

A COMPENDIUM OF BEST PRACTICE AND INNOVATION IN ASSET MANAGEMENT OF WATER SERVICES INFRASTRUCTURE

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ABSTRACT

As part of a water services infrastructure asset management best practice and innovation initiative of the Global Water Research Coalition (GWRC), the Water Research Commission (WRC) agreed to contribute a selection of ten South African best practice examples to a compendium of case studies.

The paper summarises the case studies.

BACKGROUND

In 2007, a number of national water research organisations, as part of a water services infrastructure asset management best practice and innovation initiative of the Global Water Research Coalition (GWRC), agreed to contribute input to a compendium of best practice case studies.

As part of this, the Water Research Commission (WRC) documented a selection of South African best practice examples.

In water services infrastructure asset management, as in other fields, documented best practices case studies and studies of innovation are very useful:

- to practitioners of asset management, helping them to identify improved approaches; and
- to those who wish to advocate for infrastructure asset management, giving them ammunition to argue with boards, mayors, customers, and others, for example in order to obtain more resources for asset management.

There is a need to develop an inventory of best practices and innovation, and a vehicle/platform and structure to share knowledge (tools, practices, data, resources,

approaches, lessons-learned and efficiencies achieved) related to water services infrastructure asset management.

Ten South African case studies are summarised here. Each concludes with a summary of learning -- a noting of its principal best practice/innovation point.

The ten were selected from a much longer list of candidates. Which of them became a case study depended on a number of factors -- not just on the merits of the case to be studied, and on its potential value, but also on, for example, how possible it would be to get the necessary information in the time available.

They differ one from another in many respects, not just as to the type of infrastructure concerned, or in the practice of infrastructure asset management that is reported upon, but also in scale, history and often the nature of the principal best practice/innovation point. Which draws attention to the caution that needs to be exercised when attempting to replicate in another place and another time practice that was successful elsewhere.

Raising this caution should not detract from the value of discovering and disseminating experience in successful practice.

The ten case studies are now summarized in random order:

- National Water Services Infrastructure Asset Management Strategy;
- Rand Water major pipeline asset management;
- Rustenburg municipal entity: upgrade and operation of water and wastewater treatment infrastructure;
- Johannesburg Operation Gcin'amanzi service upgrading and demand management;
- Free State monitoring and improvement of water quality;
- Western Cape provincial government collaborative programme of asset management planning support to local municipalities;
- IMESA suite of training programmes in infrastructure asset management;
- European Union/DPLG four municipalities pilot project asset planning;
- national intervention to bring about turnaround in Emfuleni;
- Sebokeng and Khayelitsha water saving through pressure management.

NATIONAL WATER SERVICES INFRASTRUCTURE ASSET MANAGEMENT STRATEGY

Insufficient attention is being paid by the majority of South African water services institutions to management of their infrastructure. In addition, many have, due to years of neglect, built up a backlog of need in respect of maintenance and also refurbishment, renewal and replacement. The competing demands made on limited operational budgets, staff and other resources, severely constrain proper management of infrastructure.

Thus the national Department of Water Affairs and Forestry (DWAF) decided in 2005 that it, as sector leader, needed to investigate the infrastructure asset management situation and thereafter to provide guidance to water services institutions. Accordingly it appointed an external team to assist it with the formulation of a national "water services infrastructure asset management strategy".

The case study describes the background, and then the phases completed thus far, viz:

- A desktop strategic study of the state of water services infrastructure and of the state of water services infrastructure asset management in South Africa.
- Analysing this information, identifying the key factors that drive the current state, discovering underlying problems and opportunities, and identifying elements needed for an enabling environment to ensure sound asset management.
- Identifying priority strategic actions.

The priority strategic actions take cognizance of DWAF's mandated responsibility and what DWAF needs to do within its own sphere and also in conjunction with others, particularly with other national government departments.

