

**Botswana**

**North-South Carrier Water Project**

Field Survey: July 2003

**1. Project Profile & Japan's ODA Loan**



Project location map



Mmamashia Water Treatment Works

**1.1 Background**

Botswana is a landlocked country that is situated in the Kalahari Basin on the plains of southern Africa (average altitude: approximately 900 meters); it is bordered by the Republic of South Africa, Zimbabwe, Namibia, and Zambia. Its territory is generally flat and covers an area of 582 thousand square meters or approximately one-and-a-half times the size of Japan. It has a sub-tropical climate, with much of the country being arid or semi-arid. Annual rainfall averages 400mm nationwide, with southwestern regions seeing the least precipitation (250mm) and southeastern areas the most (600mm). Rainfall levels are seasonally affected and unstable. Botswana has few surface water resources in consequence of its topographical and geographical features and sources the majority of its water from groundwater fossil resources.

At the time of appraisal, the water supply rate was 100 percent in urban areas centered around the capital, Gaborone, but in view of the fact that demand was growing at exponential rates, large-scale development of underground water was problematic and water resources around the capital had been developed, the country was considering water transmission from other regions. In addition, Gaborone was importing water on a regular basis from South Africa and the country harbored a long-cherished wish to develop independent national water resources. By contrast, the water supply rate in the regions was 50 percent and reliant on groundwater.

**1.2 Objectives**

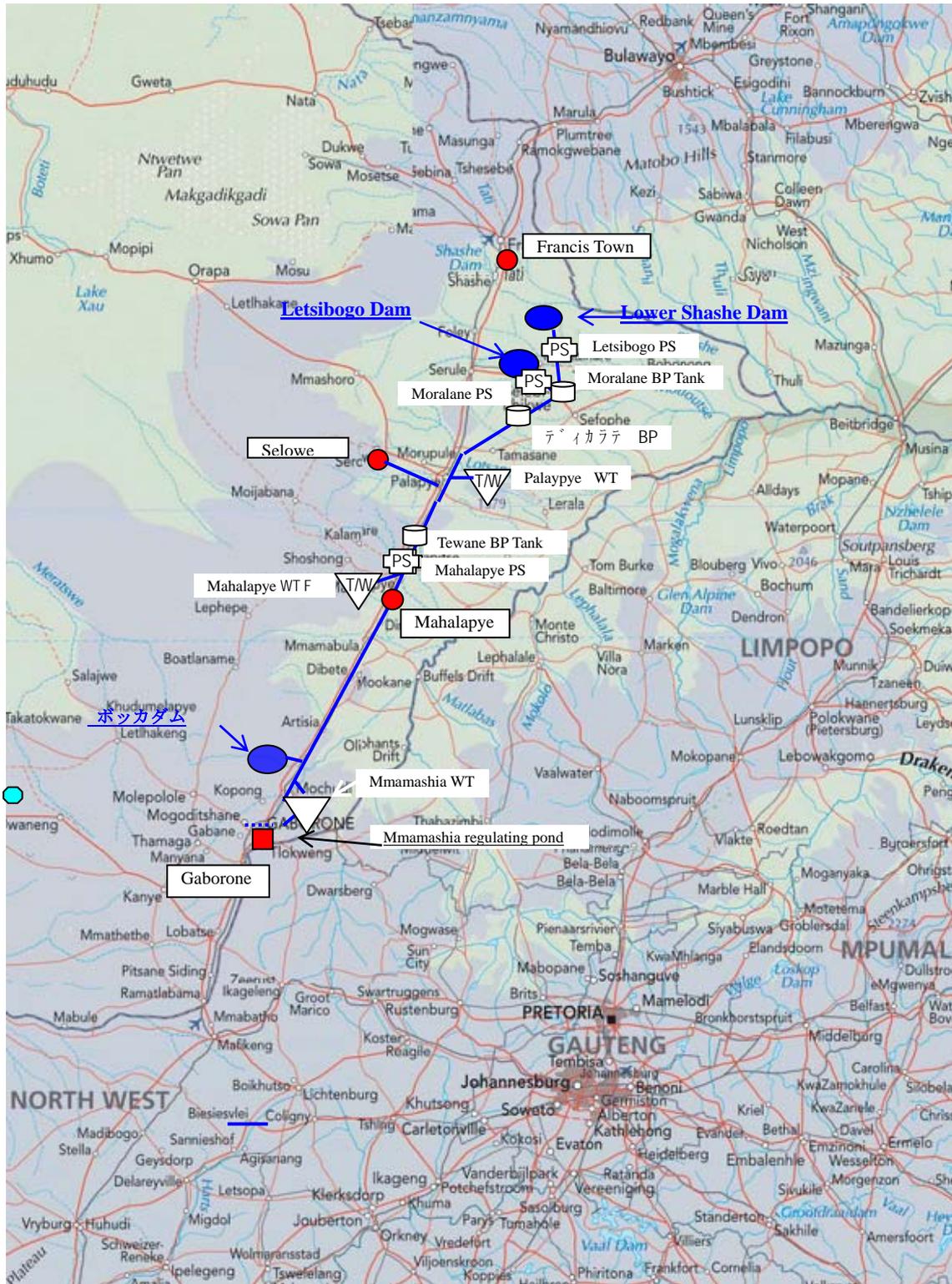
This project consists of the construction of dams, water transmission systems and water treatment works and was designed to develop water resources in the northeast of the country,

