/day, the required monthly production is 226,800m³.

An operational cost of G\$27/m³ produced (derived as part of the World Bank Intervention Feasibility Study) will be used as a base. This estimate includes chemical, electrical and labour costs. Adding 40% to cater for overtime, transport, security, equipment, tools and spares the estimated cost of production is G\$38/m³.

The estimated operational cost for the treated water scheme will therefore be G\$8,618,400 per month.

This project will increase the operational cost of the division by G\$895,592 every month.

8 Total Requested Project

8.1 Increase in Annual O&M

Based on the estimates of the cost per m³, the project's operating cost will be in the region of G\$8.6M per month (inclusive of labour and energy costs). It is envisaged that upon commissioning of the plants, 9 boreholes will be decommissioned. The estimated monthly operating cost for these boreholes is G\$7.7M. As such, the estimated increase in operational cost due to the project is G\$0.9M.

8.2 Anticipated budget and source for O&M

The anticipated operational cost for the entire project is G\$6.1M. It is anticipated that funds for the operation and maintenance of the plants will be generated from revenue collection within the project area and throughout the division.

8.3 Expected increase in Water Income after Project

No increase in the tariff is planned following the commissioning of the plants.

8.4 Plan for water tariff increase after project

Tariff increase subject to the PUC's approval, but none is planned.

GW Division 5 Response to JICA Questionnaire

DRAFT RESPONSE

1 General Information

1.1 Background Data

1.1.1 Land Use

The major economic activity within the project area is agriculture and as such, much of the land within the project area is used for farming. The population density is high along the main highway in the project area, but decreases significantly with proximity to the highway.

Plans for future land use in Corriverton are contained in the Region 6, Sub Regional Land Use Plan, compiled by the Guyana Lands and Surveys Commission (copy provided). The current land uses are indicated on the drawings of the pipe network.

1.1.2 Topographic Maps

There are no significant variations in the elevation of the land within the project area, and as such topographic maps may not be necessary.

1.1.3 Economic Background

Information regarding the average household income in Corriverton is not available.

1.1.4 Annual Inflation Ratios

Information for Corriverton is not available.

1.1.5 Choice of Project Area

The project is intended to provide access to potable water to customers in Region 6 that currently do not receive a treated supply. This is in line with one of the principles of the Poverty Reduction Strategy Paper of investing in physical capital with emphasis on better and broader provision of safe water and sanitation. Access to potable water is one of the most important indicators of poverty in Guyana, and in light of this fact, Guyana Water Incorporated (GWI) has an important role to play in reducing poverty throughout Guyana.

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1.1.6 General Situation of Water Supply in Region 6

Approximately 90% of the population in region 6 is concentrated along the coast. Residents in New Amsterdam and Rosehall (approximately 40,000 persons) receive treated water. The remaining coastal population (approximately 110,000 residents) receive untreated groundwater.

¹ KPMG, *Guyana Water and Sanitation Sector Studies, Volume 2, Part 2, December 1999*

2 Water Supply Sector of Corriverton

2.1 Current State of Drinking Water

2.1.1 System Description

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Water supplied by the distribution is not recommended for drinking purposes owing the relatively poor raw water quality and the fact that the supply lines are not continuously pressurized.

2.1.2 Non Revenue Water

1	Total Population in Project Area	Approximately 45,000
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System input (m ³ /month)	Authorized consumption	Billed Authorized consumption	Billed metered consumption	Revenue Water
			Billed unmetered consumption	
		Unbilled authorized consumption	Unbilled metered consumption	Non revenue water
			Unbilled unmetered consumption	
	Water losses	Apparent losses	Unauthorized consumption	
			Metering inaccuracies	
		Real losses	Leakage on transmission and distribution	
			Leakage and overflows at storage tanks	
			Leakage on service connection	

The following assumptions were made in determining the leakage

- Occupancy = 4 persons/household
- Cost per m³ = G\$58
- Per capita consumption = 0.135m³/day

Monthly Production (m ³)	Category	Estimated Customers	Value (G\$)	Volume (m ³)
1,547,299	Billed metered consumption	2835	\$6,541,047	112,777
	Billed unmetered consumption	22945	\$18,890,463	371,709
	Unbilled unmetered consumption	455		7,371
	Unbilled metered consumption	5155		83,511
	Unauthorized Consumption	1% of production		15,473
	Metering inaccuracies	5% of metered consumption		5,639
	Leakage			950,819

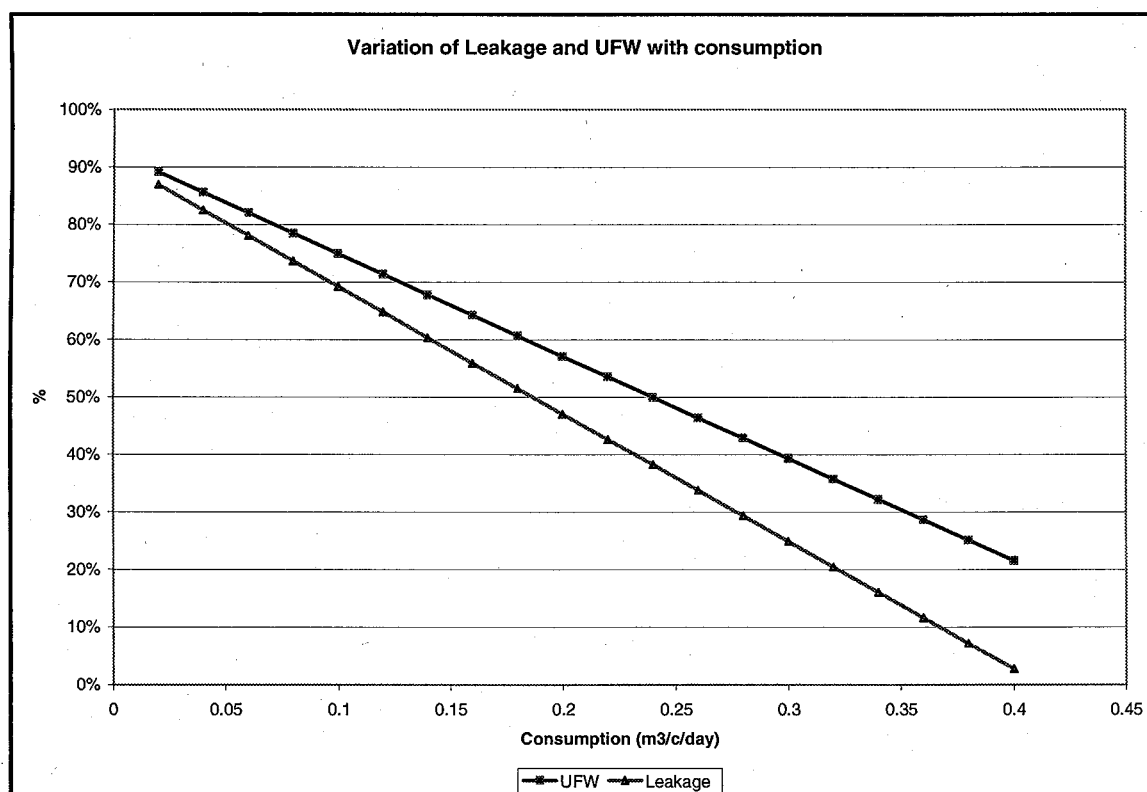
Summary

Item	Estimated Monthly (m ³)	%
Revenue Water	484486	31
Nonrevenue Water	1062813	69
Leakage	950,819	61

Overall, leakage within the division is very hard to estimate, as the number of unmetered customers is far in excess of metered customers. This issue is further complicated by the fact that billing of metered customers within the project area is very low.

