



water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

DAM SAFETY REGULATION:

2014/2015 ANNUAL REPORT



**ADMINISTRATION OF DAM SAFETY
LEGISLATION IN TERMS OF
CHAPTER 12 OF THE NATIONAL WATER ACT,
1998 (ACT № 36 OF 1998)**

FOREWORD

South Africa has a relatively good core network of national economic infrastructure. The challenge is to maintain and expand it at international standards to address the demands of a growing economy. Water is a strategic resource for social and economic development. By 2030, it is envisaged that effective management of water and the services derived from it will support a strong economy and a healthy environment.

The large dams belonging to the Department, municipalities, water boards and other government departments can store up to 92% of the total capacity of clean water in the country.

Dam Safety Regulation known as the Dam Safety Office, with its 28th year of existence, regulates the safety of new and existing dams with a safety risk so as to reduce the potential harm to the public, to property and to resource quality. The total number of registered dams in South Africa is currently 5 102.

Dam Safety Regulation also faces a limited human resource capacity similar to the capacity of professional persons available to the dam sectors. The dam sector partners, the Engineering Council of South Africa (ECSA) and its volunteer association, the South African Commission on Large Dams (SANCOLD), have made strides to assist with alleviating capacity constraints while elevating the profile of dam safety.

In October 2014, ECSA (in cooperation with the Department) released its policy statement on evaluation of applications for professional persons on dams – which has led to the establishment of a register of Approved Professional Persons (APP) in terms of the National Water Act and its regulations.

The general theme of SANCOLD's September 2015 conference was the safety, maintenance and rehabilitation of dams in South Africa. The rehabilitation of dams and the prior monitoring, analysis and assessments were priority issues highlighted for members to address in support of the dam sector.



Mrs N P Mokonyane
Minister of Water and Sanitation

EXECUTIVE SUMMARY

The **mission** of the Dam Safety Office (DSO) is to promote the safety of new and existing dams with a safety risk so as to reduce the potential harm to the public, to property and to resource quality. The work of the DSO is carried out in terms of Chapter 12 of the National Water Act, 1998 (Act No. 36 of 1998). This report covers the activities of the Dam Safety Office for the period 1 April 2014 to 31 March 2015.

A total of 72 dams were registered by Dam Safety Regulation during the year under review, bringing the **total number of dams registered to date in South Africa to 5 102**. This figure includes the new dams that were completed during the year, as well as existing dams that were not registered previously. Altogether, 109 previously registered and proposed dams were classified. The total number of existing dams now classified is 5 029, which is 98,6% of the registered dams. There are only 73 registered dams left that have not been classified yet.

Dam safety control over the construction of new dams and alterations to existing dams, involves the evaluation of design and other reports that form part of licence applications. A total of 28 dam safety licences were issued i.e. 11 licences to construct, 4 to alter/repair, 10 to impound and 3 to decommission.

During the year under review, a total of approximately 1 575 letters were sent to mainly dam owners to ensure compliance with dam safety legislation. This included a total of 220 dam safety evaluation instructions issued to dam owners. A total of 183 applications / notifications for approval as Approved Professional Persons for dam safety tasks were processed, of which 11 applications were submitted to ECSA for their recommendation.

The main mechanism to promote the safety of existing dams is compulsory dam safety evaluations that must be performed by Approved Professional Persons on behalf of dam owners. There are currently 2 191 category II and III dams in the country and the target is that these dams should be inspected at an average interval of about 7,5 years. A total of 170 dam safety evaluation reports were submitted by dam owners during the year under review; and a total of 203 reports, which include reports standing over from the previous year, were evaluated and accepted.

Progress with the upgrading of the safety of dams is slow but steady. Personal finances and apathy on the part of some dam owners continue to be the most common stumbling block hampering progress with regard to the rectification of deficiencies at dams.

From statistics provided in the report, it is clear that **special attention should be focused on the first 100 to 200 dams on the DSO's priority list to ensure their safety** as they have the greatest potential impact on the public. It is significant that 80% of the first 100 dams on the priority list belong to DWS and Municipalities. Dams lower down on the priority list should not be neglected, even though they are not part of the first 100 to 200 dams. **Important recommendations are made in the report in order to maintain and preferably accelerate progress with the dam safety programme.**

The total direct expenditure incurred in administration of the dam safety legislation at Head Office was R7483 000 compared to R5328 000 in the previous reporting year, i.e. an increase of 40,4% is mainly due to filling of critical vacant posts and cost of living increases. Some technical and administrative posts remained vacant in the year, impacting negatively on the efficiency of the dam safety programme. Filling of vacant technical posts is an ongoing challenge. As an interim measure, two Graduate Trainees (one Civil Engineer and one Civil Engineering Technician) were seconded to the Dam Safety Office from the Learning Academy for most of the year under review.

The direct cost of the Dam Safety Office is considered moderate compared to the benefits derived from the dam safety programme in South Africa. One of the significant benefits is that not a single new category II or III dam which has been built in terms of the dam safety regulations (i.e. a licence to construct was issued and dam was built under supervision of an Approved Professional Person according to the approved design) has failed since 1987 when the dam safety legislation came in force in South Africa.

*Note: A copy of this annual report is available on the Department's website:
www.dws.gov.za (under sites/dam safety office/publications)*

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GLOSSARY OF TERMS

Classification of a dam with a safety risk- every dam with a safety risk must be classified on the basis of its size and hazard potential to determine the level of control over the safety of the structure that is applicable in terms of the dam safety regulations. The size classification of dam is based on the maximum wall height

Size Classification	Size class	Max wall height (m)
	Small	Less than 12 m
	Medium	Equal or more than 12 m less than 30m
	Large	Equal or more than 30m

Hazard potential classification	Rating	Potential loss of life	Potential economic loss	Potential adv impact on resource quality
	Low	None	Minimal	Low
	Significant	Not more than 10	Significant	Significant
	High	More than 10	Great	Severe

Category classification	Size class	Hazard potential rating		
		Low	Significant	High
	Small	Category I	Category II	Category III
Medium	Category II	Category II	Category III	
Large	Category III	Category III	Category III	

Dam with a safety risk' means any dam -

- (i) which can contain, store or dam more than 50 000 cubic metres of water, whether that water contains any substance or not, and which has a wall of a vertical height of more than five metres, measured as the vertical difference between the lowest downstream ground elevation on the outside of the dam wall and the non-overspill crest level or the general top level of the dam wall;
- (ii) belonging to a category of dams declared under section 118(2) to be dams with a safety risk; or
- (iii) declared under section 118(3)(a) to be a dam with a safety risk;

Registration – the owner of the dam must register that dam in terms of section 120 of the Act on an official application form obtained from the Department. The completed form must be signed by the owner and submitted to the Director-General.

Hazard potential means a qualitative indication of the potential loss of life, potential economic loss or potential adverse impact on resource quality that any failure of a dam with a safety risk could have as a result

Potential adverse impact on resource quality means the effect that failure of a dam could have on the water resource and is for the purposes of the dam safety regulations related to a prescribed system for classifying water resources, or equivalent system being used by the Director-General at the time of classification of a dam with a safety risk

LIST OF ABBREVIATIONS

AAR	alkali-aggregate reaction
APP	Approved Professional Person
CMA	Catchment Management Agency
dse	dam safety evaluation
dsi	dam safety inspection
DSO	Dam Safety Office
DSP	Dam Safety Programme
DWA	Department of Water Affairs, renamed DWS in 2014
DWS	Department of Water and Sanitation
ECSA	Engineering Council of South Africa
EPP	Emergency preparedness plan
H	Maximum dam wall height in metres
m	metre
m ³	cubic metre
NOC	Non-overspill crest
NWA	National Water Act, 1998 (Act No. 36 of 1998)
O&M	Operation and maintenance
OMM	Operation and maintenance manual
R	Rand (South African)
RMF	Regional maximum flood peak
SANCOLD	South African National Committee on Large Dams
V	Storage capacity of dam in cubic metres
WARMS	Water Authorisation & Registration Management System
WMA	Water management area
x 10 ⁶ m ³	million cubic metres
<	This sign means “less than” (e.g. H < 12 m is pronounced as “H is less than 12 metres”)

1. INTRODUCTION

This annual report covers the activities of the Directorate: Dam Safety Regulation within the Department of Water and Sanitation with regard to administration of the dam safety legislation in terms of Chapter 12 of the National Water Act, 1998 (Act 36 of 1998) read together with the relevant dam safety regulations, during the financial year 1 April 2014 to 31 March 2015. The annual report also serves as an auditing tool to measure progress with the dam safety programme by comparing the current statistics with those of previous years as well as with targets that were set in the strategic business plan enclosed in **Appendix A**.