to relieve tight water demand in the southeast and to supply water to the central regions that are dependent on groundwater.

### **1.3 Outputs**

This project was co-financed by the European Investment Bank (EIB), the African Development Bank (AfDB) and other international donors; its outputs are as shown in Table 1, whilst this evaluation focuses on those components funded by the Japan Bank of International Cooperation (JBIC).

Figure 1: Project site map



- Capital
- Provincial capital
- Dam
- ▽ WTP
- Regulating pond
- Pump station
- Break pressure tank
- Water transmission pipe

Table 1: Outputs of Individual Aid Agencies

Facility	Construction site	Content & Capacity	Responsible Agency
Letsibogo dam	Letsibogo	Capacity: $1.42 \times 10^6 \text{m}^3$	EIB* <sup>1</sup>
Access roads	Letsibogo		Botswana government
Preparatory work			Botswana government
Water transmission main	Letsibogo-Gaborone	Total length: approx 360km	NDF* <sup>2</sup> , etc.
Water treatment plants (3) / regulating ponds	Palapye, Mahalapye, Mmamashia	14,000 m <sup>3</sup> /day, 12,000 m <sup>3</sup> /day, 92,000m <sup>3</sup> /day	JBIC
Pumping stations (3)	Letsibogo, Moralane, Palapye	1.01m <sup>3</sup> /second, 1.51m <sup>3</sup> /second, 1.33m <sup>3</sup> /second	JBIC
Break pressure tanks* <sup>3</sup> (3)	Moralane, Dikalate(BPT2), Tewane	Capacity: 4,500m <sup>3</sup> each	JBIC
Power supply facilities	Mmamashia, etc.		AfDB, etc.
Consulting services			Botswana government, etc.

#### 1.4 Borrower / Executing Agency

Republic of Botswana / Water Utilities Corporation\*<sup>4</sup> (WUC hereunder)

#### 1.5 Outline of Loan Agreement

Loan Amount	4,685 million yen
Disbursed Amount	4,685million yen
Exchange of Notes	October 1995
Loan Agreement	December 1995
Terms & Conditions	
Interest Rate	2.5% p.a. (2.1% for consulting services)
Repayment Date (Grace Period)	25 years (7 years)
Procurement	General untied

<sup>1</sup> EIB: European Investment Bank

<sup>2</sup> NDF: Nordic Development Fund

<sup>3</sup> The pumps were installed in separate zones to facilitate pump operation and prevent negative pressure in downstream areas.

<sup>4</sup> A wholly government-funded public corporation that was established under the water utilities corporation law in the 1970s.

## **2. Results & Evaluation**

### **2.1 Relevance**

The water sector was designated a key sector for development under Botswana's seventh five-year national development plan (1994-1999), and securing sources of daily life water, industrial and agricultural water and supplying sufficient water to the rural population were defined as its goals. Accordingly, given its objectives to develop water resources and supply water, this project was consistent with the national development plan and relevant at the time of appraisal. Meanwhile, the development of water resources and water supply continued to hold prominent positions in the country's eighth (1999-2003) and ninth (2003-2008) national development plans, thus the project has maintained its consistency with Botswana's development goals and was relevant at the time of evaluation.