The estimated leakage of 61% is extremely high for any system. Taking into account the fact that service is usually provided for 12 hours or less on a daily basis, and that customers actually receive an adequate supply, the scenario of unbilled unmetered and billed unmetered consumption being in excess of 0.135m³/c/day is entirely likely.

To obtain a better estimate of the true value of unaccounted for water in the project area, a sensitivity analysis was conducted to ascertain the variation of unaccounted for water in the project area with assumed consumption. In the calculations above, the consumptions for the unbilled customers and billed unmetered customers were estimated using the theoretical consumption of 0.135m³/person/day. In the sensitivity analysis, the effect of varying the consumption on the leakage and non-revenue water is better understood. The result of this analysis is summarised in the graph below.



Recommendations have been made, internally, to use a theoretical consumption of 0.25m³/c/day. Should this figure be incorporated into design guidelines, the actual UFW within the project area is estimated at 48% and leakage at 36%.

2.1.3 Data on Water Borne Diseases

Diseases	200	2001	2002	2003	2004
Amoebiasis	0	0	0	0	0
Bacillaer Dysentry	1	1	1	0	0
Typhoid Fever	28	31	8	0	0
Acute Diarrhoeal Diseases (under 5 years)	435	462	439	896	380
Acute Diarrhoeal Diseases (over 5 years)	309	397	476	1053	496

2.1.4 Other Systems

Within the project area, there is one system that is currently operated by the Sugar Industry Labor Welfare Fund (SILWF) located at Skeldon. The service levels in the system are similar to systems operated by GWI. GWI has plans to take over the system in 2005.

2.1.5 Privately owned systems

There are no privately owned systems in the project area except the SILWF system in Skeldon.

2.1.6 Service level data

See service level maps provided.

2.2 Water Production

2.2.1 Production by Source

Production Borehole	Recorded Production Before 2004 (m³)	2004 Total Production (m³)	Total Production (m³)
Orealla	8,376	-	8,376
Sisters	45,418	-	45,418
Mara	45,856	7,625	46,164
Edinburg (New)	1,316,171	117,521	1,433,692
Lochaber	647,151	176,212	823,363
Sheet Anchor	1,381,786	809,592	2,191,378
Cumberland	2,596,950	1,036,471	3,633,421
Adelphi	1,170,047	355,915	1,525,962
#19	509,062	63,932	572,994
Fyrish	2,892,122	289,200	3,181,322
Albion	523,310	-	523,310
Port Mourant	2,120,321	1,873,595	3,993,916
Rosehall (Project)	4,785,505	166,614	4,952,119
Letter Kenny	2,288,958	811,382	3,100,340
Adventure	2,996,094	1,246,314	4,242,408
Bushlot	42,143	-	42,143
Cromarty	100,000	151,821	251,821
Eversham	1,355,984	450,528	1,806,512
Mibikuri	1,204,612	537,141	1,741,753
Johanna	878,276	343,170	1,221,446
Yakusari	822,640	341,600	1,164,240
#47	1,039,839	490,409	1,530,248
#57	2,398,999	877,450	3,276,449
#63	2,169,307	694,192	2,863,499
#69	1,952,694	649,854	2,602,548
Springlands/CWC	345,225	-	345,225
#75	2,137,490	766,082	2,903,572
Springlands	116,948	497,772	614,720
Crabwood Creek	2,321,831	996,461	3,318,292
Line Path	110,011	210,810	320,821
Queenstown	116,050	140,465	256,515
Sub-total	41,412,135	14,085,076	55,497,211
New Amsterdam	8,681,993	2,328,593	11,010,586

Water Works			
Total	50,094,128	16,413,669	66,507,797

2.2.2 Source Wise Production for 2004

Production figures for 2004 and 2005 attached.

2.3 Existing Facilities

2.3.1 Water Source

Tables 2 and 3 completed and attached. Table 4 is not applicable.

Digital Copies of location maps will be provided.

Outline map contained in distribution drawings.

2.3.2 Distribution Facility

Location map of distribution facility is contained in distribution drawings.

	PVC / DUCTILE IRON (m)						TOTAL	
	4"	6"	8"	10"	16"	18"		
	100mm	150mm	200mm	250mm	400mm	450mm	m	km
Existing Mains	190,000	130,000	20,000	2,500	-	-	342,500	343
Year Installed	90% Ranges from 1992 to 2005							

- The Distribution system is comprised mainly of PVC transmission and distribution mains and ductile iron stream crossings.
- Unaccounted for water is estimated at 69% in the project area. Leakage is estimated at 61%. The major cause of leakage is poor workmanship on service connections.
- In 2004 approximately 2.2km of distribution pipes installed under Government of Guyana funds. In 2003, 14.8km of transmission and 4.3km of distribution pipes were installed.
- Leakage counter measures – Leakage is managed through a leakage strategy (digital copy provided) developed by the Technical Services Department. A major aspect of the leakage strategy is the setting up of district metered areas, in which the actual consumption of a section of the network is known through domestic metering along with

the flow supplied to the area. Comparison of production against actual consumption will assist in allocation of leakage resources.

2.3.3 Service Facility

Division 5

Type of Connection	2002	2003	2004
Household			31390
Industrial			
Commercial			
Public			
Others			
Public Tap			
Water Tanker	0	0	0

2.4 Current Operation Maintenance and Management

2.4.1 Operational Methods to alleviate shortages

These are some of the operational practices aimed at reducing water shortages:

- Water Rationing – Flow within the network is directed to specific sections for allotted times each day. This is achieved through the use of flow control valves.
- Leakage inspection – Regular inspections are conducted throughout the system in an effort to reduce unaccounted for water attributed to leakage.
- Flushing of lines – Sections of the network are isolated and pressurized for a short period after which the contents of the line are flushed into existing drainage canals. Flow is maintained through pumping.
- Borehole Maintenance – Air scouring and air lift of boreholes and also the servicing of production pumps.

2.4.2 Major Operational Issues

Major operational and maintenance issues include the following:

- High operating cost of boreholes and treatment plants.
- Limited human resources. Human resources are particularly limited in the support services needed for leakage strategy, such as meter readers and leakage inspection teams.

- High unaccounted for water within the system – due mainly to poor workmanship on service connection installations and customer wastage.

2.4.3 Major Problems in managing system

Major management problems include the following:

- Limited operational budget – some projects identified by the division need to wait for funding from an external source.
- Low level of revenue collection – complicates the issue of a limited operational budget.