The statistics included in this report reflect the position as for the current nine DWS regions, which are based on river drainage regions that differ from provincial boundaries and reflect on the key functions performed including:

- Registration and classification of dams;
- Dam safety evaluation;
- Application for approval of Approved Professional Persons and teams;
- Licences;
- Compliance monitoring of dam owners.

2. ADMINISTRATION

The Administration of the dam safety legislation is carried out jointly by the DSO and selected personnel from the regional offices.

The personnel listed below were employed by the Dam Safety Office at Head Office during the reporting year:

- Three Chief/Specialist Engineers
- One Candidate Engineering Technician
- One Deputy Director
- One Assistant Director
- One Senior Administrative Officer
- One Administrative Officer doing logistic duties
- One Senior Administrative Clerk
- Two Senior Administrative Clerks doing registry clerk duties
- One Senior Administrative Clerk doing data capturing
- One Graduate Trainee (Civil Engineer) for part of the year
- One Graduate Trainee (Civil Engineering Technician)

During the year under review, a total of approximately 1 575 letters/documents were compiled by the Dam Safety Administration officials, with the assistance of the two registration clerks. The relevant statistics for the past two years are compared in the two Tables below and it can be seen that there was a 21% improvement in total "output". This was mainly brought about by the newly implemented Register of Approved Professional Persons, which significantly simplified the administrative processing of APP-applications, releasing human resources for other work.

Statistics for the current reporting year (1 April 2014 – 31 March 2015)

TASK	GA	FS	EC	NW	KZN	L	MP	WC	NC	Total
Registration and classification of dams										
Classification of dams (new/proposed)	1	2	3	0	4	5	2	8	0	25
Registration of dams/ class and reg (existing)	23	3	46	0	6	4	2	42	4	130
Dam safety evaluation letters										
Dam safety evaluation (inspection) instructions	30	24	8	2	24	12	6	113	1	220
Implementation of recommendations of dse reports	24	7	27	1	11	2	2	78	1	153
General letters and reminders/warnings	34	14	28	1	19	7	21	99	6	229
Letters re inspection, investigation	33	15	23	0	24	8	15	94	11	223
Applications for approval of professional persons and professional teams										
Processed administratively	8	8	24	6	7	17	9	90	3	172
Processed after consultation with ECSA	1	3	0	0	3	1	2	1	0	11
Owner information										
Verification of ownership	35	54	37	0	29	12	51	128	10	356
Deeds	0	0	12	0	0	4	0	0	0	16
Other										
Legal Actions	0	0	0	0	0	0	0	0	0	0
Exemptions	0	0	0	0	0	0	0	0	0	0
Declarations of a dam with a safety risk	0	0	0	0	0	0	0	0	0	0
Dams not a safety risk "by definition"	4	1	3	0	0	0	1	3	0	12
Letters in connection with subsidies	0	0	0	0	0	0	0	0	0	0
Licences										
Licence to construct/alter	1	0	0	0	4	0	3	7	0	15
Licence to impound	2	0	1	0	3	0	1	3	0	10
Licence to abandon	0	0	0	0	1	0	0	2	0	3
Total for Period	196	131	212	10	135	72	115	668	36	1575

Statistics for the previous reporting year (1 April 2013 – 31 March 2014)

TASK	GA	FS	EC	NW	KZN	L	MP	WC	NC	Total
Registration & classification of dams										
Classification of dams (new/proposed)	6	4	1	0	0	4	1	10	0	26
Registration of dams/ class and reg (existing)	22	27	51	1	14	37	27	92	6	277
Dam safety evaluation letters										
Dam safety evaluation instructions	5	6	16	0	3	2	6	50	1	89
Implementation of recommendations of dse reports	5	7	11	0	8	4	1	18	2	56
General letters and reminders/warnings	24	22	45	1	30	14	11	102	3	252
Letters re inspection, investigation	31	26	77	0	38	23	17	123	13	348
Applications for approval of professional persons and professional teams										
Processed administratively	24	6	18	3	13	7	16	80	2	169
Processed after consultation with ECSA	5	2	0	0	1	1	0	9	0	18
Owner information										
Verification of ownership	1	3	14	1	1	1	1	6	1	29
Deeds	0	1	1	0	1	0	1	3	0	7
Other										
Legal Actions	0	0	0	0	0	0	0	0	0	0
Exemptions	0	0	0	0	0	0	0	0	0	0
Declarations of a dam with a safety risk	0	0	0	0	0	0	0	0	0	0
Dams not a safety risk "by definition"	0	0	2	0	0	1	0	0	0	3
Licences										
Licence to construct/alter	2	0	1	0	2	4	5	3	0	17
Licence to impound	2	0	0	0	0	0	2	2	0	6
Licence to abandon	0	0	0	0	0	0	0	0	0	0
Total for Period	127	104	237	6	111	98	88	498	28	1297

3. DIRECT COST OF DAM SAFETY ADMINISTRATION

The direct expenditure incurred in administration of the legislation at Head Office is shown in Table 1 below.

Table 1: DSO Direct expenditure

Item	Expenditure (R'000)	
	2013/14	2014/15
Employee component	4890	6 931
Goods & Services	371	536
Transfers	0	0
Machinery	67	17
Grand Totals	5 328	7 483

The total direct expenditure was R7 483 000 compared to R5 328 000 in the previous year, i.e. an increase of 40,4%, mainly due to filling of critical vacant posts and cost of living increases.

Indirect costs (i.e. expenditure incurred by regional offices that assist the DSO, and Head Office overhead cost) are not included in these amounts.

4. REGISTRATION OF DAMS

In terms of Section 120 of the NWA, all dams with a safety risk (i.e. if the wall height exceeds 5,0 m **and** if the storage capacity exceeds 50 000 m³) must be registered by dam owners. A total of 72 dams were registered during the year, bringing the total number of dams registered to date in South Africa to 5 102. The figure of 72 includes registration of new dams that were completed during the year, as well as of existing dams that were not registered previously. Some corrections were also made to the database. The progress with registration of dams is illustrated in figure 1.

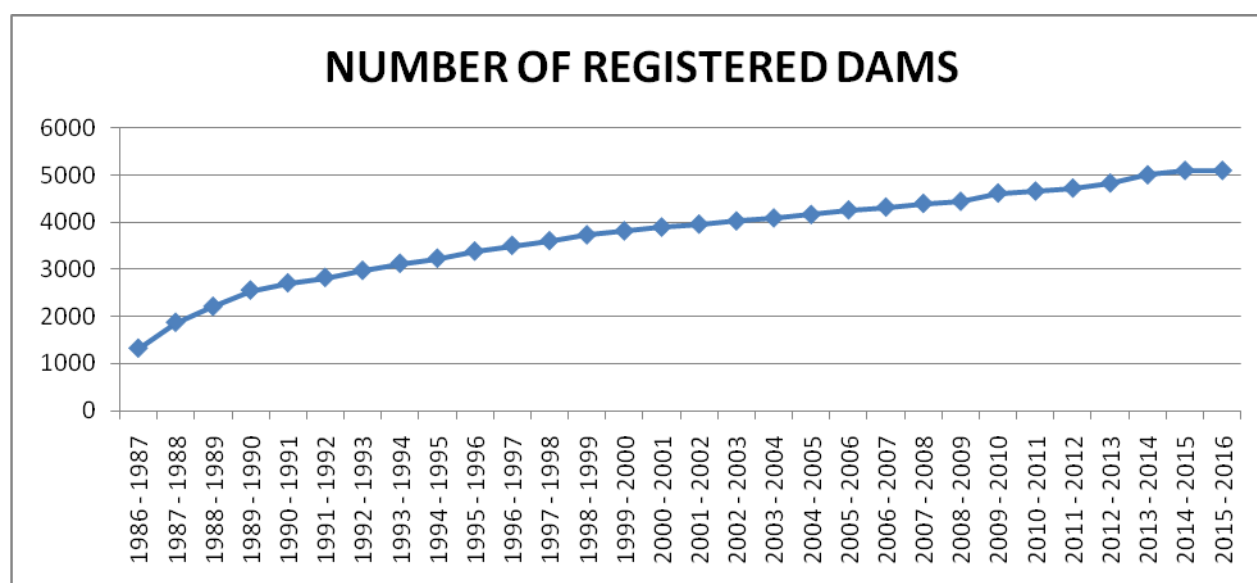


Figure 1: Progress with registration of dams

The distributions of registered dams according to size class, reservoir capacity and regional location are given in Tables 2 to 4.