### **2.2 Efficiency**

#### **2.2.1 Outputs**

According to the plans, Japan's ODA loan was to cover the construction of three water treatment plants, three pumping stations, and three break pressure tanks and these were executed essentially in line with the plans.

#### **2.2.2 Project Period**

At the planning stage, the execution period was schedule to span 34 months, from December 1995 through September 1998; however, technical problems at the start of operations (leakage from pipe connections, damaged valves at the pumping stations, etc.) were primarily responsible for delays amounting to 21 months, thus the actual execution period spanned 55 months, from December 1995 through June 2000.

#### **2.2.3 Project Costs**

Actual project costs (for the portion funded by JBIC)\*<sup>5</sup> were 9,368 million yen against the appraisal figure of 6,246 million yen; the overrun was generated by the need to counter the aforementioned technical problems and inflation.

### **2.3 Effectiveness**

#### **2.3.1 Status of Facility Usage & Operation**

##### **2.3.1.1 Water Treatment Works**

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<sup>5</sup> Converted at BWP 1 = JPY37.0 (appraisal); BWP 1 = approx. JPY 26.75 (evaluation) (IFS-based simple period average)

[Capital (Gaborone): Mmamashia water treatment works] Due to shortages of water volume at the Letsibogo dam, the intended primary water source, the plant is being operated using alternative water sources: i.e. water imported from South Africa and water supplied from the Gaborone dam (not covered by this project). In 2001, supply volumes to the Gaborone area had reached 66 percent of the target level (see Table 2).

[Rural sector: Mahalapye water treatment works, Palapye water treatment works] Both works are sourcing their water from the Letsibogo dam; in 2001, supply volumes to the Mahalapye and Palapye areas had reached 16 percent and 12 percent, respectively, of the target levels (see Table 2).

Table 2: Comparison of Indices for the Three Water Supply Facilities Source: WUC

	Mmamashia	Mahalapye	Palapye	Total
Supply volume (million m <sup>3</sup> /year) (Appraisal projections for 2001)	33.58	4.38	5.11	43.07
Supply volume (million m <sup>3</sup> /year) (Results for 2001)	22.00	0.72	0.60	23.32
Supply attainment rate (%)	66	16	12	54



Mahalapye Water Treatment Works



Palapye Water Treatment Works

**2.3.1.2 Regulating Ponds**

The regulating pond that was constructed adjacent to the Mmamashia water treatment works is an indoor reservoir facility that is used to store the water produced by the water treatment works until it is discharged into existing water supply systems. Between 2000 and 2002, it supplied an average 62,400m<sup>3</sup> per year, which accounts for 80 percent of its maximum capacity: 78,000m<sup>3</sup>.

**2.3.1.3 Pumping stations**

Slight modifications were made to the pump capacities cited in the original plans on the basis of the outcome of the detailed design.

**2.3.1.4 Break Pressure Tanks**

All break pressure tanks were constructed essentially as planned.

### 2.3.2 Attainment of Project Objectives

As stated above, in fiscal 2001, water supply attainment rates stood at 54 percent against the target for entire project; however, this is believed to be attributable to reduction of rainfall levels and to low reserves in the Letsibogo dam. Slower than projected population growth in the three areas covered by this project (particularly the Mahalapye and Palapye areas) is estimated to be another causal factor. In view of the fact that there was no evidence of notable water shortages in any of the beneficiary areas during this survey, it is considered that the project is having some effect.

### 2.3.3 Recalculation of Financial Internal Rate of Return (FIRR)

The FIRR was not recalculated because it was not possible to acquire sufficient data during this field survey.

## 2.4 Impact

### 2.4.1 Attainment of Project Goal

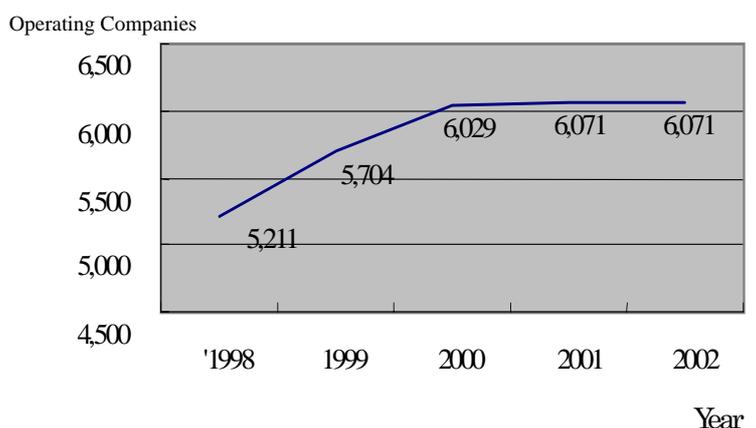
1. Promotion of commercial / industrial activities (especially in the southeastern greater Gaborone area) by securing supplies of service water.