2.4.4 Procurement of Chemicals

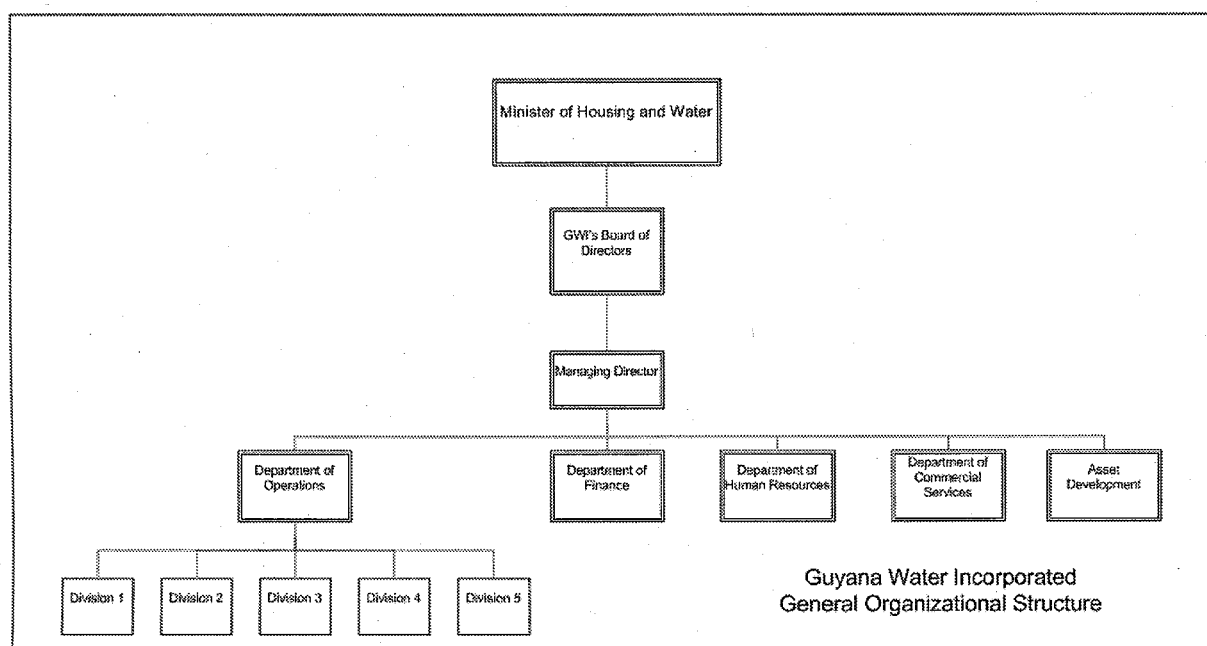
Chemicals procured in 2004

Plant	Alum (kg/year)	Chlorine (tonnes/year)	Lime (tonnes/year)
Rosehall	0	8.3	13.9
New Amsterdam	0	5.8	9.8

2.4.5 Procurement Status

Chemicals are procured in adequate quantities.

2.4.6 Organizational Chart



For more details on the GWI's organizational structure, check hard copies provided.

2.4.7 Production Details for Division 5

Service Population	App. 170,000
Coverage Ratio (%)	>90%
Number of water meters	7990
Total daily production (m ³)	51,576
Total daily UFW (m ³)	31,461
Total Yearly Production Cost (G\$M)	407
Cost per m ³ produced (G\$)	21

Estimated yearly operational budget (GWI) = G\$1,720,000,000

Population served by GWI = 730,000

Yearly Operational cost per customer = G\$2356

Population in division 5 = 170,000

Estimated Yearly Operational Budget (Division 5) = G\$405,000,000

2.5 Monitoring of Water Quality and Quantity**2.5.1 Quality, Quantity and Groundwater levels**

	Quality	Quantity	Groundwater Level
Frequency	Once in three months	Daily	Monthly
Institution	GWJ	GWJ	GWJ
Items	Iron, turbidity, total coliform, e. coli, pH	Flow	Static level, pumping level
Water Quality Standards	WHO	Not applicable	Not applicable
Others	None	None	None

2.5.2 Water Quality, Quantity for treated water

	Quality	Quantity
Frequency	Weekly	Daily
Institution	GWJ	GWJ
Items	Iron, turbidity, total coliform, e. coli, pH, aluminum, color	Flow
Water Quality Standards	WHO	Not applicable
Others	None	None

2.5.3 Water quality and quantity at service taps

	Quality	Quantity
Frequency	Once in three months, for all systems and every 2 months for treated water schemes (at 3 points in each system)	Monthly
Institution	GWJ	GWJ
Items	Iron, turbidity, total coliforms, e. coli, pH	Flow
Water Quality Standards	WHO	Not applicable
Others	None	None

2.5.4 Chlorine dosage

Target dosage is 0.2 -0.4 mg/l free chlorine. The actual dosage is much less due to institutional problems and poor plant performance.

2.5.5 Free Chlorine at service taps and reservoirs

No standard in place for free chlorine. Ideally residual of 0.05mg/l is necessary to prevent contamination.

2.5.6 Water Quality Data

Water quality data are available in digital format for 2003 and 2004.

2.6 GWI Financial Status

2.6.1 GWI's Financial Status

2002 and 2003 annual reports.

2.6.2 Water supply Budget

Summary of 2003 and 2004 capital investment programs are available.

2.6.3 Financial Information

- Statement of Income – 2002 and 2003 financial reports.
- Income and expenditure account - 2002 and 2003 financial reports.
- Balance sheet - 2002 and 2003 financial reports.
- Operational budget for division 5.

2.6.4 Monthly charge for typical household

The monthly charge varies depending on the tariff category. The majority of households within the project area fall within the low revenue domestic category. The fixed rate for this category is G\$8,160 per year (USD 41) for unmetered customers and G\$58/m³ (USD 0.29/m³) for metered customers.

3 Water Supply Plan in Corriverton

3.1 Water Supply Plan

3.1.1 Plans

There are no published plans with regards to water supply in Corriverton. With regards to region 6, projects are identified every year by the division for funding under the Government of Guyana coastal water supply program. At the moment, 2006 projects have not been compiled.

3.1.2 GWI investment plan

Presently, GWI is not in a financial position to fund any major infrastructural works. It is planned that the company will be able to generate enough revenue by 2012 to finance such infrastructural works.

3.2 Past Water Supply Projects

Name of Project	Agency	Cost	Year	Description
New Amsterdam Water Treatment Plant	European Union		1995	Construction of boreholes, treatment facility, elevated storage, ground storage, transmission and distribution.
Rosehall Water Treatment Plant	European Union		2000	Construction of boreholes, treatment facility, elevated storage, ground storage, transmission and distribution.

3.3 On Going Water Supply Projects

The following are water supply project planned for 2005:

- Adventure Transmission Main – the project entails the upgrading of a section of the transmission main along the Adventure public road. The project is expected to commence in July 2005 with completion scheduled for September 2005. The anticipated cost for the project is G\$17.5M (USD 87,500).
- East Berbice Trench Crossing Upgrades – Scope of works entail the upgrading of existing PVC crossings to ductile iron throughout the Division. The project is valued at G\$6M (USD 30,000) and will commence in July 2005. The project duration is 3 months.
- East Berbice Metering Project – The project entails the installation of service connections in Rosehall and New Amsterdam. The project is estimated at G\$5.4M (USD 27,000) and should commence in July 2005. The project duration is 3 months.

4 Sewerage System

4.1 Description

The project area does not have any sewers.

4.2 Environmental Protection

The Ministry and Housing and Water, as well as the Ministry of Agriculture are informed by the Environmental Protection Agency of their obligation to the environmental protection. The EPA are empowered by the Environmental Protection Act to intervene should there be any significant environmental impacts caused by any project.