Table 2: Distribution of registered dams according to size class

Size class	Number	%
Small (less than 12 m)	3832	75,1%
Medium (12 m – 30 m)	1093	21,4%
Large (30 m and higher)	177	3,5%
Total	5 102	100

Table 3: Distribution of registered dams according to reservoir storage capacity

Capacity (x 10 ⁶ m ³)	Number	%
0,00 – 0,05	148	2.9%
0,05 – 0,10	1316	25.8%
0,10 – 0,25	1829	35.9%
0,25 – 1,00	1186	23.2%
1,00 – 10,00	451	8.8%
10,00 – 100,00	117	2.3%
100 – 1 000	49	1.0%
1 000 – 10 000	6	0.1%
Total	5102	100

Table 4: Regional distribution of registered dams with a safety risk

Region	Total No. registered to date	%
Eastern Cape	761	15%
Free State	428	8%
Gauteng	344	7%
Northwest	154	3%
KwaZulu-Natal	986	19%
Limpopo	396	8%
Mpumalanga	507	10%
Northern Cape	82	2%
Western Cape	1444	28%
Total	5 102	100%

The distribution of type of ownership of registered dams is indicated in Table 5 and the 20 largest dams in the RSA in terms of capacity, from large to small, are listed in Table 6.

Table 5: Distribution of type of ownership of registered dams

Ownership Sector	Total number of registered dams
DWS	324
Municipalities	321
Other State Departments	68
Water Boards	51
Mines, Industries, Business	337
Agriculture	4 001
Total	5102

Table 6: 20 Largest dams in terms of storage capacity

Name of dam	Completion date	River or Watercourse	Wall height (m)	Capacity ('000 m ³)
Gariiep	1971	Orange	73	5 342 932
Vanderkloof	1977	Orange	108	3 187 557
Sterkfontein	1980	Nuwejaar spruit	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	Assegaai	29	453 440
Woodstock	1982	Tugela	54	373 000
Loskop	1939	Olifants	49	361 000
Grootdraai	1981	Vaal	42	350 000
De Hoop	2013	Steelpoort	74	347 000
Goedertrouw	1982	Mhlatuze	88	301 000
Albert Falls	1976	Mgeni	30	289 100
Spioenkop	1973	Tugela	53	279 000
Kalkfontein	1938	Riet	36	258 274
Mtata	1977	Mtata	38	253 674
Inanda	1989	Mgeni	59	252 000
Driekoppies	1998	Komati	50	251 000

5. CLASSIFICATION OF DAMS

Altogether 109 existing and proposed dams were classified or reclassified during the year. The total number of registered existing dams which have now been classified is 5 029, which is 98,6% of the 5 102 dams registered to date.

There are only 73 registered dams remaining that have not been classified yet. These outstanding classifications generally represent small dams and their hazard potential would mostly be low. The distribution of existing dams classified according to hazard potential rating and category classification is given in Tables 7 and 8.

Table 7: Classification of existing dams according to size-class and hazard potential

Size class	Hazard potential rating			Total
	Low	Significant	High	
Small	2 820 (56%)	972 (19%)	44 (1%)	3 836 (76%)
Medium	298 (6%)	599 (12%)	128 (3%)	1 025 (21%)
Large	0 (0%)	21 (0%)	147 (3%)	168 (3%)
Total	3 118 (62%)	1 592 (32%)	319 (6%)	5 029 (100%)

Table 8: Category classification of existing dams

Category classification	Number of dams	%
Category I*	2838*	56 %
Category II	1899	38 %
Category III	292	6%
Total	5 029	100 %

*18 of these dams are actually medium sized dams with a low hazard potential, and have been classified as Category I dams, in terms of regulation 3.2 of the old dam safety regulations.

6. CONTROL OVER THE CONSTRUCTION & ALTERATIONS OF DAMS

6.1 Licencing

Dam safety control over the construction of new dams, including alterations to existing dams, involves the evaluation of design and other reports that form part of a licence application. A total of 28 dam safety licences were issued as shown in Table 9:

Table 9: Licences issued by DSO in the year

	Licence to:				
	Construct	Alter/Repair	Impound	Decommission	Total
Total	11	4	10	3	28

6.2 Site visits to dams

Response from APPs with regard to the submission of reports after site visits during construction work at dams varied from very good to fair.

Members of the DSO technical staff made a total of 104 visits to dams during the year under review compared to 27 visits in the previous year. Of these, 9 were to dams under construction whilst the remaining 95 were to existing dams. Where possible, contact was made with APPs to discuss design issues, general problems and quality control.

6.3 Evasion of the dam safety legislation

Where dams are being constructed unlawfully it is ideal to have construction halted immediately and plans put in place to rehabilitate. If the dam is already constructed or construction is near completion an assessment is required of the likelihood of a water use licence being granted. If not, then, in terms of section 53 of the NWA, 1998, the contravention must be rectified (which may include removing of the dam wall in its entirety). If a water use licence would be granted, then, following a dam safety evaluation, the dam would have to be upgraded to acceptable safety standards before any water may be stored in the dam. Enforcement action would then take its course.

7. CONTROL OVER THE SAFETY OF EXISTING DAMS

7.1 Progress with compulsory dam safety evaluations

The main mechanism to promote the safety of existing dams is by means of compulsory dam safety evaluations that must be performed at intervals between 5 and 10 years, taking into account the condition of a dam. Shortcomings at dams must be identified during these dam safety evaluations. The following table summarises the progress with compulsory dam safety evaluations for Category II and III dams.

Table 10: Progress with compulsory dam safety evaluations of Category II & III dams

Owner Sector	DWS	Municipalities	Industry Mines Business	Other State Dept.'s	Water Boards	Agriculture	Total
Total number of Category II & III dams	284	267	236	34	46	1324	2 191
<u>Target</u> - Required number of evaluations per year based on an average 7,5 year interval	38	36	31	5	6	176	292
<u>Actual</u> number of evaluations submitted in year	23	15	23	2	8	99	170
Actual as % of Target (2014/15)	60%	42%	74%	40%	133%	56%	58%
(2013/14)	(54%)	(109%)	(80%)	(20%)	(67%)	(59%)	(66%)
(2012/13)	(95%)	(69%)	(55%)	(0%)	(16%)	(43%)	(53%)
(2011/12)	(100%)	(44%)	(50%)	(100%)	(17%)	(33%)	(47%)
Outstanding first evaluations	21	33	69	5	5	468	601
Total number done since 1987	794	522	352	56	76	1 426	3 226

The "Actual vs. Target" analysis indicates that most owner sectors will have to commit more resources to submission of the compulsory dam safety evaluations in order to achieve the target (based on a 7,5 year interval). Performance seems to vary significantly from year to year.

The flow of dam safety inspection reports through the Dam Safety Office during the reporting year is shown below

Table 11: Flow of dam safety evaluations

	2011/2012	2012/2013	2013/2014	2014/2015
Dam safety evaluation instruction letters issued	218	155	83	220
Dam safety evaluation reports received	123	144	189	170
Dam safety evaluation reports accepted	94	145	123	203

Currently, there are 2 191 Category II and III dams in the country and these dams should be inspected at an average interval of about 7,5 years. To achieve this, the ideal long term target should be set at 292 dam safety evaluations per year.

The current capacity of Dam Safety Regulation to perform an in-depth evaluation of the quality of each report submitted is limited. A total of 203 reports were evaluated and accepted. More technical capacity to evaluate the reports is essential to ensure that APPs submit reports of adequate quality. As long as the number of engineers in the DSO is not increasing, the DSO will

only be able to do an in-depth evaluation of a small sample of 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. 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.

7.2 Progress with implementation of recommendations on Categories II and III dams

The Dam Safety Office aims to follow up in writing (ideally every 6 months) all cases where instructions were 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. A total of 605 follow up letters were compiled and sent in the reporting period.