DWAF at the end of 2007 was poised to commence the next phase, one of more detailed planning and programming for implementation of the strategy.

The principal best practice/innovation point is:

- A national government department has taken the lead in developing a strategy for water services infrastructure asset management in all water services institutions, including providing for a level of assistance to institutions where needed.

RAND WATER MAJOR PIPELINE ASSET MANAGEMENT

Rand Water is the parastatal bulk water supplier to the industrial and commercial heartland of South Africa, including the metropolitan areas of Johannesburg and Pretoria. It abstracts an average of 3500 Megalitres per day from the Vaal River, treating it, and pumping it of the order of 380 m uphill to the service reservoirs, 65km and more away, of the local municipalities. The reliability of its major pipelines is of obvious great importance to the national economy, and therefore the asset management regime of these pipelines needs to be of a very high order.

Asset management of the major pipelines is characterised by:

- reliable and comprehensive information;
- a disciplined approach to operational and investment decisions.

That Rand Water is financially robust gives it the space to treat infrastructure as a valuable long-term investment, and to make decisions based on optimising the life cycle of that infrastructure.

In respect of "reliable and comprehensive information", inter alia --

- good records have been kept over the years (including when built, repair records, refurbishment records, leakage records);
- environmental factors are recorded (including dolomitic areas, water and groundwater chemistry, surface encroachments);
- coupled to comprehensive condition assessment procedures, where necessary using the most sophisticated appropriate technology available;
- all linked to a common GIS database; and
- backed by a database of experience elsewhere with similar infrastructure in usefully analogous conditions.

In respect to "a disciplined approach" to, for example, asset management decisions --

- the comprehensive information is utilised to identify the problem probability profiles of all significant infrastructure elements;
- the strategic importance of these infrastructure elements is also identified, and the risks (i.e. consequences of infrastructure failure) are matched with the problem probability profiles;
- in order to identify priorities for attention, and what that kind of attention should be (e.g. alternative ways to cover the risks identified).

Budget decisions can then with confidence be based on this reliable and comprehensive information, and disciplined approach.

The principal best practice/innovation point is:

- That Rand Water pipeline asset management represents best practice water services infrastructure asset management in South Africa, and that there is no substitute for the underlying factors that enable Rand Water to manage its assets in this way, these factors being --
 - financial stability;
 - top management's willingness to budget more or less adequately for infrastructure asset management; and
 - sufficient technical capability to advise, to plan, and to implement -- and to brief, procure and supervise outsourced skills.

RUSTENBURG MUNICIPAL ENTITY: UPGRADE AND OPERATION OF WATER AND WASTEWATER TREATMENT INFRASTRUCTURE

From the 1950s, the town of Rustenburg, in the North West Province, obtained most of its water supply from the municipality's WTW at Bospoort Dam, downstream of the town. As the town grew, it found additional sources of water. Two municipal WWTWs were in the intervening years built downstream of the town but upstream of the dam. These were more than adequate to discharge effluent of an acceptable standard into the dam. Some of the effluent was sold to nearby mines, which found the treated effluent to be adequate for purposes that did not require potable water.

In recent years, due to rapid growth of the area and of its water consumption, these WWTWs became overloaded, leading to deterioration in the quality of the effluent. When quality fell to a certain point, the mines refused to receive any more of the effluent. As the effluent quality deteriorated further, the Bospoort Dam became seriously polluted and highly eutrophic. The effect of that, in turn, was that the WTW at the dam was no longer able to cope with the high pollution load of its influent, and six years ago it was closed.

As a result of all of this, Rustenburg Local Municipality was faced with --

- reduced revenue (due to the mines no longer purchasing treated effluent);
- three unusable treatment works;
- increasingly polluted waters and dams downstream; and
- forced increased reliance on (more expensive) water supplies from sources further from the town.

