Swakopmund Municipality's new wastewater treatment plant

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The new wastewater treatment plant currently under construction outside Swakopmund is that municipality's most ambitious engineering project to date. The urgent need for this facility to go live presented daunting challenges to all involved, including a tight deadline and very little margin for error

MAINTAINING MUNICIPAL infrastructure and the expected level of service that the public demands is no easy feat, especially when the expansion of a municipality puts a severe strain on that very same infrastructure. When the site for the existing Swakopmund sewage treatment plant was chosen in 1957, it was considered the most appropriate, in part because it was located far away enough from the town boundaries, and therefore posed very little risk in terms of annoyance or inconvenience to the town's inhabitants. However, the staggering development of Namibia's premier holiday destination in the intervening years has seen the town's boundaries creep nearer and eventually surround and then extend far beyond the confines of the existing plant.

Two problems arose as a result: firstly, demand has matched the capacity of the plant, and while the plant remains static, the population of Swakopmund keeps growing. Secondly, residents were increasingly complaining about unpleasant odours and on-going problems with flies. The plant was upgraded in 2000, which somewhat ameliorated these complaints. However, it did not take long before the same issues were experienced again, and in September 2007 the Swakopmund Town Council's Tender Board awarded a tender for the design and development of a new sewage treatment plant to Windhoek Consulting Engineers. A tender for the construction of this new plant was advertised in 2010 and awarded to Botes & Kennedy Civils (Namibia). Construction on the new plant began on 17 January 2011, and the project is slated for completion on 14 December 2012.

According to Mr Eckart Demasius, CEO of the Swakopmund Municipality,

Blasting for the new Swakopmund wastewater treatment plant gives an indication of the size of the site

An earlier version of this article appeared in *Engineering Namibia* 2011/12.
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Work begins in all earnest in April 2011

Casting the digester roof slab

there was absolutely no room for error on this project. "Ideally Swakopmund should have had a new sewage plant two years ago, but that wasn't possible and we've been operating on the edge capacity-wise with the current sewage works till now. During the holiday season at the end of every year Swakopmund experiences a massive influx of people. It is said that the town's population doubles in this time, and while I don't think it's quite that dramatic, the surge in numbers tests our infrastructure – especially that of our sewage system – to the absolute limit. Given the fact that the current wastewater treatment plant is well within the city limits, we cannot afford to have it pack up on us. Hence, we need a new plant with (much) bigger capacity and that's why the deadline for 14 December is non-negotiable. Testing still needs to be done on the biological part of the plant, and the new plant needs to be phased in, initially piggy-backing on the existing one. We estimate that this will take three months, but it's absolutely critical that we get the process going as soon as possible. Ultimately we intend for the plant to be operating by February 2013, or March at the very latest."

Another factor that demanded that the project be kept within a strict budget and time frame was that, remarkably, the Swakopmund Municipality was financing the total N$167 million project itself, without any assistance from banks or the government or burdening the public. Says Demasius, "It's unusual for a municipality to be able to finance a project of this magnitude itself, and in all honesty it's unlikely – given today's rocketing building costs – that something like this will happen again in Namibia. However, given that we were forking this money out, the technology used needed to be right, the budget and time frame had to be adhered to strictly, and the engineering and construction had to be first class. I'm pleased to say that to date this has all turned out to be the case, and speaking as a qualified engineer myself, the concrete work done by Botes & Kennedy Civils on this project was some of the best I've seen yet."

The new municipal wastewater plant proved to be a banner project for Botes & Kennedy Civils (Namibia) as one of the largest projects that the company

has worked on to date. This is in fact a once-in-a-lifetime project in Namibia, as a sewage plant of this scale is not built that often (the site measures 168 m x 339 m). The project necessitated close collaboration with numerous subcontractors, and overcoming stumbling blocks such as encountering rock at shallow depths, a shortage of skilled labour and a temporary shortage of reinforcing steel, which set the project back by three months. However, these challenges were overcome and the project is well on track. Another contributing factor to the successful progress of the project was the use of advanced construction techniques, including specialised formwork systems and the pumping of concrete.

ACHIEVING A FIT IN TERMS OF LOCATION AND TECHNOLOGY

Preparations for the selection of a site for the new wastewater treatment plant in early 2008 encompassed community involvement, a detailed environmental impact assessment (EIA) scoping report, as well as a geological assessment to determine the soundness of the founding conditions.

During the course of the EIA four potential sites were identified. These sites all fitted into the long-term development plan for Swakopmund (the planning horizon for this project was 2022), and fell behind a natural barrier, namely the Henties Bay by-pass road. No major obstacles were found to any of the sites, but certain issues did crop up: there was a potential stormwater drainage problem at two of the sites; a potential bird threat to air traffic at one site and to a lesser degree at another; and while all sites were favourable in southwest wind conditions, all failed in terms of east wind conditions. Two sites had a lot of rocky material, while another had a base of rock covered by much softer material.