7.3 Prioritisation of existing dams

Updating the priority list of existing dams is an ongoing activity and takes place after receipt of dam safety evaluation reports, compiled by APPs. The total number of existing Category II and III dams on the full list increased from 1 426 (2013/14) to 1 464 (2014/15). The goal is to eventually reflect all Categories II and III dams (private as well as State dams) on the list. The list of the first 100 dams (thus including the most important outstanding dam safety work in South Africa) is appended in **Appendix B**. A simplified risk-based assessment is done to determine the relative risk and ranking of a dam on the list, based on information provided in dam safety inspection reports. The relative risk is based on the "possible loss of human life during the life-span of a dam" (assumed as 100 years on average) and is calculated as the product of the following parameters:

- The estimated probability of failure of a dam (failure probabilities due to different causes at one dam are combined by using de Morgan's rule to prevent double-counting);
- The consequences of such a failure (hazard potential in terms of loss of life during a worst case scenario);
- A reduction factor determined from the standard of operation, maintenance, monitoring programme, emergency preparedness and general condition of a dam.

The priority list serves as a management tool for the DSO to:

- Identify priorities for the DSO;
- Determine appropriate inspection frequencies for dams (The proposed frequency as indicated in the last column of the list in **Appendix B** is one of the parameters used for the determination of intervals (years) between inspections;
- Monitor progress with the dam safety programme e.g. by comparing the total expected loss of life for all dams on the list, and also just for the first 50 dams on an annual basis.

It was found that the total relative risk or "possible loss of life" for all dams on the list increased by 1,6%— from 4 259 (2013/14) to 4 329 (2014/15) — partly due to new entries into the list and partly due to different assessments of risks in new dam safety evaluation reports. The total "possible loss of life" for the first 50 dams on the list increased by 11,5%— from 2 270 (2013/14) to 2 532 (2014/15) — due to the same reasons as given above. It should also be noted that there is a time lag before recent betterment work is reflected on the priority list, as the list is only updated after receipt of the next dam safety evaluation report following completion of rehabilitation work. Thus the list is not yet adequately "stable" and responsive to be used as an accurate short term monitoring tool to measure progress with the dam safety programme. Nevertheless, some useful information can be extracted from the priority list as shown in the following paragraphs.

The information and statistics in Table 12 and in **Appendices A, B2 and B3** have been corrected to take recently completed rehabilitation work into account. Table 12 shows three main shortcomings under the first 100 dams on the priority list that require urgent attention. The relevant dams are listed in **Appendix B2**.

Table 12: Main shortcomings under the first 100 dams on priority list

Shortcoming	No. of dams
• Deficient flood handling capacity	33
• Deficient structural stability	29
• Dams not complying with basic safety standards*	51

*For the purposes of this Table, "compliance with basic safety standards" means the probability of failure of a dam is estimated to be less than 0,05% (1/2000) or 0,5% (1/200) per year for category 3 and 2 dams respectively.

An aspect that must be borne in mind is that some dams appear high on the priority list merely because of their massive size and high theoretical hazard potential. Although no betterment work may be required at these dams because they comply with appropriate dam safety standards, it is important that adequate maintenance, monitoring, emergency preparedness and security measures are in place at these dams. These dams have been removed from the lists provided in **Appendices B2 and B3** in order to highlight shortcomings at dams that need to be addressed in the short term.

Table 13 shows that 78% of the top 100 dams on the priority list belong to DWS (Also see **Appendix B3**) and Municipalities. Most of the large dams in the country fall within these two sectors.

Table 13: Number of dams per sector within first 100 dams as ranked on priority list.

Sector	Total number of registered Category I and II dams	Number of dams within first 100 dams as ranked on priority list (%)
DWS Dams	284	52
Municipal Dams	267	26
Other State Dams	34	2
Water Board Dams	46	1
Mines, Industries, Business	236	3
Agricultural Dams	1324	16
TOTAL	2 191	100

The following useful information has been extracted from the priority list:

- Of the total "possible loss of life" for all dams on the list (4 329), approximately 69% is caused by the first 100 dams, or 81% by the first 200 dams. It is clear that special attention should be given to the first 100 to 200 dams on the priority list as they have the greatest potential adverse impacts on the public. Category I dams lower down on the priority list, should not be neglected, even though they are not part of the first 100 to 200 priority dams.
- 78% of the top 100 dams on the priority list belong to DWS and the Municipalities as shown in Table 13. It should be possible for these major dam owners to obtain and budget adequate funds to upgrade and/or maintain these dams in pristine condition;

- **The most important shortcomings of the top 100 dams that need to be addressed in the short term are listed in Appendices B2 and B3—with the latter showing DWSdams only. There are 23 dams on the latter list, of which 8 dams are in the planning, tender, design or construction phase;**
- The priority list also serves as a tool to help assess the current state of dam safety in South Africa and this is summarised under item 5 of the strategic business plan in **Appendix A**. It is clear that several role players must still do a lot of work to bring the state of dam safety in South Africa to satisfactory levels. The current rate of dam safety betterment work in South Africa is slow but steady. As reflected in Table 14, DWS's current rehabilitation programme is making an important contribution in this regard.

8. APPROVAL OF PROFESSIONAL PERSONS FOR TASKS

A total of 183 applications / notifications for approval as Approved Professional Persons (APPs) were processed during the year. A total of 11 applications were sent to the Engineering Council of South Africa (ECSA) for a recommendation and these were handled by its Committee on Professional Engineers for Dams.

A total of 172 applications were processed administratively on the strength of similar previous recommended approvals by ECSA and they were not again referred to ECSA for a recommendation. This task (administrative procedure) has now been simplified by the register of APPs, which provides for automatic approval on certain conditions. This register was implemented on 27 February 2014, after consultation with ECSA in terms of section 123(1)(a) of the National Water Act, 1998 (Act 36 of 1998) and regulation 46 of the dam safety regulations as promulgated on 24 February 2012 (Government Notice R. 139). The register was updated in August 2014 in terms of regulation 46(4).

Since 1987, 162 persons have been approved as APPs for dam "tasks". A total of 92 APPs are classified as still active. An analysis of the age profile of APPs is presented in Fig 2. The age of active APPs varies between 34 years and 80 years, with roughly 66% older than 60 years old and only 33% (about 30) younger than 60 years old. 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.