In 2003, a consortium consisting of Magalies Water (the parastatal water authority for the region north of the town), an engineering consultancy and a bank won its bid to refurbish and upgrade the two WWTWs, refurbish and upgrade the WTW, and refurbish a bulk water pipeline. The offer included funding (total project cost R 280 million including capitalised interest) and in the short term operating the infrastructure.

The first of the treatment works was returned to service in 2006, and the second during 2007. The municipality owns the assets, and in the usual manner charges users of the water and sanitation services, but the income, less municipal costs, is paid to the Rustenburg Water Services Trust, a municipal entity. This Trust, which was formed to develop the project, pays the operator (Magalies Water), pays for the professional services, and repays the loan made to it (the Trust) by the bank. Thus the financial benefits are shared by the municipality and the consortium.

The principal best practice/innovation point is:

- The private sector and parastatals can bring to a municipality the resources (principally, expertise and funding) that the municipality is otherwise unable to obtain, and can address infrastructure problems that have financial, health and social or environmental consequences -- and can do this to mutual benefit.

JOHANNESBURG OPERATION GCIN'AMANZI SERVICE UPGRADING AND DEMAND MANAGEMENT

Johannesburg Water was established in 2001 as a business entity of the Johannesburg City Council. It inherited the water supply and distribution system of a municipality of 3.5 million people, created by amalgamating a number of local governments that had over the years practised very different infrastructure asset management regimes.

In 2003, Johannesburg Water launched "Operation Gcin'amanzi" ("Save Water") for water services upgrading in Soweto. The objective of this programme is to repair all

pipes and fittings leading to and on all residential properties, and, with the co-operation of communities and each resident, to put a management plan in place. Meters, generally of the prepayment type, will be installed on all properties that are not currently metered (note that the first six cubic metres of water supplied to households each month is free in terms of the government's programme on free basic services).

Thanks to leakages in the municipal infrastructure or on individual properties, or to wasteful practices, of the order of 7 million cubic metres was unaccounted for in Soweto every month, costing about R 160 million per year. Given that, the expected total cost (2003 prices) of R 450 million could be recovered in only three years.

Reduced water leakages will also reduce the sewer flows, directly resulting in environmental benefits and reduced cost of sewage treatment. And although the population of the area served by the nearby treatment works is increasing steadily, and will continue to do so, the capacity won by Operation Gcin'amanzi will allow a 10-year postponement of already planned increase in capacity.

The programme has been extensively presented to and discussed with the community, and Johannesburg Water is confident that, with very few exceptions, the residents of Soweto support the efforts to improve the levels of service and serviceability.

The work has been completed in respect of in the order of 40% of the eventual 170 000 properties. The work has for the most part been carried out by Soweto-based small contractors, the product of a contractor development programme.

The principal best practice/innovation point is:

- Substantial long-term operational and capital savings, as well as environmental benefits and improved service to customers, can accrue from targeted short duration repair and rehabilitation programmes and long-term infrastructure asset management.

FREE STATE MONITORING AND IMPROVEMENT OF WATER QUALITY

In South Africa, the statutory water services authorities (generally municipalities or combinations thereof) are responsible for drinking water quality. Many of them, particularly those away from the metropolitan areas, are unable to comply with the laid-down standards.

For two decades the Department of Local Government and Housing of the Free State province has used an external agency to sample drinking water quality from the treatment works. It was up to the municipalities what they did with this information. However in 2002, in response to rising non-compliance with standards, the decision was taken to firstly expand and improve the data capture and feedback system, and secondly to use the information to more actively manage improvement to water quality.

Thus an electronic water quality data capture, information dissemination, and management tool has been developed, using Open Source software. This both guides municipal officials to good water quality management practices and provides real-time water quality data for the information of, and action by, the provincial government and the national Department of Water Affairs and Forestry (DWAFF). Piloted from 2004 at a limited number of sites, the so-called "eWQMS" was found to be effective, easy-to-use, robust, practical and inexpensive. Rolling it out to all municipalities in the province is now well advanced. Associated with it is a risk-based methodology to summarise the current status of key water quality management sustainability indicators for each municipality.

