Emfuleni Local Municipality

Metsi-a-Lekoa
The Water Services Unit of Emfuleni Local Municipality

Sebokeng/Evaton Water Loss Reduction: Public Private Partnership

OVERVIEW

The Sebokeng/Evaton Leakage Reduction Public Private Partnership was initiated by Mr Sam Shabalala of Metsi-a-Lekoa, the water services unit of the Emfuleni Local Municipality which is located some 50 km south of Johannesburg in South Africa.

The main objective of the project was to reduce water leakage (and thereby also reduce pumping energy costs) and levels of wastage in the Sebokeng and Evaton water distribution systems through a Public Private Partnership between Metsi-a-Lekoa and the WRP/DMM joint venture. The project is the first of its type in South Africa where the Consultant has taken on 100% of the financial risk through an extremely complex Public Private Partnership (PPP) involving no fewer than 12 key role players.

Commendation for SAICE Award for Most Outstanding Civil Engineering Achievement in Technical Excellence 2005

IRCA Health and Safety Award

Winner of the 2005 SAACE Glenrand MIB Excellence Award

While the technical aspects of the project are clearly noteworthy, since it is now the largest advanced pressure management installation of its type in the world, the project is also unique in the manner in which it was managed and commissioned in a 3 month period which few, if any, believed could be achieved. The rapid implementation has resulted in huge water savings being achieved at the earliest possible date.

The project represents a significant advancement in Public-Private Partnerships (PPP's). It offers a potential solution for many other projects throughout South Africa (and other developing countries) where development is being delayed due to within development institutions and Municipalities, as well as a lack of support from many financial institutions.

The project is also worthy of note on the basis of the extremely efficient project management and quality control procedures developed by the Project Team. Through a continuous process of monitoring, very detailed planning and extremely stringent quality control procedures, the project was fully operational less than 3 months without any major delay or injury.

PROJECT PURPOSE AND DESCRIPTION

The purpose of the project is to reduce the unusually high levels of leakage and wastage of water in the Sebokeng and Evaton areas which currently result in a water bill to the Municipality from the bulk water supplier of almost R110 million ($US 20) million per annum. Based on normal acceptable levels of service, it is estimated that the annual water bill for the area should be closer to R30 million ($US 5 million) per year and it is this difference that has caused the Municipality so much financial hardship over the past 10 years due to the fact that payment levels for water in the area are negligible. It should be noted that the high leakage levels inside the properties lead to water bills that few residents can afford to pay. This leads to very low levels of payment and leakage in turn is therefore largely ignored. It is a typical cyclic problem in which one issue leads to the next and the only solution is to break the cycle of high leakage after which the water bills will reduce which in turn will eventually lead to realistic payment levels. In addition, the high levels of wastage have resulted in excessive sewer flows necessitating the upgrading of the local sewage treatment works at enormous expense.

The project is both technically advanced as well as conceptually unique in several respects which will influence future Public Private Partnerships in South Africa. The project is the first of its type where a Public-Private Partnership has been formed to fast-track a very serious problem which has been continuing for many years. The new installation is also the largest advanced pressure control installation in the world and is addressing what is thought to be one of the highest minimum night flows ever recorded. It should be noted that all water supplied to the area is pumped through a head of approximately 300m which results in high energy costs and use. All water savings will therefore also result in energy savings since the two factors are clearly linked.

The project represents the first phase of a long-term strategy to reduce water consumption (and energy consumption) in the project area to normally acceptable levels which in turn will lead to realistic levels of payment and finally to a sustainable and solvent water utility. Without the project, the water supply into the Sebokeng/Evaton areas would probably have been reduced to an intermittent supply within the next year or two in an attempt to reduce costs and water leakage levels. Intermittent supply is a very drastic action and often results in poor water quality leading to typhoid and cholera within the community. - it must be avoided at all costs