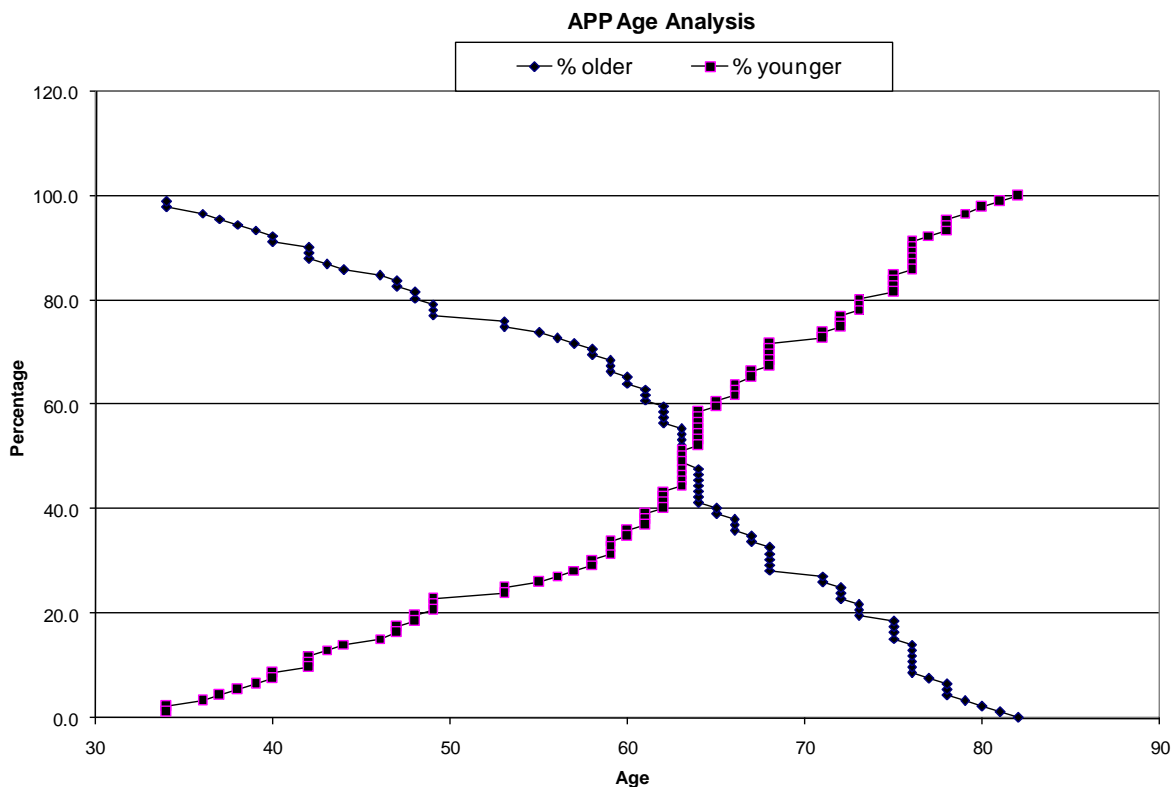


Figure 2: Age Analysis of APPs

9. UPGRADING OF EXISTING DAMS

The major rehabilitation programme by DWS’s Infrastructure Branch is continuing to make a significant contribution to upgrade the safety of existing DWS dams. Total annual expenditure during the last 7 years varied between R384 million and R220 million, following a downward trend. Reported challenges include the difficulty experienced by DWS’s construction unit to procure goods in time within the current supply chain management system, and the shortage of engineers. **Table 14** provides some statistics on progress showing that rehabilitation of roughly 50% of dams earmarked for major rehabilitation work have been completed. However, it should be borne in mind that the relatively easier projects have been completed first, as the more difficult ones require longer lead times of investigation, planning and design. The Infrastructure Branch has appointed PSPs to assist with the rehabilitation of 6 dams and it is expected that expenditure will start to follow an upward trend.

Table 14: Upgrading of safety at existing DWS dams

Description	Number of dams
Rehabilitated during last 10 years (dam safety betterments) (mechanical refurbishment still continuing at some dams)	39
Current rate of completion of rehabilitation (per year)	4
Major outstanding rehabilitation work	42

10.DAM SAFETY INCIDENTS

The DSO is keeping record of all major incidents at dams that are reported by means of an incident catalogue. The catalogue provides valuable statistics and details of the causes of dam incidents (including failures) that have occurred in South Africa. From the catalogue the major causes of dam failures are:

- Inadequate spillway capacity (46%);
- Piping through earthfill walls (19%);
- Failure through erosion of spillways and outflanking of weirs (14%).

Incidents at Dams

The following significant incident at a dam was reported to the DSO during 2014/15:

Table 15:

NAME OF DAM	LOCALITY NUMBER	HEIGHT(m)	CAPACITY('000 m ³)	CAT	INCIDENT OR DAMAGE
Sandspruit	V302/52(near Dundee, KZN)	10	800	1	Earthfill wall overtopped in January 2015 and was damaged but did not fail Incoming flood exceeded Q ₁₀₀ .

11. IMPLEMENTATION OF THE NEW DAM SAFETY REGULATIONS

Good progress has been made with implementation of the new provisions of dam safety regulations that were promulgated on 24 February 2012 (published in Government Notice R. 139 in English and in Government Notice R. 138 in Sepedi, both dated 24 February 2012). Two important improvements that have been implemented are:

- A register of Approved Professional Persons (APPs) for tasks at dams with a safety risk was implemented on 27 February 2014, after consultation with ECSA, in terms of section 123(1)(a) of the National Water Act, 1998 (Act 36 of 1998) and regulation 46 of the dam safety regulations. The register has significantly reduced the administrative task of considering applications and writing letters of approval for each and every task at dams.
- The requirements (and thereby the standard) for licence applications to construct/ alter/ enlarge/ repair category I dams were raised in the 2012-regulations. Prospective dam owners are effectively forced to obtain adequate technical help in order to compile the design report and engineering drawings, and this will have a positive impact on the safety of new Category I dams.

12. CONCLUSIONS AND RECOMMENDATIONS

A summary of the current state of dam safety in South Africa is given in the strategic business plan for the dam safety programme (DSP), attached as **Appendix A**. This strategic business plan also gives an indication of progress made since commencement with the DSP in 1987. In addition, recommendations to achieve the objectives of DSP by different key role players (not only the DSO) are included in the last column. The salient points relating to the current state of dam safety in South Africa are as follows:

- At the current rate, 99% of all registered dams should be classified by 2016 compared to the current estimate of 98%. It is expected that most Categories II and III dams are already registered, but there may still be a number of category 1 dams that have not been registered. Steps to improve on this statistic are proposed in the business plan. The DSO has started to use the WARMS database to identify unregistered dams.
- Most new Categories II and III dams with a safety risk are being built in accordance with appropriate safety standards. Proposed steps to further improve on the quality of the design and construction include training of the important role players. SANCOLD, through its annual courses and/or conferences, is assisting in this regard.
- Of the total of 2 191 Categories II and III dams, 1590 (72,6%) dams have already undergone the first round of evaluations (including inspections) by Approved Professional Persons/engineers. Most of the larger and more important dams have been inspected. Steps to ensure that all Categories II and III dams are inspected at regular intervals are proposed in the business plan.
- It is a requirement of the new dam safety regulations that all category II and III dam owners must have an O&M manual and emergency preparedness plan compiled by an APP when so instructed by the Director-General. At present only about 50% of these dam owners comply with this objective. In the business plan, steps to improve the standard of O&M at all dams with a safety risk are proposed.
- **Only an estimated 58% of the first 400 Categories II and III dams on the priority list comply with basic dam safety standards.** Steps to improve on this statistic are proposed in the business plan. Upgrading of the non-complying dams to appropriate safety standards remains a long-term task (until 2020 or later) and provisional targets are set on a prioritised basis in the business plan.
- **It is clear that a lot of work must still be done by several role players to bring the state of dam safety in South Africa to satisfactory levels.** The current rate of dam safety betterment work is slow but steady. The rehabilitation programme by DWS for DWS dams (see Table 14) is making an important contribution in this regard.
- Of the total "possible loss of life" for all dams on the list (4 329), approximately 69% is due to the first 100 dams and 81% due to the first 200 dams. It is clear that **special attention should be focused on the first 100 to 200 dams on the priority list** as they have the greatest potential impact on the public. Category II dams lower down on the priority list, should not be neglected.
- 78% of the top 100 dams on the priority list belong to DWS and the Municipalities as shown in Table 13. It should be possible for these major dam owners to obtain and budget adequate funds to upgrade and/or maintain these dams in pristine condition.
- **The most important shortcomings under the first 100 dams that need to be addressed in the short term are listed in Appendix B2 (and of DWS dams only in Appendix B3).**
- The total direct expenditure incurred in administration of the dam safety legislation at Head Office was R7 483 000 compared to R5 328 000 in the previous reporting year, i.e. an increase of 40,4%, mainly due to filling of critical vacant posts and cost of living increases.

The total direct expenditure is considered modest compared to the benefits derived from the dam safety programme.

- The filling of especially vacant technical posts remains a challenge and impacts negatively on the efficiency of the dam safety programme.

The following specific recommendations are made in order to maintain and preferably accelerate progress with the dam safety programme:

- The technical personnel component within the DSO should be maintained and preferably strengthened. The DSO has been unable to fill three vacant Chief Engineer posts over a long period of time.
- A detailed action plan to achieve the objectives of the dam safety programme is proposed in the last column of the strategic business plan in **Appendix A**.

APPENDIX A: STRATEGIC BUSINESS PLAN FOR DAM SAFETY PROGRAMME

Vision: That all dams with a safety risk shall comply with appropriate safety standards in order to minimize loss of life, damage to property and harm to the environment.

Responsibilities: The success of the dam safety programme depends on action by several role players: Firstly dam **owners** (including Infrastructure Branch within DWS [**DWS-IB**]), secondly various components within DWS (Dam Safety Office [**DSO**], Regional Offices [**RO**], Legal Services [**LS**]), Enforcement (**E**), thirdly Catchment Management Agencies (**CMA**), Disaster Management Structures [**DM**] and also SANCOLD.