Based on the Enterprises and Establishments Registration (EER) list (2002 edition) compiled by Botswana's Central Statistics Office, Gaborone, and as shown in Table 2, the numbers of enterprises / establishments in all industrial sectors operating in the Gaborone area are increasing (5,211 in 1999, 5,704 in 2000, and 6,029 in 2001).

2. Improvement of living environments (especially in Mahalapye and Palapye, rural areas in central Botswana) by improved public health, use of clean water.

Prior to project implementation, communities in the Mahalapye and Palapye areas were reliant on well water, but the construction of the two water treatment works has made it possible to supply these areas with treated water from the Letsibogo dam, which is potable. The number of households connected to the mains supply system is increasing and stand pumps have been installed near residences that are not connected to the

Figure 2: Trends in Enterprise/Establishment Numbers in the Gaborone Area



Source: Central Statistics Office Enterprises and Establishments Registration List 2002

mains, which supply water to these residences. According to the beneficiary survey<sup>6</sup>, among residents who answered the questionnaire, the answer that the time spent drawing water was achieved by the implementation of this project was 77% in Parapie, while 96% was in Maharapie. Moreover, the answer that health condition (including the decrease of diarrhea) was improved by the use of hygienic water was 70% in Parapie, while 83% was in Maharapie. Thus, it has been confirmed that the implementation of the project contributed to the improvement of public health and life environment. Moreover, it has been confirmed that the reductions in the labor involved in drawing water from distant wells (around one per village) have increased job opportunities for women, such as help for the agriculture.

Wells are now predominantly used to draw water for livestock production and there is virtually no use of this source for drinking purposes.

#### **2.4.2 Socio-environmental Impacts**

In connection with socio-environmental project impacts, construction of the Mmamashia regulating pond involved the involuntary resettlement of thirteen households, but compensation has been provided in line with the Land Boards' policy. No influence against natural environment has been identified.