Guyana Water Incorporated is responsible for the maintenance of existing sewerage facilities and not the expansion or development of any new system. As such, no Ministry is charged with the actual development of sewerage systems.

4.3 Location maps of sewerage facility

Not applicable

4.4 Service population and service area

Not applicable

4.5 Method of Sewage Treatment

Septic Tanks and a few pit latrines

4.6 Discharge points of treated and untreated sewage

Septic tanks are discharged into the existing drainage and irrigation facilities.

4.7 Increase in Purified Water

As more water is supplied to households, there will be a corresponding increase in wastewater produced by these homes. However, the anticipated waste water quality is not such that it will result in significant environmental degradation.

5 Existing and Proposed Facility**5.1 Existing Facility****5.1.1 Operation and Maintenance of Treatment Plant****Operational Costs (Monthly)****New Amsterdam Treatment Plant****Energy**

Month	KWh	Cost (G\$)	Cost (USD)
Jan-05	61,800	\$3,213,600	\$16,068
Feb-05	53,400	\$2,776,800	\$13,884
Mar-05	62,160	\$3,232,320	\$16,162
Apr-05	61,920	\$3,219,840	\$16,099
May-05	58,920	\$3,063,840	\$15,319
Average	59,640	\$3,101,280	\$15,506

Chemicals

Chemical	Design Dose(kg/m ³)	Monthly Plant Production (m ³)	Mass needed (kg)	Chemical Cost (G\$/kg)	Monthly Cost (G\$)	Monthly (USD)
Chlorine	0.003	162540	488	\$358.0	\$174,568	\$873
Lime	0.005	162540	813	\$41.0	\$33,321	\$167
Total					\$207,889	\$1,039

Labour

Labour	Number	Monthly Salary (G\$)	Monthly Cost (G\$)	Monthly Cost (USD)
Supervisor	3	80,159	\$240,477	\$1,202
Plant Operator	3	48,242	\$144,726	\$724
Electrician	1	80,159	\$80,159	\$401
Craftsman 1	1	38,629	\$38,629	\$193
Craftsman 2	1	48,242	\$48,242	\$241
Security			\$107,520	\$538
Sub Total			\$659,753	\$3,299
Add 20% for overtime, sick leave, annual leave			\$131,951	\$660
Total			\$791,704	\$3,959

Total Costs

Item	G\$	USD
Energy	\$3,101,280	\$15,506
Chemicals	\$207,889	\$1,039
Labour	\$791,704	\$3,959
Total	4,100,872	\$20,504

Rosehall Treatment PlantEnergy

Month	KWh	Cost (G\$)	Cost (USD)
Jan-05	160,000	\$8,320,000	\$41,600
Feb-05	163,320	\$8,492,640	\$42,463
Mar-05	136,800	\$7,113,600	\$35,568
Apr-05	160,680	\$8,355,360	\$41,777

May-05	139,200	\$7,238,400	\$36,192
Average	152,000	\$7,904,000	\$39,520

Chemicals

Chemical	Design Dose(kg/m3)	Monthly Plant Production (m ³)	Mass needed (kg)	Chemical Cost (g\$/kg)	Monthly Cost (G\$)	Monthly (USD)
Chlorine	0.003	231000	693	\$358.0	\$248,094	\$1,240
Lime	0.005	231000	1,155	\$41.0	\$47,355	\$237
Total					\$295,449	\$1,477

Labour

Labour	Number	Monthly Salary (G\$)	Monthly Cost (G\$)	Monthly Cost (USD)
Supervisor	3	80,159	\$240,477	\$1,202
Plant Operator	3	48,242	\$144,726	\$724
Electrician	1	80,159	\$80,159	\$401
Craftsman 1	1	38,629	\$38,629	\$193
Craftsman 2	1	48,242	\$48,242	\$241
Security			\$107,520	\$538
Sub Total			\$659,753	\$3,299
Add 20% for overtime, sick leave, annual leave			\$131,951	\$660
Total			\$791,704	\$3,959

Total

Item	G\$	USD
Energy	\$7,904,000	\$39,520
Chemicals	\$295,449	\$1,477
Labour	\$791,704	\$3,959
Total	\$8,991,153	\$44,956

5.1.2 Current Organizational Chart

Check the company's chart.

5.1.3 Raw Water and Treated Water Quality

- New Amsterdam

Parameter	Units	Raw	Treated
pH		5.52	6.36
Turbidity	NTU	2.4	3.5
Iron	mg/l	0.15	0.03
Total Coliform	CFU	11	6

- Rosehall

Parameter	Units	Raw	Treated
pH		5.89	6.3
Turbidity	NTU	10.4	6.3
Iron	mg/l	0.61	0.15
Total Coliform	CFU	5	0

5.1.4 Flow Charts and Drawings

- New Amsterdam
- Rosehall

Digital copies of treatment flowchart provided.

5.2 Proposed Facility5.2.1 Status of Land Acquisition

The Minister of Housing assured that land will be acquired as much of the land in the project area is state owned.

5.2.2 Soil Condition

The upper stratum is classified as weak Demarara Clay.

5.2.3 Raw Water Quality

Data is available for Division 5 as far back as 2002. This information was compiled by GWI water quality unit. The Hydro-meteorological department of the Ministry of Agriculture does not monitor groundwater quality.

5.2.4 Ground Water Levels

Data on static level up to January 2003 compiled

5.2.5 Planned Land Use TP

Land will probably be reserved for treatment facility only.

5.2.6 Planned Land Use Boreholes

Land use may be predominantly agriculture and housing through project area.

5.2.7 Drawings of Proposed Facility

At the moment no drawings of the proposed facility are available.

5.2.8 Basis of Plant Capacity

Based on a population growth rate of 0.75% per annum over 20 years applied to the 2002 population census figures. The plants are designed to meet the 2025 maximum day demand, assuming a consumption of 180l/person/day and a maximum day factor of 1.4.

5.2.9 Cost Basis of Proposed Facility

Cost estimation based on standard cost per person for a treated water scheme. Much of the unit costs were derived from the World Bank Intervention.

5.2.10 Increase in Technical Staff

Assuming two treatment plants are built the project will create employment at the following positions:

Position	Number required
Supervisor	6
Plant Operator	6
Electrician	2
Craftsman 1	2
Craftsman 2	2

5.2.11 Increase in O&M Costs

Information regarding the maintenance costs within the project area is unavailable.

Current Operational Costs

The current operational cost within the project will be derived based on electrical operating costs and labour costs as shown in the table below.

Borehole	Energy							Labour		
	Energy Consumption (KWh)						Monthly Cost (G\$)	Operator	Number	Cost (G\$)
	Jan	Feb	Mar	Apr	May	Average				
#47	9232	7881	8709	8584	8693	8619.8	\$448,230	\$38,629	1	\$38,629
Dead Tree Farm #57	22442	18590	21191	22136	20222	20916.2	\$1,087,642	\$38,629	1	\$38,629
Benab #63	13564	11805	15288	13628	14047	13666.4	\$710,653	\$38,629	1	\$38,629
Friendship #69	17052	18726	13430	16158	16286	16330.4	\$849,181	\$38,629	1	\$38,629
Spring Garden #75	18537	17984	16554	17989	17956	17804	\$925,808	\$38,629	1	\$38,629
Springland	9910	10038	9222	9241	9290	9540.2	\$496,090	\$38,629	1	\$38,629
Queenstown	30000	27667	30000	31559	17878	27420.8	\$1,425,882	\$38,629	1	\$38,629
Line Path D	0	0	0	0	0	0	\$0	\$38,629	1	\$38,629
Crabwood Creek	30563	25261	26210	25710	23230	26194.8	\$1,362,130	\$38,629	1	\$38,629
Subtotals							\$7,305,615			\$347,661
Add 20% for overtime, transportation, security										\$69,532
Total							\$7,305,615			\$417,193

Estimated operational cost = G\$7,722,808

Monthly Operational Cost upon completion of project

The operational cost of the system upon completion is difficult to determine as the exact treatment process, service area and location of the plants have yet to be determined. However, figures regarding the estimated cost per m³ produced derived in the feasibility study for the World Bank Intervention will be used.