THE PROJECT AREA

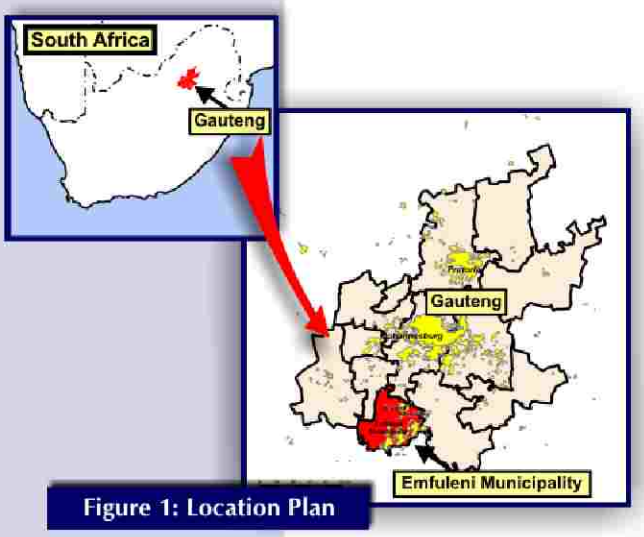
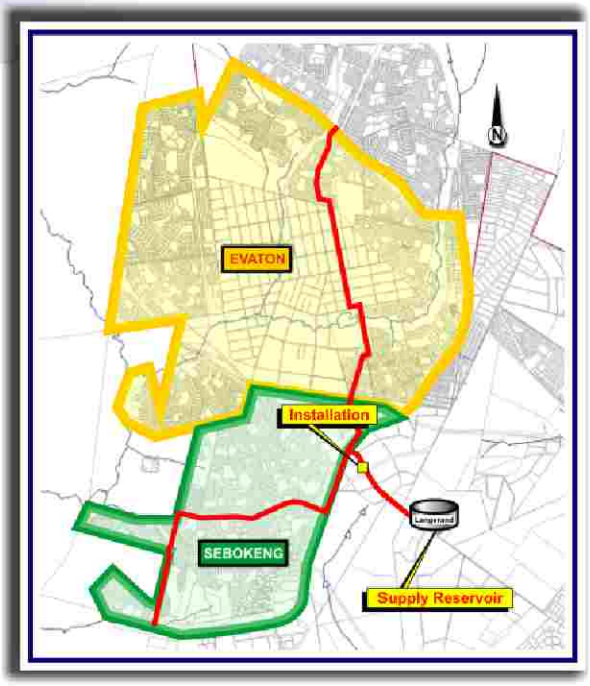


Figure 1: Location Plan

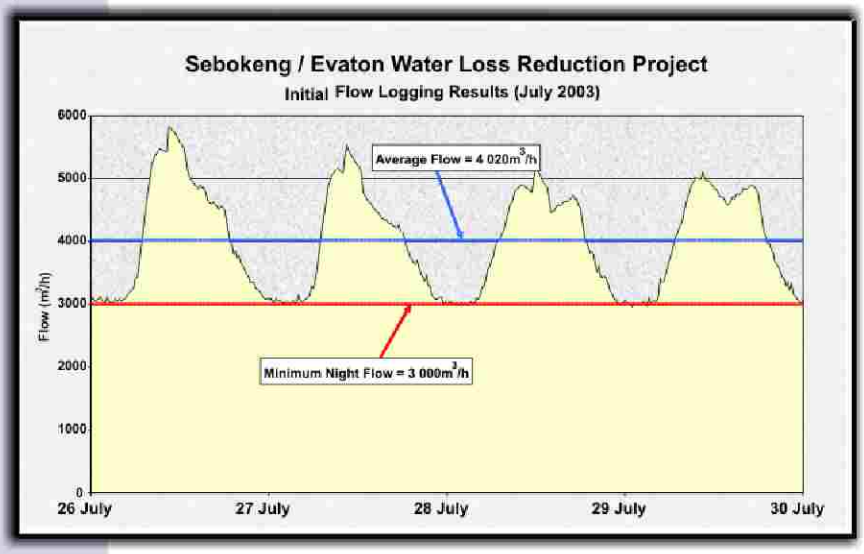


The Sebokeng and Evaton areas form part of the Emfuleni Local Municipality (as shown in **Figure 1**) which is located to the south of Johannesburg, the main industrial centre of South Africa. The areas are supplied with potable water from a large reservoir through two large water mains (1000mm and 675 mm diameter respectively) which run parallel to each other before splitting into the two discrete areas. The new pressure management installation is located just before the two pipes split into Sebokeng and Evaton respectively. This enables the water pressure into both areas (supplying almost 500 000 residents) to be controlled from a single point-: a very unusual feature of this particular project.