Objectives (Key Performance Areas)	Short Term Targets	Current Status*	Possible actionplan to attain objectives (+Responsible Role Player in addition to DSO, where applicable)
That all dams* are <ul style="list-style-type: none"> registered classified 	99% dams* registered by 2016. <ul style="list-style-type: none"> 99% of reg. dams classified by 2016. 	<ul style="list-style-type: none"> 5102 ($\pm 98\%$-estimate) 5 029 (98,6% of 5 102) 	<ul style="list-style-type: none"> Register dams from WARMS database plus advertising campaign. (RO, CMA) Check by Google-Earth (RO, CMA) Introduce fines to owners for late registration? (LS/E)
2. That all new dams* are designed/ built / altered in accordance with appropriate standards.	95% by 2016 (measurement of quality of construction subjective, especially of Cat I dams)	$\pm 95\%$ for cat 2&3 (estimate allows for deficient quality of illegal dams) $\pm 75\%$ for cat 1 dams (APPs not involved)	<ul style="list-style-type: none"> Prevent illegal construction by e.g. air and road reconnaissance. (RO, CMA) Introduce fines? (LS/E) Training courses for APPs/contractors/ clerks of works? (SANCOLD) Improve control over cat I dams. (RO, CMA)
3. That all Cat II & III dams are inspected and evaluated by APPs* according to schedule and to current dam engineering standards.	1620 1 st evaluations by 2016. 80% of follow-up evaluations at required intervals by 2020.	1st 1590 Only $\pm 55\%$ of follow-up evaluations received at required interval in reporting year.	<ul style="list-style-type: none"> Accelerate instructions. Improve system of reminders, warnings, legal action, etc. (E) Inspection of some DWS dams should be contracted out. (DWS-IB) Training of APPs (SANCOLD)
4. That all dams* are operated & maintained in accordance with appropriate safety standards and that effective OMMs* and EPPs* are in place.	1200 OMMs & EPPs compiled for Cat II and III by 2016. Standard OMM & EPP issued for all Cat I dams by 2017.	± 1100 OMMs & EPPs for Cat II and III dams (accurate statistic not available yet – it was only recently provided for in database).	<ul style="list-style-type: none"> Instruct all Cat II and III dams to get OMMs & EPPs. (Owners) Regularly remind owners of above obligation. Compile a standard OMM & EPP for Cat I dams and issue. Motivate dam owners to keep up O&M by annual circular/letter. Implement Disaster Management Act. (DM)
5. That all dams* shall comply with appropriate safety standards (e.g. SANCOLD guidelines). Where necessary, dams must be upgraded to acceptable standards.	<u>According to order of priority list:</u> <ul style="list-style-type: none"> 1st 100 dams 80% by 2020 2nd 100 dams 70% by 2020 3rd 100 dams 70% by 2020 4th 100 dams 70% by 2020 80% of all Cat II & III dams by 2030 	<u>Basic* compliance:</u> <ul style="list-style-type: none"> 1st 100 dams 49% (50%) 2nd 100 dams 61% (60%) 3rd 100 dams 65% (68%) 4th 100 dams 57% (61%) Average (1 st 400) 58% (60%) (previous year in brackets)	<ul style="list-style-type: none"> Upgrade dams on prioritized basis. Focus on first 100-200 dams on priority list. (Owners) Send out motivational follow-up letters. Improve system of reminders, warnings, legal action, etc. (E) Training courses for APPs/contractors/ clerks of works? (APPs, SANCOLD) Budget R400 M+ per year for upgrading DWS dams. (DWS-IB)

*Notes: **APP** means approved professional person. **Basic compliance** means the probability of failure of a dam is estimated to be less than 0,05% (1/2000) and 0,5% (1/200) per year for category III and II dams respectively. **Dams** in this Table mean dams with a safety risk. **EPP** means emergency preparedness plan. **OMM** means O&M manual. **Current status** is the status as on 31 March 2015.

APPENDIX B: PRIORITISATION OF DAMS WITH A SAFETY RISK

APPENDIX B1: First 100 dams on list (10 pages)

Upon receipt of dam safety evaluation reports on categories I and II dams, a basic risk assessment is done and the priority of a dam is determined on the basis of its "possible loss of life during the lifespan of the dam", taken as 100 years. There is a time lag before the list is updated after completion of the dam safety betterment work, as the next dam safety evaluation is only done 3-5 years thereafter. There are currently **1464** dams on the full list.

APPENDIX B2: Dams under first 100 on list requiring urgent attention (55 dams)

As **Appendix B1** but without dams that have been rehabilitated recently and without dams that are considered to comply with basic safety standards (annual probability of failure less than 1/200 for Category II dams and less than 1/2000 for Category III dams). Some dams in **Appendix B1** appear high on the list because of their massive size and high theoretical hazard potential although they comply with appropriate safety standards. These dams have been omitted in **Appendix B2**. **Dams on this list should receive urgent attention because their annual probability of failure is considered to be too high.** Some of the dams on this list may require further investigations or reappraisal of their risks only.

APPENDIX B3: As Appendix B2 but only for DWS dams (23 dams)

Of these dams on this list, most are already in the investigation, planning, tender, design or construction phases for upgrading work.

LEGEND FOR PRIORITY LIST:

PF	<i>Probability of failure during lifespan of dam</i>
LL	<i>Hazard potential in terms of loss of life</i>
EL	<i>Possible loss of life during lifespan of dam based on worst case scenario (e.g. failure during night and slow evacuation)</i>
AL	<i>Reduction factor for good O&M and EPP</i>
N	<i>Lifespan of dam (assumed as 100 years)</i>
T	<i>Average "recurrence period (years) between failures"</i>
1/T	<i>Annual probability of failure</i>
EPP	<i>Emergency preparedness plan</i>
Sector	<i>A (Agriculture), M (Municipal), W (DWS), S (State departments excluding DWS), O (Industry, Mines, Business)</i>

The following guideline is used to determine intervals between dam safety evaluations (shown in the last column of Appendix B):

EL	Intervals between dam safety evaluations (years)
<0,5	10
0,5 to 2	9
2 to 10	8
10 to 20	7
20 to 50	6
>50	5

APPENDIX B1

No.	Sector	Loc. No.	Name of dam	Category						EPP (Y/N)	Status/Progress	DSI Interval (years)	
					Major risk aspect	Action to be taken	T(years)	PF	LL				AL
1	M(W)	N120/01	NQWEBA DAM	3								5	
					Structural Stability	Feasibility study to rehabilitate	0 200	0.000 0.394	0 1125	0 0.7	310.5		DWA to take over Dam
2	W	W440/01	PONGOLAPOORT DAM	3								5	
					Spillway Capacity Structural Stability	Investigate further. Operate at reduced FSC(66%). Investigate	5000 5000	0.020 0.020	6600 6600	0.7 0.7	181.2		N Programmed for 2009 Programmed for 2010
3	M	B100/04	WITBANK DAM	3								5	
					Spillway	* Investigate and improve (gated spillway)	200	0.394	350	1	177.7		Y Programmed for...?
					Structure	Monitor Pendulums, cracking, Concrete corrosion	1000	0.095	350	1			Programmed for...?
			Poor O&MM	Improve O&MM	1000	0.095	350	1		Programmed for...?			
4	M	B100/13	MIDDELBURG DAM	3								5	
					Spillway Structure	Investigate options (overtopping spillway) None except when overtopping	3000 10000	0.033 0.010	6000 6000	0.5 0.5	127.2		Y Ongoing Adequate
5	W	H800/03	DUIVENHOKS DAM	3								5	
					Spillway capacity Structural stability	None necessary (a) Investigate stability (b) Stabilize left abutment	2000 100	0.049 0.634	100 200	1 1	126.8		Y Adequate
6	W	C300/02	WENTZEL DAM	2								5	
					Spillway Structure	*Detailed investigation and improve None, but monitoring essential	133 1000	0.530 0.095	312 312	0.7 0.7	125.5		N Rehabilitation completed but report outstanding Adequate
7	W	J330/01	STOMPDRIFT DAM	3								5	
					Spillway Structure	* Increase spillway capacity * Improve structural adequacy	111 200	0.595 0.394	100 200	0.8 1	96.5		Y Programmed for 2009/10 Programmed for 2009/10
8	W	B310/05	RHENOSTERKOP DAM	3								5	
					Spillway	Investigate further	5000	0.020	4000	0.7	82.8		N Adequate
					Structure	Do survey of saddle dam	10000	0.010	4000	0.7			Programmed for 3/97. Outstanding
			No O&MM and EPP	Compile	0	0.000	0	0		Programmed for 3/98. Outstanding			
9	W	A210/01	ROODEKOPJES DAM	3								5	
					Spillway gate malfunction Structure	Regular Mechanical Maintenance	1000 2000	0.095 0.049	500 900	1 0.8	80.1		N
10	M	M100/01	GROENDAL DAM	3								5	
					Spillway Structure	None None	2000 2000	0.049 0.049	1000 1000	0.7 0.7	66.6		Y Adequate Adequate