Plant Location	Production Cost per m ³
Div 1	24
Div 2	27
Div 4	29
Average	27

The project is expected to supply potable water to approximately 45,000 residents in Division 5. Assuming a consumption of 180/person/day, the required monthly production is 226,800m³.

An operational cost of G\$27/m³ produced (derived as part of the World Bank Intervention Feasibility Study) will be used as a base. This estimate includes chemical, electrical and labour costs. Adding 40% to cater for overtime, transport, security, equipment, tools and spares the estimated cost of production is G\$38/m³.

The estimated operational cost for the treated water scheme will therefore be G\$8,618,400 per month.

This project will increase the operational cost of the division by G\$895,592 every month.

Table 2

Water Source Name	Source Type	Average Monthly Yield (m ³)	Year Constructed	Estimated Design Capacity (m ³ /hr)	Daily Average (m ³ /hr)	Delivery Area	Problems		
							Quantity	Quality	O&M
Orealla	A- Sands	0	1969	275	NA	Distribution Network	None	Iron Content	No bulk meters
Sisters	A- Sands	0	1928	611	NA	Distribution Network	None	Iron Content	No bulk meters
Mara	A- Sands	635	1957	916	NA	Distribution Network	None	Iron Content	No bulk meters
Edinburg (New)	A- Sands	9,793	1998	764	61.8	Distribution Network	None	Iron Content	High energy cost
Lochaber	A- Sands	14,684	1971	458	6	Distribution Network	None	Iron Content	High energy cost
Sheet Anchor	A- Sands	67,466	1989	611	66	Distribution Network	None	Iron Content	High energy cost
Cumberland	A- Sands	86,373	1973	458	185	Distribution Network	None	Iron Content	High energy cost
Adelphi	A- Sands	29,660	1976	611	NA	Distribution Network	None	Iron Content	No bulk meters
#19	A- Sands	12,786	1940	NA	NA	Distribution Network	NA	NA	NA
Fyrish	A- Sands	24,100	1974	0	114	Distribution Network	None	Iron Content	High energy cost
Albion	A- Sands	0	1978	NA	NA	Distribution Network	NA	NA	NA
Port Mourant	A- Sands	170,327	2000	871	258	Distribution Network	None	Iron Content	High energy cost
Rosehall (Project)	A- Sands	13,885	1984	458	NA	Distribution Network	None	Iron Content	No bulk meters
Letter Kenny	A- Sands	67,615	1979	458	162	Distribution Network	None	Iron Content	High energy cost

Adventure	A- Sands	103,860	NA		916		180	Distribution Network	None	Iron Content	High energy cost
Bushlot	A- Sands	0		1970	642		198	Distribution Network	None	Iron Content	High energy cost
Cromarty	A- Sands	30,364	NA			NA		Distribution Network	NA	NA	NA
Eversham	A- Sands	37,544		1991	611		258	Distribution Network	None	Iron Content	High energy cost
Mibikuri	A- Sands	44,762		1972	611		126	Distribution Network	None	Iron Content	High energy cost
Johanna	A- Sands	28,598		1972	1069		126	Distribution Network	None	Iron Content	High energy cost
Yakusari	A- Sands	28,467		1982	611	NA		Distribution Network	None	Iron Content	High energy cost
#47	A- Sands	40,867		1954	1268		100	Distribution Network	None	Iron Content	High energy cost
#57	A- Sands	73,121		1970	611		144	Distribution Network	None	Iron Content	High energy cost
#63	A- Sands	57,849		1970	611		210	Distribution Network	None	Iron Content	High energy cost
#69	A- Sands	54,154		1981	764		186	Distribution Network	None	Iron Content	High energy cost
Springlands/CWC	A- Sands	0		1973		NA		Distribution Network	None	Iron Content	High energy cost
#75	A- Sands	63,840		1999	764		210	Distribution Network	None	Iron Content	High energy cost
Springlands	A- Sands	41,481		1948	458		138	Distribution Network	None	Iron Content	High energy cost
Crabwood Creek	A- Sands	83,038		1973	458		204	Distribution Network	None	Iron Content	High energy cost
Line Path	A- Sands	17,568		1953		NA		Distribution Network	NA	NA	NA
Queenstown	A- Sands	11,705	NA			NA		Distribution Network	NA	NA	NA

Table 3

Treatment Plant Name	Year Constructed	Source	Max. Design Capacity (m ³ /hr)	Daily Production (m ³ /hr)	Pumping Capacity (m ³ /hr)	Service Area
New Amsterdam	1995	A-sands	350	387	630	New Amsterdam
Rosehall	2000	A-sands	500	550	900	Roshall

Response to JICA Follow-up Questionnaire

DRAFT RESPONSE

August 20, 2005

1 Water Quality

1.1 GWI's Testing Ability

GWI has a water quality laboratory located at the head office in Kingston, Georgetown. The lab has the capacity to conduct the following tests:

- pH
- Turbidity
- Iron
- Coliform
- Aluminum
- Nitrates
- Hardness
- Flouride

1.2 Specific Information

- Iron – 90% of the water supplied to customers is obtained from groundwater. There are 3 aquifer systems along the coast of Guyana, the upper A sands, the A sands and the B sands. Most of the boreholes are tapped into the A-sands aquifer. The iron content of the water from this aquifer is typically in excess of 0.5mg/l up to around 2.0mg/l.
- Colon Bacillus – GWI's water quality laboratory has the capacity to test for e. coli.

1.3 Waterborne Diseases

- Information requested from the Ministry of Housing.

2 Water Leakage

2.1 Reliability of Power Supply

Power supplied to boreholes is fairly reliable with a few instances of failure, though this is not a common occurrence.

2.2 Supply Period

- The primary reason for the discontinuity of the supply is the high cost of energy. Systems are run for less than 24 hours a day simply because GWI cannot afford to run them for longer periods.
- Some customers use overhead tanks to provide a reliable to supply to their households. It is difficult to say with any certainty whether these tanks overflow. This issue should be addressed in the basic design study.
- Some leakage occurs on distribution pipes, but mostly on service connections.

2.3 Unaccounted for Water

Non revenue water in the system is estimated at 78%. This was determined based on the following water balance:

A	B	C	D	E
System input (m ³ /month)	Authorized consumption	Billed Authorized consumption	Billed metered consumption	Revenue Water
			Billed unmetered consumption	
		Unbilled authorized consumption	Unbilled metered consumption	Non revenue water
			Unbilled unmetered consumption	
	Water losses	Apparent losses	Unauthorized consumption	
			Metering inaccuracies	
		Real losses	Leakage on transmission and distribution	
			Leakage and overflows at storage tanks	
			Leakage on service connection	

Within Division 5, there are approximately 8000 metered connections. However, meter reading throughout the division is low and sporadic. As such, reliable data regarding actual consumption is unavailable.