The Sebokeng and Evaton areas are predominantly low-income residential areas with more than 65 000 connections, each of which supports water borne sewage. The residents previously experienced average water pressures of between 30m to 60 m.

The combination of low income coupled with high unemployment resulted in a general deterioration of the internal plumbing fittings over a period of many years in Sebokeng and Evaton. The poor quality fittings caused high levels of leakage which was clearly evident from the unusually high levels of sewer flow during the late evening and early morning periods. The minimum night flow of 3 000 m^3/hr in July of 2003 (see **Figure 2**) for the Sebokeng/Evaton areas was one of the highest levels recorded anywhere in the world. This minimum night flow represents 75% of the Average Daily Flow (ADD) which was measured to be 4 020 m^3/hr. In a typical well managed system with no leakage problems, the MNF to ADD ratio is usually in the order of 10% to 15% which would suggest an acceptable MNF of less than 400 m^3/hr. While this low MNF may be too optimistic an area such as Sebokeng or Evaton due to various historical factors, the figures clearly highlight the scale of the leakage problem in the area.

Figure 2: Flow entering the Sebokeng/Evaton areas in July 2003



WHY PRESSURE MANAGEMENT ?

All water distribution systems experience significant fluctuations in demand throughout the day with morning and evening peaks coupled with periods of low demand during the night and sometimes also during the early afternoons. Many systems also experience seasonal fluctuations caused by climatic factors that influence irrigation requirements or by holiday migration that can significantly influence the demand for periods of days or weeks at a time.

Since the water supply systems are designed to provide a set minimum pressure throughout the day, they are generally designed to meet this pressure requirement during periods of peak demand when the friction losses are at their highest and inlet pressures at their lowest. As a result of this design methodology, many systems experience higher pressures than necessary during the remaining non-peak demand periods. This concept is shown graphically in **Figure 3** which represents a typical pressure situation for a zone at peak demand periods where the minimum pressure required is 20 m. The same zone is shown again in **Figure 4** for periods of low demand, typically experienced during the late evening and early hours of the morning (assuming that the properties use direct supply with little or no roof storage).

Figure 3: Typical zone pressure distribution during peak demand periods

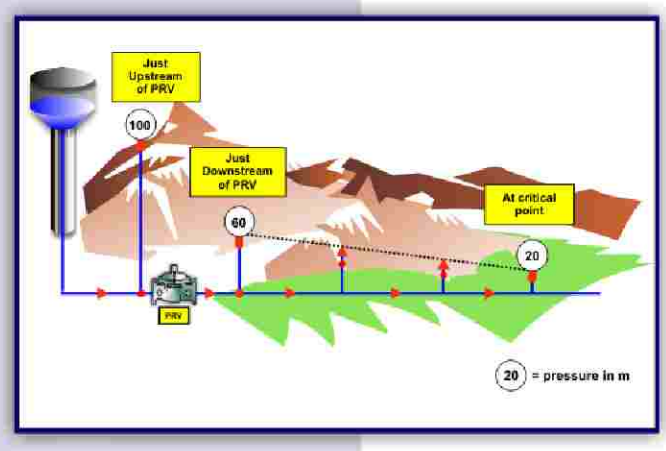
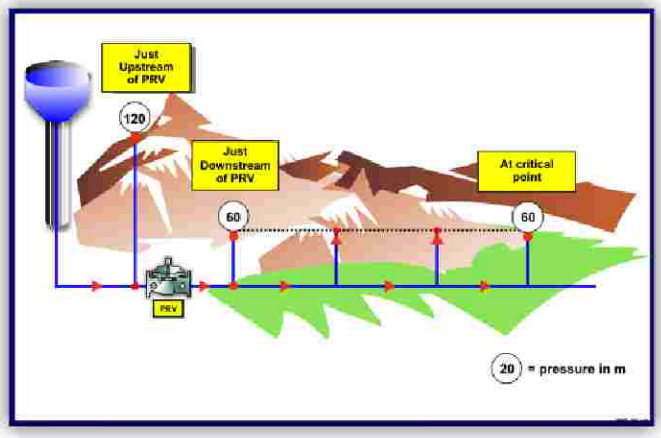