No.	Sector Major risk aspect	Loc. No.	Name of dam Action to be taken	Category T(years)	PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)
11	W Spillway Structure	C801/10	STERKFORTEIN	3	2000 5000	0.049 0.020	1350 2700	0.5 0.5	58.8	Y	5
12	W Spillway Structure	C120/01	VAAL DAM None None	3	2000 10000	0.049 0.010	1600 1600	0.6 0.6	55.9	Y Adequate Adequate	5
13	W Spillway Structure	C520/02	KRUGERSDRIFT None None	3	2000 2000	0.049 0.049	930 930	0.6 0.6	53.1	Y Adequate Adequate	5
14	A Spillway Capacity Structural Stability Piping	G401/AM	SPIOENKOP None necessary * Repair cracking Permanent monitoring	3	10000 50 50	0.010 0.867 0.867	20 40 60	0.8 0.9 1	52.0	Y Adequate Programmed for...?	5
15	W Spillway Structure	U200/01	ALBERTFALLS DAM * Improve the spillway capacity Monitor seepage	3	1500 5000	0.065 0.020	1200 1200	0.5 0.5	49.8	Y Programmed for 2007/8 Adequate	6
16	W Spillway Structure - stability	N230/01	DARLINGTON DAM Investigate and improve	3	250 2000	0.330 0.049	60 608	1 0.9	44.5	Y	6
17	W Spillway Structure No O&MM and EPP Spillway gate operation (human error)	E100/02	CLANWILLIAM DAM None Rehabilitation Compile and improve EPP Remove spillway gates - rehabilitation.	3	10000 1000 0 100	0.010 0.095 0.000 0.634	76 76 0 76	0.8 0.8 0 0.8	40.8	Y Adequate Inadequate.Programmed for 2015-17 Programmed for 2017 Programmed for 2015-17	6
18	W Spillway Structure No O&MM and EPP	A300/03	KLEIN MARICOPOORT *Improve spillway None, except monitoring Compile	3	500 1000 0	0.181 0.095 0.000	126 206 0	1 1 0	39.8	N Programmed for 2007/8 & 2008/9 Adequate Programmed for 2007/8	6
19	W Spillway Structure	R300/01	NAHOON DAM None None	3	2000 1000	0.049 0.095	400 400	0.7 0.7	39.0	Y Adequate Adequate	6
20	W Spillway Structure	C520/04	GROOTHOEK DAM (MOU) None None	3	5000 10000	0.020 0.010	1870 1870	0.7 0.7	38.7	Y Adequate Adequate	6

No.	Sector Major risk aspect	Loc. No.	Name of dam Action to be taken	Category T(years)	PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)
21	M	C221/45	ORLANDO POWER STAT 2						Y		6
	Spillway			200	0.394	9	1	35.8			
	Structure		Rehabilitate NOC & Slopes	20	0.994	9	4				
22	S	X103/50	MBAMBISO DAM	3					Y		6
	Spillway		Confirm / analyse spillway discharge capacity.	5000	0.020	40	1	34.9		Adequate	
	Structure		Maintenance must be done.	5000	0.020	40	1			Adequate	
			Relocate water supply pressure pipeline or Investigate and relocate.	50	0.867	40	1			Programmed for ...?	
23	W	B200/01	BRONKHORSTSPRUIT DA	3					N		6
	Spillway capacity		Inspect apron area	10000	0.010	1740	1	34.5		Programmed for...?	
	Structural stability		Carry out FEA	10000	0.010	1740	1			Programmed for...?	
24	W	A900/03	ALBASINI DAM	3					Y		6
	Spillway		Must be improved.	200	0.394	100	0.8	33.9		Programmed for 2012	
	Structure		Post-stressed cables must be monitored,investigate	2000	0.049	100	0.8			Programmed for ...?	
25	W	R101/01	CATA DAM	3					N		6
	Spillway			6000	0.017	750	0.7	33.9			
	Structure			2000	0.049	750	0.7				
26	W	R101/03	MNYAMENI DAM	3							6
	Spillway Capacity		* Improve	200	0.394	80	1	31.5			
	Structural Stability			0	0.000	0	0				
	O & MM			0	0.000	0	0				
27	M	C601/01	BLOEMHOEK DAM	3					Y		6
	Spillway			6000	0.017	300	0.9	29.7			
	Piping		Monitor drainage system.	1000	0.095	300	0.9				
28	W	C230/04	BOSKOP DAM	3					Y		6
	Spillway capacity			2000	0.049	519	0.6	29.6		Adequate	
	Structural capacity		Low due to poor maintenance + sinkholes.	2000	0.049	519	0.6			Adequate	
29	B	X100/22	DRIEKOPPIES DAM	3					Y		6
	Spillway Capacity		None	10000	0.010	2000	0.5	29.6		Adequate	
	Structural Stability - piping potential		Monitoring	5000	0.020	2000	0.5			Adequate	
30	W	B402/35	DER BROCHEN DAM	3					Y		6
	Spillway capacity: Cavities beneath spillwa		Improve spillwal against erosion	50	0.867	30	1	26.2		Programmed for...?	
	Structural stability		Monitoring essential	2000	0.049	30	1			Adequate	

No.	Sector	Loc. No.	Name of dam	Category	PF	LL	AL	EL(total)	EPP (Y/N)	DSI Interval (years)
	Major risk aspect		Action to be taken	T(years)					Status/Progress	
31	W	A210/02	HARTBEESPOORT DAM	3					Y	6
	Spillway		Routed flood that can be handled before overtopping	1000	0.095	323	0.7	23.6		Programmed for ...?
	Structure		None	10000	0.010	323	0.7			Adequate
32	M	D200/18	SMITHFIELD DAM	3						6
	Spillway Capacity			200	0.394	60	0.9	21.3		
	Structural Stability			0	0.000	0	0			
	O & MM			0	0.000	0	0			
33	M	A600/06	DONKERPOORT DAM	3					Y	6
	Spillway capacity		Investigate + improve	200	0.394	100	0.5	21.2		Programmed for ...?
	Structural stability		Investigate	2000	0.049	100	0.5			Programme for...?
34	W	K100/09	KLIPHEUWEL DAM	3					Y	6
	Spillway capacity		None	5000	0.020	30	0.5	20.8		Adequate
	Structural stability: Dispersive soil		Inspect outlet pipe by vidu camera	50	0.867	30	0.8			Programmed for?...?
35	W	B800/02	EBENEZER DAM	3					Y	6
	Spillway		*Investigate further.	200	0.394	43	0.5	20.6		Programmed for ...?
	Structure		*Install safe seepage monitoring system.	1000	0.095	43	0.5			Programmed for ...?
	Potential clogging of shaft spillway.		*Install structure to prevent clogging.	50	0.867	43	0.5			Programmed for ...?
36	A	H402/AC	STETTYN NO. 5 DAM	3						6
	Spillway Capacity			500	0.181	12	1	20.5		
	Structural Stability			500	0.181	112	1			
	O & MM			0	0.000	0	0			
37	W	A601/42	VAALKOP NO.II-DAM	2					N	7
	Spillway		*Improve	100	0.634	20	1	20.0		Programmed for ...?
	Structure		*Improve	20	0.994	20	1			Programmed for ...?
38	A	G401/65	GEELBOS DAM	2					Y	7
	Spillway		None	50	0.867	20	1	19.0		Adequate
	Structure		None	100	0.634	20	1			Adequate
39	A	G402/79	HOUOED DAM	2						7
	Spillway Capacity		Increase spillway capacity	50	0.867	20	1	18.4		
	Structural Stability			200	0.394	20	1			
	O & MM			0	0.000	0	0			
40	W	B800/29	MIDDEL LETABA DAM	3					N	7
	Spillway capacity		Investigate by model study	1000	0.095	100	0.7	18.2		Programmed for ???
	Structural stability		Re-evaluate stability and improve monitoring	500	0.181	100	0.7			Programmed for ???