2.4 Flow Meters

Bulk flow meters are installed throughout the pipe network. Most boreholes have working bulk flow meters installed on the discharge line. A few district metered areas have been created at the following areas:

- Bond Yard/Free Yard – 700 customers
- Lesbeholden – 150 customers
- Area H & J Albion – 400 customers

2.5 Leakage

Most leakage occurs at the service connection installation where the system is weakest. The distribution network is structurally more stable and durable than connections as these lines are tested at 75m (110 psi) prior to commissioning.

2.6 Construction Works

Projects identified for funding under the Government of Guyana are subject to an open tender procedure. The same applies to donor funded projects. However, a number of small projects are contracted out at the divisional level, such as, installation of service connections and minor repair jobs.

2.7 Customer Complaints

Raw data of customer complaints is available in digital format.

3 Environmental Considerations

3.1 Groundwater Sustainability

There is no solid evidence to indicate that current abstraction rate is unsustainable. Although there is real possibility of saline intrusion, chloride levels in ground water throughout the coast of Guyana remain very low.

3.2 Groundwater Studies

Studies are available.

3.3 Skeldon Expansion Project

The Skeldon Expansion Project relates to the construction of new sugar factory at Skeldon, which is a neighboring village of Corriverton, and will not actually infringe on the town of Corriverton. Land usages are identified in the region 6 land use plan.

3.4 Flooding

The project area is generally not affected by flooding. Main roads and second floors of houses have not been covered by flood waters for over 10 years in the project area. During the recent floods in Region 4 and 5, some houses were covered up to their second floors.

3.5 Borehole Registration

All boreholes are registered at the Hydrometeorological Department of the Ministry of Agriculture. Boreholes that were unregistered before the Water and Sewerage Act of 2002 were registered within 3 months of act's implementation.

Any new boreholes would require application to the Hydrometeorological Department.

3.6 Site Location

Although the exact location of the plants will be determined during the detailed design, it is possible that sugarcane fields will be reclaimed to accommodate the plants.

3.7 Willingness to Pay

- Most residents in Corriverton rely on water provided by GWI. However, some amount rainwater harvesting is done throughout the region.
- Information regarding affordability is unavailable.
- The sensitivity of the project with regards to revenue collection needs to be investigated in the detailed study.

3.8 Environmental Screening

Screening will commence on July 11, 2005 and will be submitted to the Environmental Protection Agency within two weeks. EPA should issue a response within one month of receiving the application.

4 Basic Design

4.1 Consumption

The standard figure used in the design of all systems by GWI is 180 l/capita/day. This figure assumes 25% non-revenue water and has been used in several other studies such as the World Bank Interventions. There have been cases where the actual consumption reduced to 135 l/capita/day through the implementation of the leakage strategy.

4.2 Supply

A supply of 180 l/person/day will be adequate for the drinking water needs of the customers within the project area.

4.3 Managerial Ability

The low rate at which revenue is collected is attributed partially to the number of vacant positions within the organization. This is especially the case with regards to metering as there is only one meter reader employed in Division 5. The issue of revenue collection is further complicated by low service levels within the division. Customers are less inclined to pay for a service that currently does not meet their expectations. As such, the issue of revenue collection should be directly correlated with poor managerial performance.

With regards to the operation of the proposed facility, the division has over 10 years experience in the operation and maintenance of treatment plants and in the context of appropriate technology, the operation and maintenance of the proposed facilities is not perceived as a problem.

The proposed treated water scheme will actually result in a reduction in operational cost in division 5 and the company as a whole. The reduction in operational cost will be achieved through the decommissioning of several boreholes and also through the reduction in unaccounted for water in the system

The possibility of an Institutional Strengthening Programme should not be ruled out and would certainly be welcomed by GWI. This programme may be necessary to provide training following the construction of the plants.

5 Sanitation

5.1 Toilet Types

Most households have toilet that are connected to septic tanks. However, there are a few pit latrines in the project area.

5.2 Waste Disposal

Solid waste disposal is a major problem encountered throughout Guyana. Within the project area, solid waste is predominantly disposed through burning or burial. However, there are plans to develop a sanitary landfill in Corriverton, using land reclaimed from the sugar plantation, and situated some distance from the population.

5.3 Environmental Issues

The project will not require the reclamation of land from mangrove forest and will not affect any prestigious ecosystems or plants.

5.4 Other Sources of Pollution

There is the possibility of pollution caused by animal excretions, but it may be small scale as there are no significant breeding of animals within the project area.

5.5 Land Subsidence

No problems.

5.6 Cultural Heritage

No problems.

5.7 Erosion of sea shore

No problems.

6 Machinery

6.1 Contractors

GWJ does not have a standard list of contractors. All major projects are subject to open tender procedures. Contractors are selected based on their experience, technical and financial merits.

6.2 Construction Materials

- Cement – imported from Venezuela and Trinidad. Cost G\$1300 per sack. (USD 7)
- Aggregate – obtained locally.
 - Sand – G\$2,000 per ton (USD 10)
 - Stone (1/2”) – G\$3,000 per ton (USD 15)
- Reinforcement – Manufactured locally.
 - 1/4” – G\$300 (USD 1.5) per 6m rod
 - 1/2” – G\$760 (USD 3.8) per 6m rod
 - 3/4” – G\$1000 (USD 5) per 6m rod

7 Cost Estimates

7.1 Topographical Surveying

Cost – G\$ 250,000

7.2 Ground Surveying

Cost – G\$600,000 per borehole (USD 3000)

7.3 Route Surveying

Cost G\$ 50,000 per km (USD 250 per km)

7.4 Water Quality

- USD 10 per metal
- pH – USD 1
- Turbidity – USD 3
- Chlorides – USD 5
- Sulphates – USD 8

7.5 Test Pumping

GWl uses the British Standard step test for the test pumping of boreholes (BS 6316). GWl will undertake to test pump all boreholes within the project area before the start of the basic design study.

7.6 Social Survey

Each questionnaire will cost approximately G\$15 (USD 0.08) to print. The questionnaires can be distributed and collected through the division.

7.7 Ultra Sound Flow Meters

GWl has no such device.

7/28 受

**Further Questionnaire Regarding
Water Supply Sector in Corriverton**

July 27, 2005

Preliminary Study Team on the Project for Water Supply in Corriverton
Haga & Yamazaki

Thank you for your cooperation to the Preliminary Study Team on the Project for Water Supply in Corriverton. We have further questionnaire as follows and will be grateful if you answer it and respond it by August 5th. Thank you for your further time and effort in advance.