Figure 4: Typical zone pressure distribution during low demand periods



The sewer flows originating from Sebokeng/Evaton at night were measured to be 2 500 m^3/hr which represented approximately 80% of the water flowing into the area at night and clearly highlighted the fact that most of the leakage was occurring inside the properties through household plumbing leaks. By controlling the pressures during the off-peak periods it is often possible to significantly reduce the losses without identifying or repairing a single leak. After the excessive pressures have been addressed, other measures such as repairing leaking pipes and/or retrofitting can then be tackled. The significance of water pressure on leakage is clearly highlighted in **Figure 5**.

Figure 5: Typical burst water main at low and high pressure

(Photos courtesy Ken Brothers)

THE INSTALLATION

From the outside, the installation is unimpressive and similar to a large concrete box 10m long by 10m wide and approximately 5m deep. Inside it contains the various pipes and valves required to manage the water pressures into Sebokeng and Evaton as shown in **Figures 6 and 7**. Since leakage is driven by water pressure, any reduction in pressure, even if only for a short period each day, will result in lower leakage as well as fewer new burst pipes. If water pressures can be lowered significantly during the off-peak periods (especially at night) then very significant savings can often be achieved.

The Sebokeng/Evaton project is thought to be the largest project of its type in the world and the savings are so large that the installation had an pay-back period of less than 3 months. The construction was completed using labour based practices in order to maximise the employment opportunities to the local communities. In addition, a series of more than 50 public meetings were presented in the local communities to inform the residents of the project and to address any concerns they had with regard to the project. Through the detailed public consultation process, the project was completed without any incidence of theft or intimidation of any nature.

The installation involved cutting into the two existing water mains and replacing a short section with a series of smaller pipes and associated valves, meters, strainers etc. The new pipework and fittings enable the pressures into the two areas to be controlled in such a manner that the water pressures can be reduced during off peak periods and restored to the original high pressures during periods of high demand. In this manner, the leakage from the system as well as the incidence of new burst pipes was greatly reduced.