### **2.5 Sustainability**

#### **2.5.1 Executing Agency**

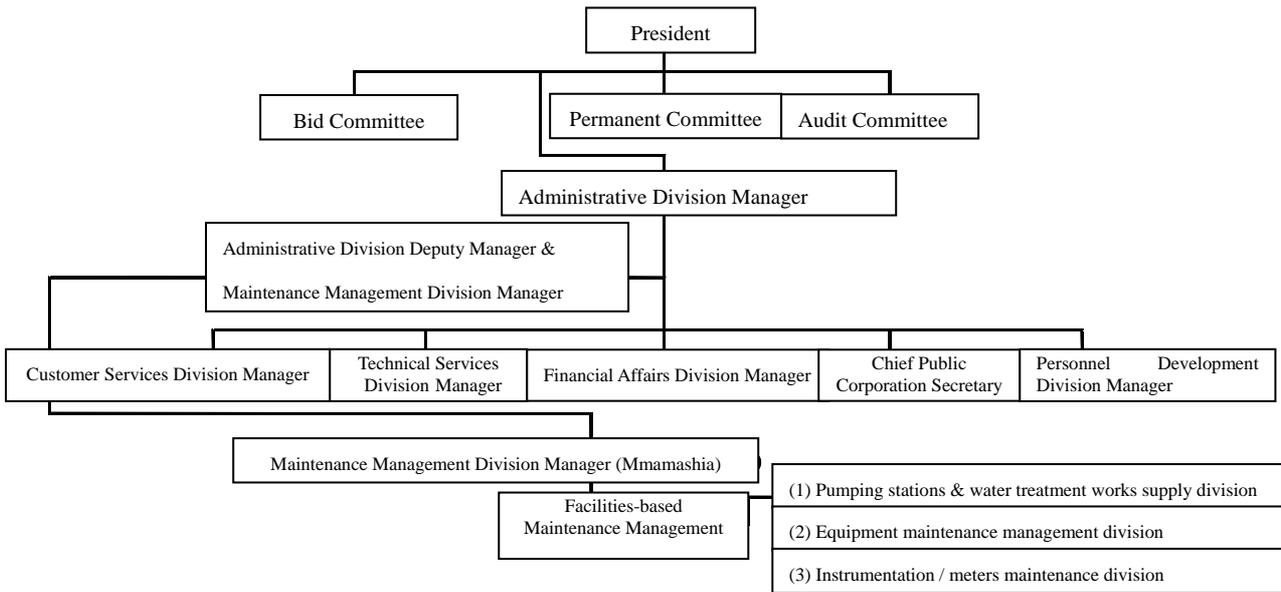
##### **(1) Technical Capacity**

Although external specialist are being used to perform repairs that require advanced technical knowledge and/or skills, routine inspections of facilities, equipment and instrumentation and breakdown repairs are handled by WUC engineers. WUC thus provides its staff with long and short-term training programs covering both techniques and knowledge.

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<sup>6</sup> The beneficiary survey targeted two areas, which were Parapie with the population of 22,000 (2001) and Maharapie with that of 41,000 (2001) where the water supply was not conducted before the implementation of this project. Also, the survey targeted qualitative and quantitative improvement of the water supply in both areas. The number of the respondents was 100 (each 50 people from both areas) in total.

Fig. 3: Organizational chart of WUC



**(2) Operation & Maintenance System**

The WUC maintenance management unit (now Mmamashia) is responsible for all maintenance of facilities and equipment under the supervision of the deputy manager of the administrative division at WUC. There are three divisions responsible for O&M: (1) the pumping stations and water treatment works supply division, (2) the equipment maintenance management division, and (3) the instrumentation / meters maintenance division; the divisions have a combined workforce of 159 (see Figure 3).

Of the facilities completed through this project, staff from (2) above, the equipment and maintenance management division, have been assigned to perform the O&M of the water treatment works (Mmamashia: 39; Mahalapye: 22; Palapye: 19). No personnel have been permanently assigned to the pumping stations and break pressure tanks, but computer at the WUC headquarters manages these facilities, and where necessary, members of staff assigned to the water treatment works will conduct tours of inspection for maintenance. Staff turnover is just 2 percent and the workforce is exceptionally stable, thus project sustainability is secure in terms of the O&M system.

**(3) Financial Status**

WUC’s finances and accounts are divided into four divisions: (1) the Gaborone / Lobatse Division, (2) the Selibe Phikwe Division, (3) the Francis Town Division, and (4) the North South Carrier Project Division, and this project is under the supervision of the North South Carrier Project Division. As shown in Table 3, in terms of the project’s cash flow, while revenues from water tariffs are increasing annually, loan repayments, including for the water resources development component are primarily responsible for ongoing over expenditure.

Table 3: Cash Flow of North-South Water Carrier Project (WUC)

Source: WUC (Unit: BWP 1,000)

	2000.3	2001.3	2002.3	2003.3
<b>Income</b>				
Water sales	0	53,502	73,557	101,357
Loans	126,333			
Shares	64,000	45,000		
Other	65,395	-1,081	-2,174	-5,714
<b>Total</b>	<b>191,728</b>	<b>97,421</b>	<b>71,383</b>	<b>95,643</b>
<b>Expenditure</b>				
Operating expenses	0	9,952	10,648	11,287
Administrative costs	5,000	5,000	5,000	5,000
Project costs	131,644	10,000	10,000	10,000
Loan repayments	28,000	31,784	35,876	45,688
Loan interest payments	54,598	52,824	49,198	45,572
<b>Total</b>	<b>219,242</b>	<b>109,560</b>	<b>110,722</b>	<b>117,547</b>
<b>(Income – Expenditure)</b>	<b>-27,514</b>	<b>-12,139</b>	<b>-39,339</b>	<b>-21,904</b>
<b>Balance</b>				

By contrast, the balance for WUC as a whole is shown in Table 4. Tariff revenues are increasing year on year and the company has been posting a positive balance of payments since 2002.

