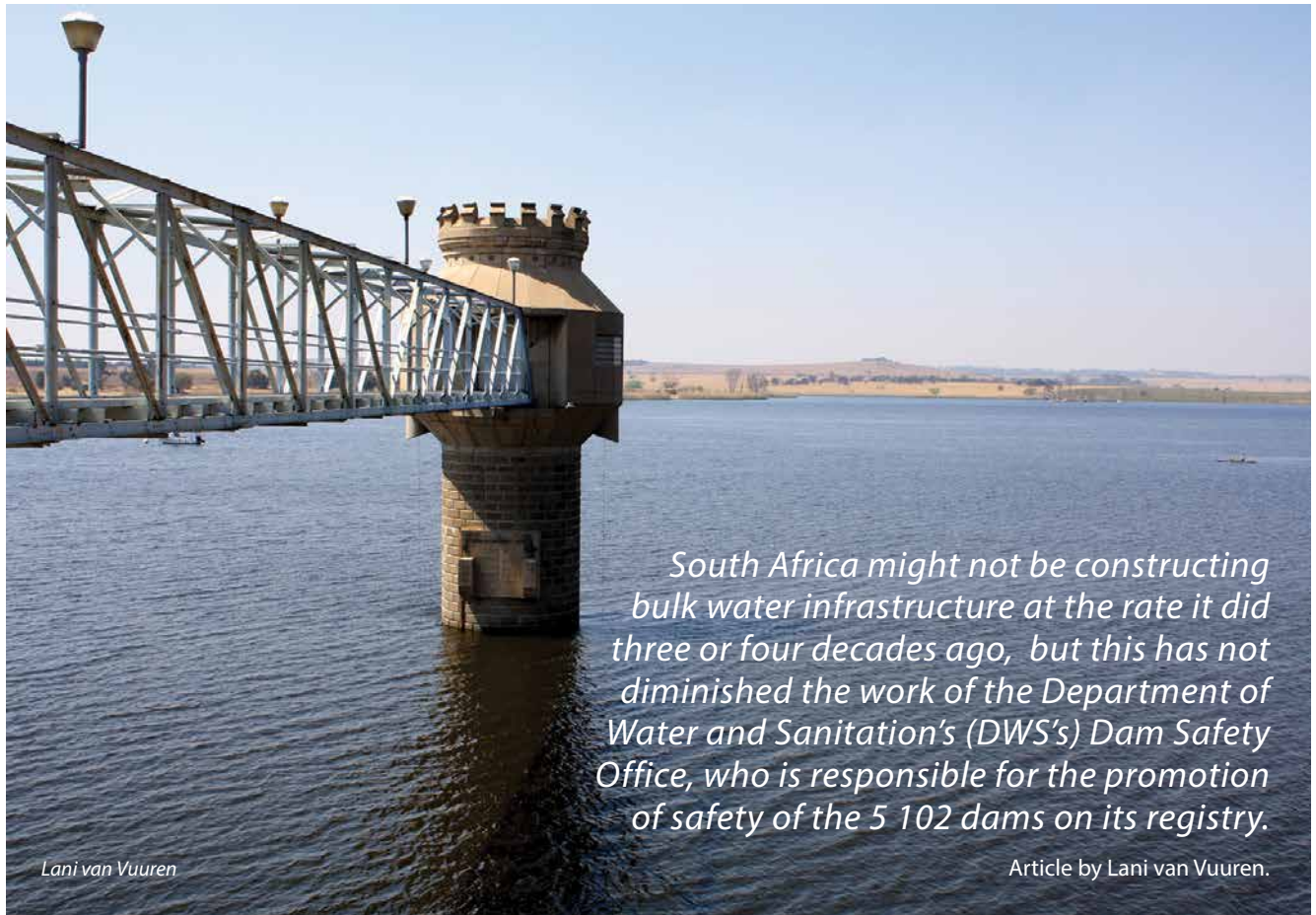


Dam safety

Dam safety – ensuring the integrity of SA's 5 000+ registered dams



South Africa might not be constructing bulk water infrastructure at the rate it did three or four decades ago, but this has not diminished the work of the Department of Water and Sanitation's (DWS's) Dam Safety Office, who is responsible for the promotion of safety of the 5 102 dams on its registry.

Lani van Vuuren

Article by Lani van Vuuren.