Also, using this information to direct effort to best effect, an intervention programme was implemented, led by the provincial government. Elements included on-site technical assistance and training of officials and of municipal councillors.

From 15% of municipalities in the Free State province (according to a self-survey by municipalities) supplying acceptable drinking water quality in 2003, compliance has according to the latest survey risen to 95%.

The principal best practice/innovation point is:

- Appropriate and accessible information is essential to improving water services infrastructure asset management. But external intervention might be necessary if that improvement is to be effected.

WESTERN CAPE PROVINCIAL GOVERNMENT COLLABORATIVE PROGRAMME OF ASSET MANAGEMENT PLANNING SUPPORT TO LOCAL MUNICIPALITIES

The Western Cape Provincial Government has pursued a programme in collaboration with municipalities to improve the management of municipal infrastructure in the province. The basis of this programme is the adoption and implementation of asset management principles in a consistent and consultative manner at the municipal level across the province. The Western Cape Department of Local Government and Housing has spearheaded the programme through information sharing, funding pilot programmes, funding the training of municipal officials, and providing a forum for feedback and interaction between municipal officials.

The case study describes three initiatives of particular value, viz:

- A backlog study of water services in all municipalities in the province.
- Preparation of a standardised framework for compilation of asset registers.
- Selected pilot projects, to test asset management initiatives before rolling them out to all municipalities.

Initial pilot projects for the compilation of infrastructure asset registers at Drakenstein and Stellenbosch municipalities have been followed up with a pilot project to prepare an asset management plan for water services at the Drakenstein Municipality. The intention

of the pilot project is for the Drakenstein Municipality to apply its resources to develop an analysis framework and methodology that will address its asset management challenges. This analysis framework can then be reviewed by the other municipalities and refined to provide a basic structure of analysis and reporting.

The principal best practice/innovation points are:

- There are considerable efficiency gains for municipalities from these initiatives of the provincial government. For example, the existence of a tested basic analysis framework and reporting structure reduces the uncertainty of both the inputs and the outputs of asset management planning studies. This clarifies deliverables, reduces cost and improves the quality of asset management studies. It also provides comparative information, municipality to municipality, thereby assisting the provincial government, and also national government, in determining their priorities.

IMESA SUITE OF TRAINING PROGRAMMES IN INFRASTRUCTURE ASSET MANAGEMENT

While a number of awareness programmes and training courses in various aspects of infrastructure asset management have in recent years become available in South Africa, those under the auspices of the Institute of Municipal Engineering for Southern Africa (IMESA) focus on the needs of municipalities and other water services institutions.

The actual training is carried out by a joint venture of an infrastructure management specialist and a consulting engineering firm, complemented where necessary by other resources. The course material is based on local experience, while drawing in best practice from selected overseas professional institutions.

The training is varied and of different levels of sophistication and detail, according to need. The training can be directed at --

- municipal councillors, to make them aware of infrastructure components, processes and the professionals involved, and of their responsibilities in ensuring sustainable infrastructure services delivery; and/or
- different groups of officials, with, according to need, emphasis on technical, financial, local economic development or other aspects.

The overall objective of the courses is to --

- promote best practice in municipal engineering and in infrastructure asset management;
- encourage a longer term and strategic approach to infrastructure management; and
- facilitate skills development generally.

The principal best practice/innovation points are:

- Municipal councillors make decisions, about budgets for example, of fundamental importance to infrastructure asset management, and therefore it may be necessary that they are taught its importance, and how to support it.

- Only part of infrastructure asset management relates to technical issues, and officials of different disciplines and at many levels need to become aware of its importance and be taught best practice.