Figure 6: Plan layout of the Sebokeng/Evaton installation

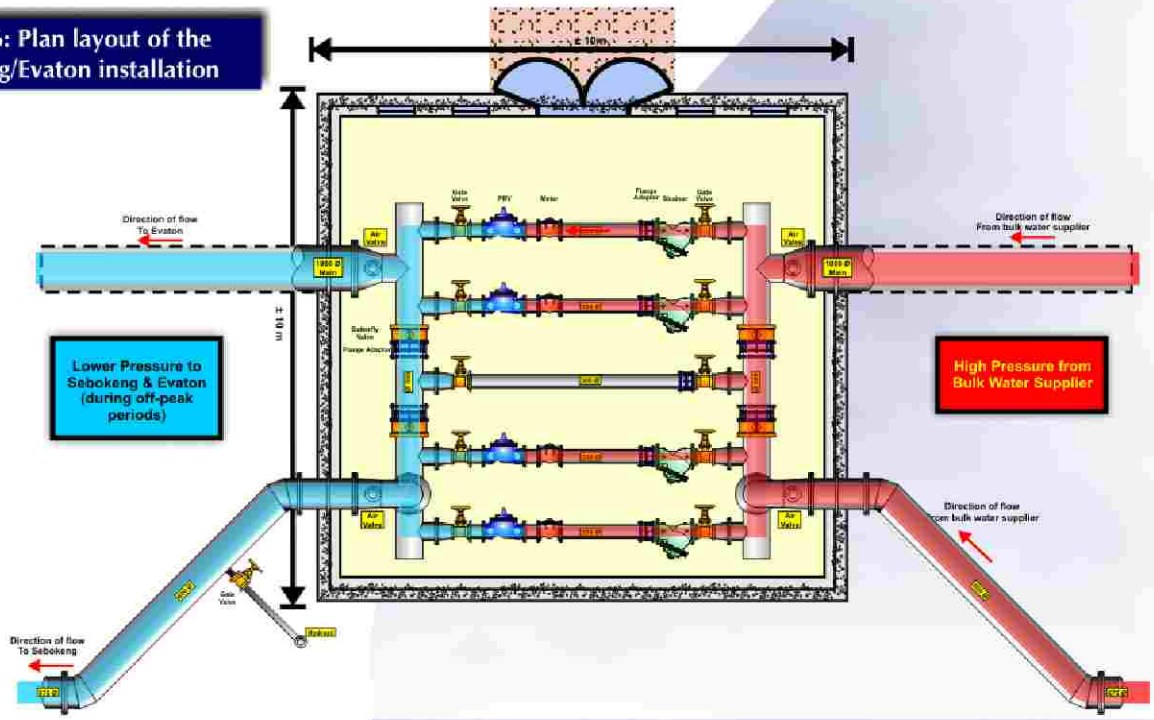
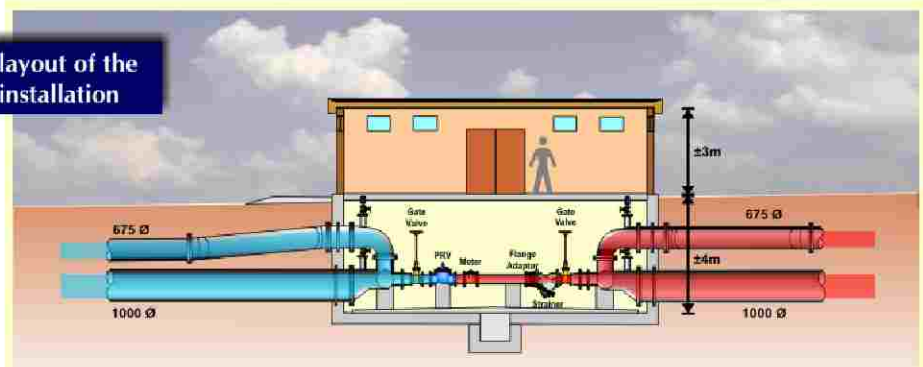


Figure 7: Elevation layout of the Sebokeng/Evaton installation



PROJECT TEAM

The project involved a unique interaction between no less than 12 main role players in a sophisticated and complex Public-Private Partnership in which the Consultant has taken on 100% of the financial risk of the project. The various key role players as indicated in **Figure 8** are as follows:

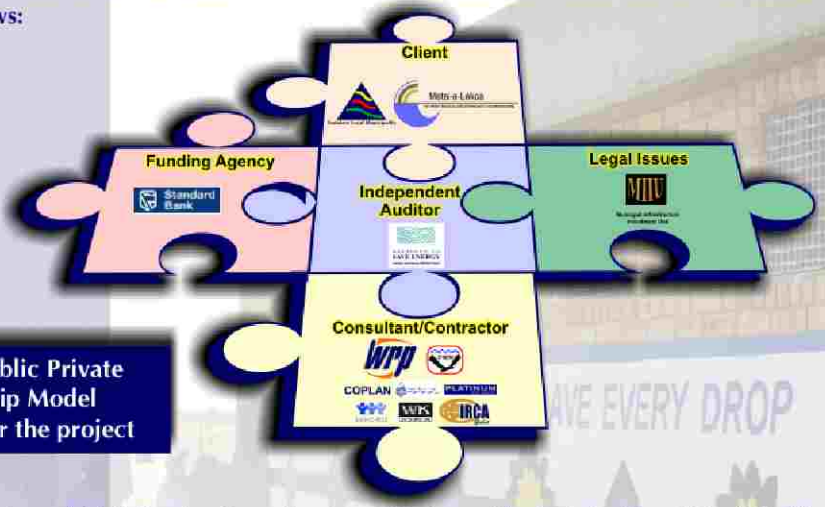


Figure 8: Public Private Partnership Model developed for the project

- The Client is Metsi-a-Lekoa which is the ring-fenced water utility formed by Emfuleni Local Municipality and managed by CEO Mr Sam Shabalala.
- The funds required to complete the project were raised privately by WRP and DMM through Ms René van der Westhuizen of Standard Bank.
- The establishment of the contract on which the project is based was funded and facilitated by the Municipal Infrastructure Investment Unit (MIIU) and Metsi-a-Lekoa with considerable support from Mr Mike Rabe of the Alliance to Save Energy's WATERGY Programme who also assumed the role of independent auditor.
- The consultant's team was led by South African based WRP Pty Ltd . Additional specialist support was provided by DMM, Platinum Consultants and Coplan. In addition Mr Tim Waldron , the CEO of Wide Bay Water in Australia acted as a specialist reviewer. Other team members include IRCA (Occupational Health and Safety), Batho Pele (community awareness) and WK Construction (main contractor).