1. What are the fiscal year of Guyana and/or the fiscal year used in GRI? Is it from January 1st to December 31st?
 - Fiscal year is from January 1st to December 31st.
2. The total number of GWI staffs you have given were 550. Which point in time (year and month) was this number given?
 - The total staff currently employed is 498 as of June 2005. The figure of 550 reflects the organizational structure if all vacancies were filled.
3. Please specify the number of staffs in each of the following department:
 - Managing Director's Office (12)
 - Administrative Department (17)
 - Department of Finance (21)
 - Department of Human Resources (8)
 - Asset Development Team (16)
 - Department of Customer Relations & Commercial Services (82)
 - Department of Operations(342) =Division 1~Division5
 - Division 1 (26)
 - Division 2 (50)
 - Division 3 (151)
 - Division 4 (45)
 - Division 5 (40)
 - Total number of staffs (498)
4. If the Japanese Project were to be implemented, (1) which department will be in charge of the Project? (Ex. Special Team for Project implementation will be made, Asset Development Team will take charge, etc.), (2) what other measures regarding O&M will be taken after Project

completion other than the increase of Division 5 staffs?

- If the project is implemented, a special team within the Asset Development Team will need to be staffed to handle the project.
 - As highlighted in the previous questionnaires, the operational cost of the project will increase as well as staffing requirements within the division. Additionally, staff at the treatment plant(s) will need to be trained in the use of chlorine and lime. GWI would welcome the possibility of an institutional strengthening programme.
5. Concerning the seven pumping stations managed by Division 5, is calcium hypochlorite really injected as in the injection chart on the wall? If answer is yes, what is the amount of residual chlorine? Also, necessary amount of hypochlorite calcium in Crabwood Creek, 4,629 grams, is given per day, per month, or per year?
- Division 5 operates 33 boreholes and not 7. Within the project area (#44 Village to Moleson Creek), there are 9 boreholes. Throughout the country and in Division 5, water is fed directly from the boreholes into the transmission without treatment. The exemption is at treatment plants where raw water from boreholes are treated and then distributed.
6. According to water leakage survey report by GWI, pumped-up water from the seven pumping station was 1,547,299 m³/month, which is calculated as approximately 50,870 m³/day. Suppose that the population size is 43,000, it is 1.18 m³/day/person. Is this calculation correct? Please give us the capacities of seven pumps.
- This would be a gross estimation of the production requirements. 61% of this production would be lost to leakage and as such the actual consumption would be less than 1.18m³/person/day. The consumption figure used to arrive at these estimates is 0.135m³/person/day. Check item 3.12 in the Response to HQ Questionnaire for more details.
 - These are the best efficiency points for the pumps

Borehole	Rated Flow (m ³ /hr)	Rated Head (m)
#47	80	60
Dead Tree Farm #57	140	60
Benab #63	140	60
Friendship #69	175	60

Spring Garden #75	175	60
Springlands	80	60
Queenstown	Not Available	Not Available
Line Path D	Not Available	Not Available
Crabwood Creek	220	70

7. Number of people who suffer water caused diarrhea on the yearly average is 1,068. Please tell us the death toll of infants under 5 years old in Corriverton, if any.

- I will check with the Ministry of Health to obtain this information.

8. As we will request the analysis of water quality items, please tell us the unit analysis cost of each item. Also, please tell us the amount of water sample necessary for each item.

Water quality item (19 items)

- turbidity (NTU), 3 USD
- color (hazen), 5USD
- temperature (°C), 5USD
- pH, 1USD
- electrical conductivity (µS/cm), 1USD
- total alkalinity (mg/L), 1.5USD
- total hardness (mg/L), 1.5USD
- calcium hardness (mg/L), 10USD
- iron (mg/L), USD 10
- manganese (mg/L), USD 10
- magnesium (mg/L), USD 10
- magnesium hardness (mg/L), 10USD
- ammonia nitrate (mg/L), 8USD
- ammonia, 8USD
- phosphorus, USD 10
- chloride (mg/L), USD 5
- coliform group count/100ml (MPN), 25USD
- coliform count/100ml (MPN), 25USD
- arsenic (mg/L) 25USD

添付資料 4 資料収集リスト

添付資料 4. 収集資料リスト

形態：図書、ビデオ、地図、写真、図面、記事切り抜き、書類（ハードコピー、webの出力も含む）、電子データに分類

番号	資料の名称	形態	収集資料	専門家作成資料	JICA作成資料	発行機関	取扱区分	図書館記入欄
A	国家計、法令、EPA							
A-1	Licence, To Supply Water and Sewerage Service and Advisory Service for Public proposes Granted to Guyana Water INC. A Company Incorporated under The Companies Act 1991 (No.29 of 1991), Under section 90 of The Water and Sewerage Act 2002 (No.5 of 2002) Issue effective, November 13, 2002	書類	○			Guyana Water Inc.	JR・CR()・SC	
A-2	Companies act of Guyana, Consent to Act as Director of Guyana Water Incorporated, Jun.2002 (ガイアナ公社法、GWIの管理者の役割、2002年6月)	書類	○			Cameron & Shepherd Attorneys-at-law	JR・CR()・SC	
A-3	Region VI sub-region land use plan Sep.2004 (ガイアナ第6県土地利用計画 2004年9月、ガイアナ土地展望委員会)	書類	○			Guyana Lands and Surveys Commission	JR・CR()・SC	
A-4	Guyana Act No. 5 of 2002, Water and Sewerage Act 2002 (ガイアナ法2002年第5法)	書類	○			Government of Guyana	JR・CR()・SC	
A-5	Guyana Act No.11 of 1996, Environmental Protection Act 1996 (ガイアナ法1996年第11法)	書類	○			Government of Guyana	JR・CR()・SC	
A-6	Environmental Impact Assessment Guidelines, Volume 1, rules and Procedures for Conducting and Reviewing EIAs, Ver.4, November 2000 (環境インパクトガイドラインス：EPAガイアナ)	書類	○			Environmental Protection Agency/ Environmental Assessment Board	JR・CR()・SC	
A-7	Management Contract 2002 (委託管理契約書：GWIとSevern Trent International Water, Ltdとの契約書)	書類	○			GWI, STWI	JR・CR()・SC	
A-8	Guyana Poverty Reduction Strategy Paper, November 2001	図書	○			Government of Guyana	JR・CR()・SC	
A-9-1	National Development Strategy, Chapter 1-9	書類	○			Guyana News and Information	JR・CR()・SC	
A-9-2	National Development Strategy, Chapter 15	書類	○			Guyana News and Information	JR・CR()・SC	
A-10	Environmental Guidelines (2004年環境ガイドライン)	電子データ				Environmental	JR・CR()・SC	
A-11	Final_GWI_WB_Feasibility_Study, 2005 (世銀、実現可能調査2005年)	電子データ				WB	JR・CR()・SC	
A-12	revised design criteria following WB mission in Sep. 2004 (改定設計指針2004年)	電子データ				WB	JR・CR()・SC	
A-13	National Development Strategy (国家開発計画第15章水)	電子データ				Government of Guyana	JR・CR()・SC	
B	調査、計画 (他トナー含む)							
B-1	Design Report, Georgetown water Supply and Sewerage Program II and Demerara River Water Quality Studies, August 2002/ Ministry of Housing and Water	書類	○			Guyana Water Inc.	JR・CR()・SC	