EUROPEAN UNION/DPLG FOUR MUNICIPALITIES PILOT PROJECT ASSET PLANNING

A consortium of consulting firms was in 2004 appointed by the South African national government Department of Provincial and Local Government (DPLG) and the European Union (EU), for the “Improvement of Management of Infrastructure” in four municipalities, under the banner of the “Programme to strengthen local government in the Mpumalanga and Limpopo provinces”. Whilst the initiative comprised a number of interventions, one key activity was to prepare Asset Management Plans (AMPs) for infrastructure networks in these municipalities.

The project was the first time in South Africa that Infrastructure AMPs were prepared in line with the concepts set out in the “International Infrastructure Management Manual” (IIMM). (“International Infrastructure Management Manual”, New Zealand National Asset Management Steering Group and Institute of Public Works Engineering of Australia, April 2000 [then the latest edition].)

Four pilot municipalities were identified as incubators for methodologies, tools and other products that can be replicated elsewhere to strengthen municipalities’ ability to sustainably deliver infrastructure services to communities. The project represented a significant step forward in efforts to improve the ability of smaller South African municipalities to manage their infrastructure.

The municipalities were at the end of the project left with documentation of the nature, extent, condition, performance and value of the various infrastructure networks; existing and target service levels; life-cycle management needs; long-term funding implications; and the actions required to improve asset management practice. In addition to the above, a number of site specific interventions were undertaken at each municipality.

However the greatest value of the project was the crafting of an appropriate South African approach for small to medium sized municipalities.

The pilot municipalities proved to be an interesting context for the application of the IIMM principles, because of issues such as their backlog in basic services, non-payment for services and capacity limitations. Challenges included officials unfamiliar with the terms of asset management (let alone the process), and large gaps in the data available.

The principal best practice/innovation point is:

- Substantial insight was gained into key challenges and benefits of infrastructure asset management planning in the lesser resourced municipalities in South Africa, and no doubt also in lesser resourced municipalities elsewhere.

NATIONAL INTERVENTION TO BRING ABOUT TURNAROUND IN EMFULENI

It is rare for national government in South Africa to intervene as directly in a municipality as it has in respect of Emfuleni Municipality, on the banks of the Vaal. Other municipalities have chronic infrastructure management and/or financial problems, and national government has kept its distance, assisting in various ways, but not dictating to anything approaching the extent that it has dictated to Emfuleni.

The main reason for the intervention in this instance is that the often poor quality of WWTW effluent, unauthorised pollution and, especially, frequent sewage pump station failure, with consequent overflowing, and spillage to the river of raw sewage, had begun to threaten the reserve water resource for Gauteng province, the industrial and commercial heartland of South Africa. In short, the quality of water in the Vaal River Barrage, the reserve supply, had deteriorated to an unacceptable level.

Accordingly, National Treasury in 2005 gave the municipality an extraordinary grant of R 130 million, half of it for water services, to be spent by the end of 2007. (Additional sums, and an extension of time, is possible.)

The national Department of Water Affairs and Forestry (DWAF) is working closely with National Treasury, and is responsible for monitoring the performance of the municipality and its entities, and of the project implementation agent -- DWAF is also providing various forms of direct assistance. Infrastructure aspects of the expenditure of the grant include: a greatly enhanced infrastructure management programme; upgrading of existing underperforming WWTWs; redesign and a new sewerage reticulation layout (involving elimination of most of the troublesome pump stations) for specific areas of the municipality; and various substantial new works. Benefits anticipated (some are already becoming manifest) include improved quality of effluent discharge and marked reduction in frequency and volume of spillage of raw sewage.

Associated reforms that are resulting from the intervention by national government include reforms of a financial nature (such as improved billing and debt collection) that will improve the financial standing of the municipality, and will thereby enhance the likelihood that the water services and other improvements can be sustained.

The principal best practice/innovation points are:

- Strict rules must prescribe the relationships between different levels and spheres of government. However when a threat to the water supply of a key area of the nation grows to constitute a threat to national economic security, then and only then can a strong case be made for selective direct forms of intervention.