Characterised as a semi-arid country, South Africa is extremely dependent on its dams for water supply. In addition to an annual rainfall that comprises only half the global average, the country suffers from high evaporation rates (a result of its abundant sunshine). On average, less than 9% of precipitation that falls on South African soil eventually reaches the country's river systems. Rain is also unevenly spread across the country, with 60% of the total annual runoff arising in only 20% of the surface area (mostly the eastern part).

Since rivers provide South Africa's only large-scale resources of freshwater, the country has had no choice but to construct storage dams to provide reliable supply of water for its various purposes. South African dam builders have mastered the art and science of manipulating water flows to allow the country to unlock its economic potential.

At last count the country had a total mean annual runoff of only 49 210 million m³/year. Of this volume, around 70% is stored behind the country's 252 largest dams. The country's bulk water

supply infrastructure is integrated and sophisticated, often involving numerous large dams, pipelines, pumps and water transfer schemes from water-abundant to water-scarce catchments.

Ensuring the integrity of this infrastructure is extremely important, especially considering the fact that most of the country's larger dams are now older than 30 years. The DWS Dam Safety Office was originally established in 1986 as a technical unit to support the implementation of dam safety legislation.

Registration of dams with a safety risk

Not all dams in South Africa are registered with the Dam Safety Office. Only dams with a considered safety risk need to be registered. These are dams with a wall height exceeding 5 m and a storage capacity greater than 50 000 m³. Any structure capable of diverting or storing water is classified as a dam, and so the dam safety register also includes, for example, mine tailings dumps, pollution control dams and potable water reservoirs that fit the classification.

In exceptional cases, the Minister may also declare a dam as having a safety risk even if it falls outside the conventional registration parameters. Every dam with a safety risk must be classified as a Category I, II or III dam (with I being the lowest risk and III being the highest risk). This is done on the basis of the dam's size and its hazard potential rating. Only 6% of South African dams have a Category III rating.

No person who intends to construct a new dam with a safety risk, or enlarge, alter or repair an existing dam with a safety risk, may begin construction work before he or she is in possession of a licence to do so. The Dam Safety Office considers and issues between 20 and 30 licences a year.

All new dams also require a water use licence for the water use activity to store water, as well as an environmental authorisation.

"The licensing system has resulted in a significant improvement in the documentation of dam designs, as well as a significant improvement in the quality of professional persons involved in the process. As a result, the general safety of South African dams has also improved," notes Leo van den Berg of the Dam Safety Office.

This is illustrated by the fact that not a single Category II or III dam for which a licence to construct was issued and which was built under the supervision of a suitably qualified professional has failed since 1987.

Who owns the dams in South Africa?

The DWS dams database contains information on each dam with a safety risk. For each dam the following information is recorded:

- The coordinates of the dam (latitude and longitude)
- The name and contact details of the owner
- Capacity, maximum wall height and classification.

The database is integrated into DWS Geographical Information System (GIS) tools so that the Dam Safety Office can see the position of any dam on a computer screen on a 1:50 000 map and on satellite images in different years. Google Earth is also used.

According to Van den Berg, parameters such as property description, drainage area numbers, contours and elevation data as well as the name and alignment of watercourses are readily available on these GIS systems. At present, the office has 5 102 dams registered on its database.

Of these dams, 75% or 3 832 are small (less than 12 m). Only 3.5% of dams on the register are larger than 30 m. Further, it is interesting to note that the vast majority of dams on the register are located in the Western Cape (1 444), followed by KwaZulu-Natal (986), and Mpumalanga (507). As expected the arid Northern Cape has the least number of dams on the register – only 2% or 82.

Since most of the water in South African dams is used for agriculture it stands to reason that this sector owns the most of the dams on the Dam Safety Register (a total of 4 001 or 80%). Interestingly, the mines & industry sector owners slightly more dams than does the DWS, 337 compared to 324 owned by the

Table 1: South Africa's ten largest dams in terms of storage capacity

Name of dam	Completion date	River/watercourse	Wall height (m)	Capacity ('000 m ³)
Gariep	1971	Orange	73	5 342 932
Vanderkloof	1977	Orange	108	3 187 557
Sterkfontein	1980	Nuwejaarspruit	97	2 616 000
Vaal	1938	Vaal	63	2 536 000
Pongolapoort	1973	Phongolo	89	2 445 900
Bloemhof	1970	Vaal	34	1 269 000
Theewaterskloof	1980	Riviersonderend	35	480 406
Kwaggaskloof/Brandvlei	1983	Breede	25	459 000
Heyshope	1986	Assegai	29	453 440
Woodstock	1982	Tukhela	54	373 000

Source: DWS

department. The department does own the largest dams in South Africa, however. South African municipalities own a further 321 dams, with the remainder of dams being owned by other government departments and water boards.