B-2	Management of the Guyana Artesian Coastal Aquifer, Preliminary Assessment of Alternative Approaches / Georgetown Aug. 1997 (ガイアナ アルデシアン 沿岸帯水層の管理MCHEQ、イスラエル)	書類	○				Dr. Abraham Mercado-Consultant	JR・CR()・SC	
B-3	World Bank Funded Water Sector Intervention, Feasibility Study / GWI Mar.2005 (水道部門介入への世界銀行基金／実現可能調査: GWI)	書類	○				Guyana Water Inc.	JR・CR()・SC	
B-4	Guyana Water & Sanitation Sector Studies, Volume II-Part 1, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	
B-5	Guyana Water & Sanitation Sector, Studies, Volume II-Part 2, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	
B-6	Guyana Water & Sanitation Sector, Studies, National Water Policy-Annex 2, Legal Report, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	
B-7	Guyana Water & Sanitation Sector, Studies, National Water Policy-Annex 3, Ground Water Report, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	
B-8	Guyana Water & Sanitation Sector, Studies, National Water Policy-Annex 4, Surface Water Resources & Management, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	
B-9	Guyana Water & Sanitation Sector, Studies, National Water Policy-Annex 5, Agricultural Water Usage, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	
B-10	Guyana Water & Sanitation Sector, Studies, National Water Policy-Annex 6, Overview of Environmental Protection, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	
B-11	Guyana Water & Sanitation Sector, Studies, National Water LRSP-Annex 8, Water Usage and Vulnerability Report, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	
B-12	Guyana Water & Sanitation Sector, Studies, National Water LRSP-Annex 9, Hinterland Review, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	
B-13	Guyana Water & Sanitation Sector, Studies, National Water LRSP-Annex 10, Water Quality, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	
B-14	Guyana Water & Sanitation Sector, Studies, National Water LRSP-Annex 11, Asset Review, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	
B-15	Guyana Water & Sanitation Sector, Studies, National Water LRSP-Annex 12, Management Information System Review, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	
B-16	Guyana Water & Sanitation Sector, Studies, National Water LRSP-Annex 13, Cost Recovery Review, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	
B-17	Guyana Water & Sanitation Sector, Annex 14-Proposed Investment Plan Working Details, 17 December 1999, Department for International Development, (KPMG)	書類	○				KPMG	JR・CR()・SC	

B-18	Guyana Water Sector Programme (GUYWASP開始時のプロジェクトドキュメント ロジカルフレーム)	書類	○			Department for International Development	JR・CR()・SC	
B-19	Center for Economic and Social Research and Action	書類	○			Center for Economic and Social Research and Action	JR・CR()・SC	
B-20	Co-operative Republic of Guyana Hydro meteorological Service, Ministry of Works and Transport (works), Ground water Recovery in Guyana, Some Aspect, by B. Geer, May 1980	書類	○			Ministry of Work and Transport	JR・CR()・SC	
B-21	Guyana water and sanitation Sector, Terms of reference for preparation of a Long-Term Strategic Plan for GUYWA and for GUYWA Tariff Studies	書類	○				JR・CR()・SC	
B-22	Water and Sewer Rehabilitation Programme II, Technical Analysis, May 1999	書類	○			Georgetown Sewerage and Water Commissioners	JR・CR()・SC	
B-23	Georgetown Water and Sewerage Master Plan, Project Memorandum: PM/GPM/11 Groundwater Resources Assessment, August 1993, The Corporate Republic of Guyana, Guyana Water authority	書類	○			Sir Wilson Halcrow & Partners Ltd.,	JR・CR()・SC	
B-24	Consultancy Services for the Review of the Water Supply Distribution System No.61 Village to Moleson Creek, Final Design Report	書類	○			Guyana Water Authority	JR・CR()・SC	
B-25	Department for International Development-Caribbean Guyana, Guyana Water Sector Programme (GUYWASP), Output to Propose Review, November 2004, Government of Guyana	書類	○			Government of Guyana	JR・CR()・SC	
B-26	Government of Guyana Funded Projects Year 2004	書類	○			Guyana Water Inc.	JR・CR()・SC	
B-27	design criteria for project (プロジェクト設計指針)	電子データ				WB & Government of Guyana	JR・CR()・SC	
C	GWI, ガイダンス、契約表、組織							
C-1	Environmental Guidelines Associated with the Construction of subprojects, October 2004	書類	○			Guyana Water Inc.	JR・CR()・SC	
C-2	Management Contract	書類	○			Guyana Water Inc.	JR・CR()・SC	
C-3	Guyana Water Inc.組織図	書類	○			Guyana Water Inc.	JR・CR()・SC	
C-4	Strategic Plan, May 2005	書類	○			Guyana Water Inc.	JR・CR()・SC	
C-5	Ministry of Foreign Trade and International Cooperation, Georgetown, Guyana, August 26, 2003	書類	○			Guyana Water Inc.	JR・CR()・SC	
C-6	Annual Report and Accounts, for the year ended, December 31, 2003	書類	○			Guyana Water Inc.	JR・CR()・SC	
C-7	Audited Financial Statements of the Guyana Water Incorporation, For the year ended, 31 December, 2003 Auditors : Office of the Audition General/ 63 High Street/ Kingston/ Georgetown/ Guyana	書類	○			Guyana Water Inc.	JR・CR()・SC	
C-8	Audited Financial Statements of the Guyana Water Incorporation, For the period, 30 May 2002 to 31 December 2002 Auditors : Office of the Audition General/ 63 High Street/ Kingston/ Georgetown/ Guyana	書類	○			Guyana Water Inc.	JR・CR()・SC	

C-9	Government of Guyana Funded Projects for Year 2004		書類	○			Guyana Water Inc.	JR・CR()・SC	
C-10	Audit of the Accounts of Guyana water Incorporated for the Period 30/5/02-31/12/02		書類	○			Guyana Water Inc.	JR・CR()・SC	
C-11	Department for International Development, Determination of Performance Target for the GWI Management Contract, June 2004.		書類	○			Halcrow Group Limited	JR・CR()・SC	
C-12	Licence, To Supply Water and Sewerage Services and Advisory services for Public Purposes, Granted to Guyana Water Inc., 13 November 2002		書類	○			Guyana Water Inc.	JR・CR()・SC	
C-13	Government of Guyana Organogramme		書類	○			Guyana Water Inc.	JR・CR()・SC	
C-14	Environmental Guidelines Associated with the Construction of Subproject/ GWI, Oct, 2005 (サブプロジェクト環境ガイドランス: GWI)						Guyana Water Inc.	JR・CR()・SC	
C-15	2003 project summary (2003年プロジェクト要約)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-16	2004 project summary (2004年プロジェクト要約)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-17	annual report for 2002 (GWI2002年報)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-18	annual report for 2003 (GWI2003年報)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-19	div 5 / 2004_2005 production (第5部業務報告2004年、2005年)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-20	div 5 / historic static levels (第5部統計)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-21	energy report (エネルギー報告)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-22	GWI contractor guidelines board (GWI契約ガイドライン)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-23	NA flowchart. Vsd (ニュー・アムステルダム浄水場フローシート)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-24	operational cost (GWI運転コスト)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-25	RH flowchart. Vsd (ローズホール浄水場フローシート)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-26	standard estimates (標準見積もり)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-27	standard estimates (標準見積もり)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-28	tbl pump reading (ポンプ記録)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-29	tbl pump reading (ポンプ記録)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-30	ten year development plan (GWI 10年開発計画)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-31	UFW div 5 (第5部の無収水量)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-32	environmental stuff (folder)		電子データ				Guyana Water Inc.	JR・CR()・SC	
C-33	GWI Structure-June 14,2005 (folder)		電子データ				Guyana Water Inc.	JR・CR()・SC	