Table 4: Cash Flow of WUC (WUC)

Source: WUC (Unit: BWP 1,000)

	2000.3	2001.3	2002.3	2003.3
<b>Income</b>				
Water sales	189,891	278,812	329,201	388,622
Interest on deposits	7,042	2,709	7,127	9,786
Investment	0	0	0	
Shares	126,333	45,000	0	
Other	109,874	958	1,051	1,152
<b>Total</b>	<b>433,140</b>	<b>327,479</b>	<b>337,379</b>	<b>399,560</b>
<b>Expenditure</b>				
Operating expenses	62,822	123,958	151,808	187,963
Administrative costs	7,700	8,660	8,720	8,800
Project costs	294,591	102,760	12,500	13,550
Loan repayments	47,788	55,763	63,121	68,403

Loan interest payments	86,723	77,245	71,682	64,449
Other	109,000	0	0	0
Dividends	670	0	0	670
Total	609,294	368,386	307,831	343,835
(Income – Expenditure Balance	-176,154	-40,907	29,548	57,725

### **2.5.2 Operation & Maintenance Status**

Sufficient O&M work is being undertaken.

## **3. Feedback**

### **3.1 Lessons Learned**

Nothing

### **3.2 Recommendations**

Nothing

Comparison of Original & Actual Scope

Item	Planned	Actual
(1) Water treatment plants (JBIC) 1. Mmamashia 2. Palapye 3. Mahalapye	92,000m <sup>3</sup> /day 14,000m <sup>3</sup> /day 12,000m <sup>3</sup> /day	92,000m <sup>3</sup> /day 14,000m <sup>3</sup> /day 12,000m <sup>3</sup> /day
(2) Regulating ponds (JBIC) Mmamashia	Capacity: 78,000 m <sup>3</sup> Reinforced concrete	Capacity: 78,000 m <sup>3</sup> Reinforced concrete
(3) Pumping stations (JBIC) 1. Letsibogo 2. Moralane 3. Palapye	Capacity / head pump: 1. 1.01m <sup>3</sup> /second, 130m 2. 1.51m <sup>3</sup> /second, 135m 3. 1.33m <sup>3</sup> /second, 115m	Capacity / head pump 1. 0.82m <sup>3</sup> /sec. · 130m 2. 0.93m <sup>3</sup> /sec. · 135m 3. 1.03m <sup>3</sup> /sec. · 115m
(4) Break pressure tanks (JBIC) 1. Moralane 2. Thoti-Hill 3. Lose-Hill	Capacity: 4,500m <sup>3</sup> × 3 Reinforced concrete	Capacity: 4,500m <sup>3</sup> × 3 Reinforced concrete Thoti-Hill and Lose-Hill were changed to Dikalate and Tewane
(5) Consulting services 1. Contract management 2. Site supervision 3. Environmental surveys	741M/M	Contractual delays extended the supervision period beyond that cited in the original plans.
(6) Letsibogo dam	Height (Max.): 28m Capacity: 1.42 × 10 <sup>6</sup> m <sup>3</sup>	Height (Max.): 28m Capacity: 1.42 × 10 <sup>6</sup> m <sup>3</sup>
(7) Water transmission pipe	Height: 360km Diameter: 1,000-1,400mm	Height: 360km Diameter: 1,000-1,400mm
1. L/A	Sept. 1995	Dec. 1995
2. Water treatment plants	Feb. 1996 – Sept. 1998	Jan. 1997 – May 2000
3. Regulating ponds	Oct. 1996 – Sept. 1998	Jan. 1997 – May 2000
4. Pumping stations	Feb. 1996 – Sept. 1998	Nov. 1996 – Jun. 2000
5. Break pressure tanks	Jan. 1997 – Sept. 1998	Apr. 1997 – Mar. 1999
6. Consulting services	Jan. 1996 – Sept. 1999	Jun. 1995 – May 2000
7. Letsibogo dam	Sept. 1995 – Oct. 1997	Sept. 1995 – May 1997
8. Water transmission pipe	Nov. 1995 – Oct. 1998	Nov. 1995 – Aug. 1999
1. Foreign currency	JPY 31,071 million (BWP 840 million)	JPY 24,093 million (BWP 901 million)
2. Local currency	JPY 13,725 million (BWP 371 million)	JPY 13,085 million (BWP 489 million)
3. Total	JPY 44,796 million (BWP 1,211 million)	JPY 37,178 million (BWP 1,390 million)
4. ODA loan portion	JPY 4,685 million (BWP	JPY 4,685 million (BWP