Comparisons were made between the four sites using a number of criteria:

- The types of systems required by the individual sites (in order to get raw sewage *to* the treatment plant, and purified effluent *from* the plant to town)
- The infrastructure expenditure required for each site, in terms of the different pumping stations, pump sizes, pipeline lengths and motors needed
- The energy required for each site (based on the current tariff)
- The estimated running costs of each site (capital costs were reduced to monthly costs over a 20-year period at 12% per annum).

Once the criteria had been assessed, appropriately weighted according to impact and then matched, the site ultimately chosen – on balance – ticked all the right boxes.

Three different wastewater treatment technologies were considered, namely a Trickling Filter Process, an Extended Aeration Biological Nutrient Removal (BNR) activated sludge process, and a Membrane Bioreactor (MBR) activated sludge process. The three technologies were compared according to a number of criteria, including proven and reliable technology, discharge quality, robust treatment technology, plant operations, plant

Constructing the digester

Reactor mixing platform under construction

maintenance, capital cost, operating cost, and environmental concerns. Ultimately, it was decided that the Extended Aeration Biological Nutrient Removal (BNR) activated sludge process should be implemented.

HOW THE PLANT WORKS

Given the general scarcity of water in Namibia, the aim of the new wastewater treatment plant is to process raw sewage until it is safe to use as irrigation water for gardens and parks in Swakopmund itself, as well as at the Rossmund Golf Estate located about 10 km outside town. This will be done as follows:

1. The raw sewage will be collected from the sewage network and pumped by means of various pump stations into a balancing tank at the old wastewater treatment plant in town.
2. The balancing tank is connected to a blower station, which adds air to the raw sewage to ensure that smells are kept to a minimum.
3. From there it will be piped through a 9.8 km long, 400 mm diameter rising main pipeline to the new wastewater treatment plant.
4. There the sewage will proceed through various stages, namely the inlet works, the primary distribution box, the biological nutrient reactor, the secondary distribution box, the final clarifiers 1 and 2, the sludge mixing box, the sludge thickener, digesters 1 and 2, the sludge drying beds, the sand filter, and the chlorine contact channel.
5. Once the water has been processed, it will enter the treated water distribution network, which will make it available for use in gardens and parks throughout the municipal area.

TEAMWORK: THE ESSENTIAL COMPONENT

Considering the technical complexity and scale of the project, it is remarkable that the average age of the management team from Botes & Kennedy Civils (Namibia) was 35 years and younger. The success of the project can undoubtedly be attributed to the mix between the ambition of the younger management and the invaluable experience of the more senior supervisors. Working on this project has been an enormously fulfilling experience – staff have not only been individually challenged from a professional point of view, but also had to pull together and commit to the project to make it a success. It has been a collaboration and team effort in every sense: if something went wrong, it was everyone's problem; if something went well, it was to everyone's credit.

Sand filter dividing walls taking shape

Long-distance view of the new Swakopmund wastewater treatment plant, which will be completed in December this year

The project also saw the company navigating new management territory. Until the start of this project Botes & Kennedy Civils (Namibia) essentially had a number of teams working on different sites. That is, each team had their own leadership, hierarchies and ways of doing things. The construction of the sewage plant, however, required the manpower and expertise of all these teams on one site, necessitating the integration of the senior management from these teams in order for them to work together efficiently towards the common objective. The integration went off without a hitch, and

after having worked many long hours and weekends, the combined team is now in the home stretch on this project.

CONSIDERING THE LONG TERM

Projecting the future growth of the municipal area is not an exact science, especially given the myriad factors involved. However, should Swakopmund's growth continue at the current rate, it is conceivable that in time the town will begin to encroach on the new plant. However, certain 'buffers' have been put in place to ensure the continued viability of the plant. Firstly, there is a long-term plan for Swakopmund's development in place – this means that development is methodical rather than haphazard, and that the plant's existence and location will be taken into account. Secondly, its location on the other side of a natural barrier will also assist in keeping the area purpose-specific (that is, you're not likely to have a suburb spring up next door overnight). And thirdly, a 500 m barrier (exclusion zone) is planned around the site, thereby avoiding or at least mitigating any future plant/resident conflict.

Number crunching

This project necessitated:

- 11 000 m^3 of concrete
- 1 300 tonnes of reinforcing steel
- 24 000 m^2 of formwork
- 19.8 km of 400 mm Class 10 HDPE pipeline

Employment, job creation and training

- At peak 225 employees were active on the site; 60% of those were under 35 years of age, many of them women.
- Botes & Kennedy Civils (Namibia) trained a number of unskilled labourers in carpentry, bricklaying, steelfixing and pipelaying. Many of these were women. The company endeavours to accommodate as many of these labourers in upcoming projects as possible.

Professional team

Client	Swakopmund Municipality
Main consultants	Windhoek Consulting Engineers, Golder & Associates
Main contractor	Botes & Kennedy Civils (Namibia)

CONCLUSION

Teamwork, cooperation and a responsibility towards the community, as well as the need to be especially prudent with the community's funds, meant that this project was challenging to all those involved. However, proper planning, collaboration and sound management have resulted in an engineering feat that is likely to be recognised as a noteworthy achievement. □

Source:
http://www.saice.org.za/downloads/monthly_publications/2012/2012-Civil-Engineering-October/#/0