SUMMARY AND CONCLUSIONS

The project cost R5 million ($US 0.7 million) to complete and the initial savings achieved after the first 10 months of operation are in excess of R20 million ($3 million) as can be seen from **Figures 9** and **10**.

The savings are clearly shown in **Figure 9** which highlights the water use in July 2003 before the project was commissioned and for the same period in 2005 after the installation was commissioned. It can also be seen from the figure that the Minimum Night Flow decreased from approximately 3 000 m^3/hr to 2 000 m^3/hr.

Figure 10 provides details of the long-term demand pattern and a comparison of the expected water use against the actual water use following commissioning of the installation. The actual figures are provided in **the accompanying table** for the first 10 months of operation. The results are self-explanatory.

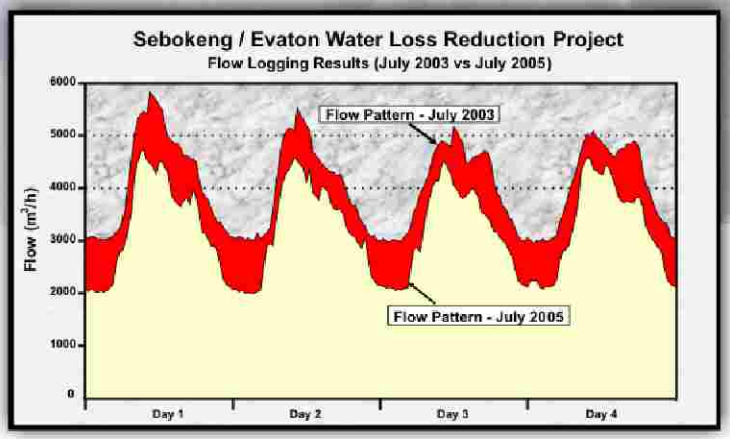


Figure 9: Comparison of water use in July 2003 to that in July 2005

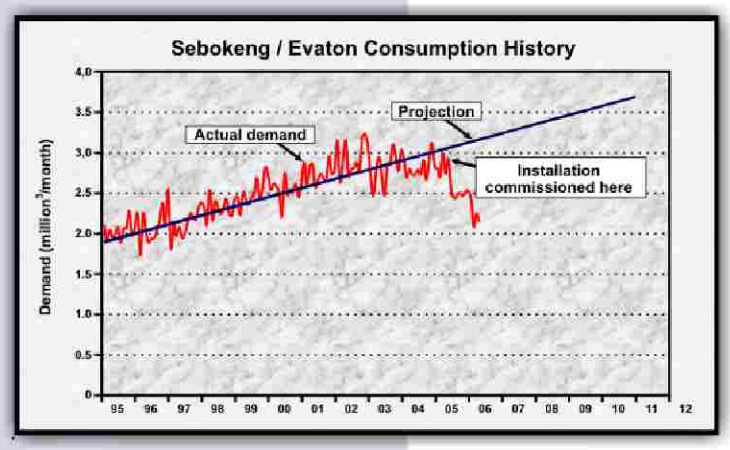


Figure 10: Results to end of April 2006

	Water use (m^3)		Savings				
Month	Expected	Actual	m^3	Rands	Dollars(US)	Cumulative (Rands)	
Jul-05	3,074,241	2,438,310	635,931	1,755,170	292,528	1,755,170	Payback period
Aug-05	3,083,840	2,460,620	623,220	1,720,088	286,681	3,475,258	
Sep-05	3,093,130	2,510,380	582,750	1,608,389	268,065	5,083,647	
Oct-05	3,102,729	2,462,650	640,079	1,766,618	294,436	6,850,265	
Nov-05	3,112,018	2,515,470	596,548	1,646,474	274,412	8,496,739	
Dec-05	3,121,618	2,530,960	590,658	1,630,215	271,702	10,126,954	
Jan-06	3,131,217	2,432,870	698,347	1,927,437	321,240	12,054,391	
Feb-06	3,139,887	2,085,150	1,054,737	2,911,074	485,179	14,965,465	
Mar-06	3,149,486	2,253,620	895,866	2,472,590	412,098	17,438,055	
Apr-06	3,158,776	1,871,610	1,287,166	3,552,577	592,096	20,990,633	
Total	31,166,942	23,561,640	7,605,302	20,990,633	3,498,439	20,990,633	

Payback from savings = 3 months

OTHER ISSUES OF NOTE

- The project is not only on of the largest advanced pressure management installations in the world but also the first project of its type in South Africa to be funded completely by the Consultant where the reward component was such a small percentage of the overall savings and included a cap.
- A detailed health and safety programme was implemented to ensure that all construction activities were undertaken in a safe and proper manner.
- A detailed public participation process was commissioned prior to construction, involving in excess of 50 public meetings.
- A schools art competition, with prize money of R20 000 , was initiated to involve the community in the external appearance of the chamber.
- The innovative design was extremely compact and efficient leading to significant savings on the overall cost of the project.
- Through very careful planning and proper quality control procedures, the installation was fully operational within 3 months from site establishment.