- Infrastructure problems, and infrastructure asset management problems, may to some extent be the symptoms of underlying problems, such as poor financial performance -- and therefore these underlying problems have to be resolved together with any addressing of the infrastructure issues.

SEBOKENG AND KHAYELITSHA WATER SAVING THROUGH PRESSURE MANAGEMENT

For a range of reasons, some historical and some current, the minimum night flows in many South African residential suburbs are extremely high. For an example, the minimum night flow 3000 cubic metres per hour recorded in Sebokeng/Evaton, south of Johannesburg, in July 2003 -- this represented 75% of the average daily flow.

With leakage at this scale, the potential for water saving is significant. The purpose of a project recently undertaken was therefore, through pressure management, to reduce this leakage. The high levels were resulting in the municipality paying Rand Water, the parastatal bulk water supplier, R110 million per annum, whereas it was estimated that this could through pressure management be reduced by of the order of two-thirds. The high levels of wastage were also resulting in excessive sewer flows, leading to a need to upgrade wastewater treatment works capacity.

The situation is similar to that in Khayelitsha, in Cape Town, where the first large advanced pressure management installation in South Africa was commissioned, in 2001. This is still operating to its full potential, and continues to give the savings estimated when it was designed, thus demonstrating that such measures are sustainable.

The project undertaken in Sebokeng/Evaton is the first of its type in South Africa where a public-private partnership was formed to undertake the work. This was the partnership between a firm of consulting engineers and the municipal water entity. The firm and its private sector funding partners funded the full cost of the installation to manage water pressures -- which installation immediately became the property of the municipality.

For a period of five years after commissioning of the installation (in 2005), a proportion of the savings ("savings" in terms of reduced purchases by the municipality from Rand Water) accrues to the firm and its funding partners, with the remainder going to the municipality. If there are no savings, then the firm and its partners receive no return on their investment. Thus far the savings (which are independently audited) have been substantial, and there is little reason why they should not continue to be.

The installation is thought to be one of the largest advanced pressure control installations in the world -- thanks to the size to which the minimum night flows had grown.

The principal best practice/innovation point is:

- Under certain circumstances public-private partnerships can be profitable for the private sector, even though income may not come from sales of a product or service, but may come from savings, on a risk-sharing basis with the water services authority.

“BEST” PRACTICE, OR “GOOD”?

The above represent best practice, indeed, and were appropriate for the time, place and circumstances in which they were undertaken. They are a valuable addition to the body of knowledge from which important lessons for water sector priorities can be drawn.

But – how replicable are they elsewhere in our country?

While knowledge of “best” practice is important, the need in so many circumstances is rather for “good” practice, or “appropriate” practice. The National Water Services Infrastructure Asset Management Strategy agrees. It states that one of “the most important principles underlying the water services IAM strategy” is that “80/20 [Pareto Principle] rules throughout”, and another is “Start with the basics, and get them right. Do not attempt to progress further until the basics are right. In almost all circumstances, “good” practice is needed, not “best”.” (Quoted in Manus et al 2008.)

Voltaire expressed it well: “The best is the enemy of the good”.

Certainly, this could be said of many under-skilled and under-resourced South African municipalities. If they could achieve only “good” infrastructure asset management practice, that would be a big improvement on where they are now.

INTERNATIONAL COLLATION DID NOT MATERIALISE

The original intention of the GWRC was that the case studies from around the world would be collated. The WRC was designated as the organisation that would do the collation, and prepare a consolidated report.

However, despite a number of national water research organisations having agreed with GWRC that they would contribute to the compendium of best practice, the response from them was too patchy to justify undertaking this compilation.

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REFERENCE

N Manus, K Moodley, K Wall, L Boshoff and A Ottermann. “The DWAF water services IAM strategy positioned within the context of other major national IAM initiatives.” WISA conference, May 2008, Sun City.