New dam safety regulations

Dam safety legislation was first implemented in South Africa in 1987, under the old Water Act of 1956. When this Act was replaced with the new National Water Act in 1998, this legislation had to be renewed. The new dam safety regulations were published in 2012.

According to Van den Berg, the new regulations are better aligned with current legislation. "Experience gained since 1987 was used to improve the regulations. However, the basic principles of the 1986 dam safety regulations have been retained."

The purpose of dam safety legislation was, and still is, to improve the safety of new and existing dams with a safety risk so as to reduce the potential for harm to

the public, damage to property or to the quality of water resources. The biggest change to the legislation has been that in addition to protecting human lives and property against unsafe conditions at dams, the new Regulations have been expanded to also protect water resources by assigning a high priority to e.g. pollution control dams, which have an impact on groundwater and surface water resources. These dams occur mostly in the mining, industrial and municipal sectors.

Category II and III dams must be inspected every five to ten years. This, and other dam safety-related work, must be done by approved professional persons or APPs. These are people registered as professional engineers, technologists or technicians who have the approval to perform certain dam safety tasks. Approvals are undertaken in consultation with the Engineering Council of South Africa (ECSA). The new Regulations saw the establishment of a register of APPs, which makes it easier for dam owners to find person(s) with the necessary qualifications.

However, as with many technical skills in South Africa, the list of people undertaking this work in South Africa is small. The Dam Safety Office has also expressed its concern over the availability of APPs. Currently there are less than 100 APPs in South Africa (approximately 1 qualified person for every 50 dams on the Dam Safety register). More than 66% of these are older than 60 years of age.

"[It is clear] that not enough young professionals are being trained to become APPs, and the Dam Safety Office expects that the availability of APPs will soon become a bottleneck for the effective implementation of the compulsory dam safety evaluations of Category II and III dams," reports Van den Berg. This lack of capacity can already be seen in the fact that during 2014/15, only 58% of targeted dam safety inspections were performed.

Capacity is also limited within the Dam Safety Office, who only has a staff of 13 (including administration staff).

Table 2: Distribution of registered dams according to size class

Size class	Number	%
Small (less than 12 m)	3 832	75,1%
Medium (12 m to 30 m)	1 093	21,4%
Large (30 m and higher)	177	3,5%
Total	5 102	100

Source: DWS

Table 3: Distribution of type of ownership of registered dams

Ownership sector	Total number of registered dams
Agriculture	4 001
Mines, industries and business	337
Department of Water and Sanitation	324
Municipalities	321
Other state departments	68
Water boards	51
Total	5 102

Source: DWS



Nqweba Dam outside Graaff-Reinet is one of the oldest municipal dams on the Dam Safety Register, having been completed in 1925.

“The licensing system has resulted in a significant improvement in the documentation of dam designs, as well as a significant improvement in the quality of professional persons involved in the process.”

“As long as the number of engineers in the Dam Safety Office is not increased, the office will only be able to do an in-depth evaluation of a small sample of the evaluation reports submitted, for example, only for dams with a high hazard potential, or for dams with a history of unsatisfactory behaviour, or those reports submitted by less experienced APPs,” says Van den Berg. “The technical capacity of both the Dam

Safety Office and the pool of APPs will have to be increased to meet the ideal long-term target of 292 dam safety evaluations per year.”

Implementing dam safety recommendations

Some dam owners respond positively to dam safety inspections by implementing important recommendations promptly. Unfortunately there are also those dam owners who allow dam safety evaluation reports to gather dust.

The Dam Safety Office aims to follow up all cases where instructions have been issued and where important recommendations of dam safety evaluation reports have not been implemented. This objective has, however, not been achieved in all cases due to the shortage of technical and administrative staff. In the case of priority

dams, provincial offices of the DWS and catchment management agencies have been requested to become involved in compliance monitoring.

DWS dam safety rehabilitation programme

In addition to the inspection of dams, the DWS has also been undertaking a major rehabilitation programme on its own dams. Over the last six years, the department spent between R385-million and R228-million on rehabilitating dams. Around 50% of dams earmarked for major rehabilitation work have now been completed.

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