- Labour based construction was used throughout the construction process to create employment for the local community. Up to 40 jobs were created during construction.
- An Environmental Impact Study was undertaken as part of the project to ensure that there would be no adverse effects on the environment or local community.

ACKNOWLEDGEMENTS

The project was a true team effort involving many organisations and individuals. The success of the project was largely due to careful planning and design, proper execution and mutual trust between the Client and Project team. In particular, the following individuals contributed significantly to the project:

NAME:	ORGANISATION:	INVOLVEMENT:
Astrup, Brad	WRP Pty Ltd	Project documentation, site supervision and contract management
Brown, Paul	WK Construction	Contract manager on behalf of Contractor for completion of super structure
De Sousa, Paul	WRP Pty Ltd	GIS and CAD drawings
Duvenhage, Hennie	Metsi-a-Lekoa	Technical support from Client
Fourie, Niel	Platinum Consulting	Structural design
Hiddema, Hugo	U Hiddema Consulting	Support on contract a documentation and legal advisor. Specialist contractual support.
Magugumela, Danai	Municipal Infrastructure Investment Unit	Support on contract preparation
McConville David	COPLAN	Mechanical and hydraulic design
McKenzie, Ronnie	WRP Pty Ltd	Project conception, development of risk- rewards contract, project funding
Mnguni, Darius	DMM cc	EIA requirements and public participation process
Mohajane, Potso	Metsi-a-Lekoa	Management and co-ordination of public involvement aspects of the project
Mostert, Hein	WK Construction	Contract manager on behalf of Contractor up commissioning of installation
Neethling, Dries	WK Construction	Construction Manager for all structural concrete work
Nolte, Hugo	Rand Water	Technical support on shut-downs of main pipelines
Rabe, Mike	Alliance to Save Energy's	Support on PPP contract and project auditor
Renke, Riana	WRP Pty Ltd	Graphics and publication material
Shabalala, Sam	Metsi-a-Lekoa	Initiation of project and overall project leader on behalf of Client
Small, Mark	Rand Water	Technical support on shut-downs of main pipelines
Van der Merwe, Ben	Metsi-a-Lekoa	Project manager for client
Van Niekerk, Neels	WK Constuction	Site Agent for the Contractor
Van Niekerk, Louis	IRCA	Site safety monitoring and reporting
Van Rensburg, Harry	Tricor	Construction management of all mechanical work
Van Rensburg, Lianné Jansen.	IRCA	Development of safety plan
Van der Westhuizen, René	Standard Bank	Facilitation of bank loan to WRP for the project
Waldron, Tim	Wide Bay Water: Australia	Specialist support on design and implementation
Wegelin, Willem	WRP Pty Ltd	Detailed design, project management and commissioning
Zondo, Petrus	Local resident	Project community liaison officer

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