	127 million)	175 million)
5. Exchange rate	BWP 1 = JPY 37.0 (1995)	BWP 1 = JPY 26.75 (IFS-based period average)

## **Third Party Evaluator's Opinion on North South Carrier Water Project**

Felix Monggae  
Chief Executive Officer  
Kalahari Conservation Society

### **Relevance and effectiveness**

In an effort to provide a reliable water supply for the Gaborone and also to minimize mining of water, the Government of Botswana (GOB) initiated a water supply programme using both surface and groundwater – the North South Carrier (NSC). The North South Carrier was therefore designed to provide water for Gaborone, but also major villages en-route to the year 2025. The NSC links Letsibogo Dam and major wellfields to Gaborone via a large diameter pipeline ~400kms in length. The NSC was commissioned in 2002 following an agreed policy by the GOB to promote conjunctive use schemes. The idea of a conjunctive use concept allows for good management practice at wellfields. When the levels in Letsibogo Dam are high, then wellfields can be switched off and groundwater levels allowed to recover.

Settlements in Botswana are divided into three categories namely, major villages which includes towns; smaller villages including rural settlements; and remote area dwellers. Provision of water services in the major villages is currently the responsibility of the Water Utilities Corporation (WUC) contrary to their Act that stipulates that they provide only urban centers. The Department of Water Affairs (DWA) supplies the smaller rural villages and rural settlements. Whereas the Ministry of Local Government through the District Council Water Unit is responsible for the provision of water to the remote area dwellers.

No charges are levied by the GOB for rural water supplies for water obtained from communal standpipes. Only yard and household connections are metered. The DWA are responsible for billing and revenue collection in respect of rural water supplies. Remote area dwellers are provided with free water. The Water Utilities Corporation recovers costs from the urban centers, which have metered supplies. The tariffs per m<sup>3</sup> of water for these centers are high and varies per location. i.e. P11.30 per m<sup>3</sup> over and above 25m<sup>3</sup> used in Gaborone compared to a rate P4.30 for the same volume in Selibe Phikwe. Annual water sales recorded (CSO 1998) were 32,007 x 10<sup>6</sup>m<sup>3</sup> which represents only 20% of the annual total water usage nationwide. There is considerable disparity between the WUC tariffs and the rates charged by the DWA for rural villages. The high rates for Gaborone are a reflection of the high capital cost of the NSC, but this cost is not passed on to other villages on the NSC. The future costing of water should be addressed, particularly in relation to the larger villages on the NSC not covered by WUC, to help reduce consumption and ensure that sustainable water usage can be maintained. Since WUC finds itself having to supply water to the major villages, as per the GOB directive, and not stipulated in their act, it can be said that this project has affected their policy and as such always threaten to cut service to these villages and therefore this has to be resolved amicably by possibly updating the WUC Act of 1970.

The populations of the major villages, Mahalapye, Serowe, Palapye, Molepolole and Kanye have increased dramatically. For example at Molepolole: - the population almost doubled from 31,700 in 1991 to 54,600 in 2001. Whereas the projected population statistics given in the 1991 Botswana National Water Master Plan (BNWMP) for Molepolole was 46,500 in 2001 rising to 65,100 by the year 2010. The water demand projections contained in the 1991 BNWMP were based on the projected population statistics which in turn formed the basis for the wellfield and water supply developments implemented during NDP 8 and planned for NDP 9. Clearly the urban population growth rates have outpaced the projections contained in the BNWMP. There is urgent need for a revision of the current and projected water demands as the 1991 BNWMP can no longer be used as a management/planning tool. Significantly the design of the NSC was based on the water demand figures of the 1991 BNWMP. Water

demands based on the both the 2001 census and new higher water usage habits need to be compared with the water demand projections used in designing the NSC. Shortfalls can be predicted and areas where environmental impact might be experienced (i.e.: where wellfields may need to be pumped more than planned) can be recognized. The design of the NSC should be reviewed to see if it can actually cope with increased water demands WUC, which is a semi-autonomous professionally operated public agency is committed to operating in a manner that does not detrimentally impact on the environment while meeting the obligation of supplying quality water. The management has to be praised for having finalized the environmental policy. The Corporation's decision to implement an Environmental Management System is the first and most difficult step towards ISO verification. These efforts are commended and hopefully the corporation will continue on the path to verification.