No.	Sector Major risk aspect	Loc. No.	Name of dam Action to be taken	Category T(years)	PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)
41	M	S300/10	BONGOLO DAM	3					Y		7
	Spillway capacity			2000	0.049	600	0.6	17.9		Adequate	
	Structural stability			100000	0.001	600	0.6			Adequate	
42	M	A211/58	RIETVLEI DAM	3					Y		7
	Spillway		None	10000	0.010	500	0.6	17.5		Adequate	
	Structure		None	2000	0.049	500	0.6			Adequate	
43	M	C212/44	MIDDLE LAKE DAM	2					Y		7
	Spillway capacity .			150	0.488	20	1	17.2			
	Structure stability.			1000	0.095	20	1				
	Lack of maintenance.			100	0.634	20	1				
44	A	A220/02	OLIFANTSNEK DAM	3					Y		7
	Spillway		None	2000	0.049	292	0.6	16.7		Adequate	
	Structure		None	2000	0.049	292	0.6			Adequate	
45	W	S302/35	SHILOH DAM-CISKEI	3					N		7
	Spillway		None	2000	0.049	250	0.7	16.7		Adequate	
	Structure		None	2000	0.049	250	0.7			Adequate	
	No O&MM and EPP		Compile	0	0.000	0	0			Programmed for 2007/8	
46	W	H300/02	PIETERSFONTEIN DAM	3					Y		7
	Spillway		None necessary	1000	0.095	210	0.7	15.8		Adequate	
	Structure		None necessary	10000	0.010	280	0.7			Adequate	
47	W	S300/16	THRIFT DAM (MOUNTHOF	2					Y		7
	Spillway		Investigate and improve	500	0.181	100	0.8	15.2		Outstanding	
	Structure		None	10000	0.010	100	0.8			Adequate	
48	W	J250/01	GAMKAPOORT DAM	3					Y		7
	Spillway		None	10000	0.010	300	0.8	15.1		Adequate	
	Structure		None	3333	0.030	543	0.8			Adequate	
49	O	X201/68	NGODWANA DAM	3					N		7
	Spillway		Adequate, but erosion should be monitored	10000	0.010	1000	0.5	14.8		Adequate	
	Structure		Adequate, but monitoring essential	5000	0.020	1000	0.5			Adequate	
50	M	G100/13	WEMMERSHOEK DAM	3					N		7
	Spillway		None	18182	0.005	2000	0.7	14.6		Adequate	
	Structure		None	10000	0.010	1000	0.7			Adequate	

No.	Sector Major risk aspect	Loc. No.	Name of dam Action to be taken	Category T(years)	PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)
51	W Spillway Structure	J340/02	KAMMANASSIE DAM None * Unblock/ clean pressure relief holes	3	1000 200	0.095 0.394	30 50	0.7 0.7	14.6	Y Adequate	7
52	M Spillway Structure	B100/09	ATHLONE DAM Improve	2	50 100	0.867 0.634	15 15	1 1	14.3	Y	7
53	M Spillway Structure	U401/08	LAKE MERTHLEY Investigate & wall stability * Investigate integrity of post stressed bables	2	1000 100	0.095 0.634	21 21	1 1	14.0	N Programmed for ??? Programmed for ???	7
54	W Spillway Capacity Structural Stability	H300/01	POORTJIESKLOOF DAM None None	3	1000 2000	0.095 0.049	40 400	0.6 0.6	13.5	Y Adequate	7
55	M Spillway capacity Structurural stability	B100/12	PIENAAR DAM Improve	2	100 100	0.634 0.634	15 15	1 1	13.0	Y Programmed for...? Adequate	7
56	W Spillway Structure Internal erosion.Leaching sand from found	H200/07	ROODE ELSBERG DAM None Structural analysis & risk analysis Monitor	3	10000 2000 200	0.010 0.049 0.394	50 50 50	0.6 0.6 0.6	12.9	N Adequate Programmed for 2010 Ongoing	7
57	W Spillway Structure	L300/01	BEERVLEI DAM None None	3	200 2000	0.394 0.049	41 41	0.7 0.7	12.2	N Adequate Adequate	7
58	W Spillway Capacity Structural Stability	V700/01	WAGENDRIFT DAM Check freeboard and spillway length Install monitoring instruments	3	2000 2000	0.049 0.049	250 250	0.5 0.5	11.9	Y Programmed for 2008 Programmed for 2008	7
59	W Spillway Structure No O&MM and EPP	D310/01	VANDERKLOOF DAM Monitoring Monitoring Compile	3	10000 80000 0	0.010 0.001 0.000	1500 1500 0	0.7 0.7 0	11.7	N Adequate Adequate Programmed for 2007	7
60	A Spillway Structure	J250/02	CALITZDORP DAM None necessary Investigate stability	3	2000 1000	0.049 0.095	50 100	1 1	11.6	Y	7

No.	Sector Major risk aspect	Loc. No.	Name of dam Action to be taken	Category T(years)	PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)
61	A	G101/AH	PARYS DAM	3					Y		7
	Spillway Capacity		None	500	0.181	20	0.8	11.3		Adequate	
	Structural Stability		None	10000	0.010	30	0.8			Adequate	
	O & MM			0	0.000	0	0				
	Erosion of spillway lining (reo mattresses) * Repair			100	0.634	20	0.8			Programmed for 2006/7	
62	W	S302/33	GLENBROCK DAM	3					Y		7
	Spillway Capacity		* Improve	100	0.634	21	0.8	11.2		Programmed for 2008	
	Structural Stability		None	1000	0.095	21	0.8			Programmed for 2008	
63	W	U200/04	INANDA DAM	3					Y		7
	Spillway		None	10000	0.010	1000	0.5	11.1		Adequate	
	Structure - foundation		RF Foundation jointed with weathering of joints	8000	0.012	1000	0.5			Adequate	
64	W	A901/42	DAMANI DAM	3					N		7
	Spillway		Adequate	1000	0.095	60	1	10.9		Adequate	
	Structure		Adequate	1000	0.095	60	1			Adequate	
	No O&MM and EPP		Compile	0	0.000	0	0			Outstanding	
65	A	U700/11	BEAULIEU DAM	3					N		7
	Spillway capacity		Reinstate NOCL	500	0.181	62	0.5	10.2		Programmed for...?	
	Structural stability		Monitoring essential	500	0.181	62	0.5			Adequate	
66	M	G204/65	DRIFTSANDS STORMWA ^T	2					Y		7
	Spillway		None	1000	0.095	106	1	10.1		Adequate	
	Structure		None	10000	0.010	5	1			Adequate	
67	M	Q920/04	ANDREW TURPIN DAM	2					Y		8
	Spillway		Investigate and Increase.	20	0.994	10	1	9.9			
	Structure			10000	0.010	6	0.9				
68	A	B401/33	LEEUKWKLIP DAM	2					N		8
	Spillway		*Enlarge / abandon	50	0.867	10	1	9.8		Programmed for 2004 Outstanding	
	Structure		*Improve / abandon	50	0.867	10	1			Programmed for 2004 Outstanding	
	No O&MM and EPP		Compile	0	0.000	0	0			Programmed for 2004 Outstanding	
69	W	B502/23	CHUNIESPOORT DAM	2					N		8
	Spillway		Investigate and improve	200	0.394	9	1	9.8		Programmed for 2007 - 2008	
	Structure		No drain - investigate dispersiveness	200	0.394	9	1			Programmed for 2007 - 2008	
	Outletpipe		*Investigate founding conditions	50	0.867	9	1			Programmed for 2007 - 2008	
	O&M Manual		Compile	0	0.000	0	0			Outstanding	
70	A	C240/05	JOHAN NESER DAM (KLE	2					Y		8
	Spillway		Cost Benefit / Risk Analysis	200	0.394	30	0.8	9.6			
	Structure			10000	0.010	30	0.8				

No.	Sector Major risk aspect	Loc. No.	Name of dam Action to be taken	Category T(years)	PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)
71	M	D120/02	KLOOF DAM	3							8
					100	0.634	15	1	9.5		
					0	0.000	0	0			
					0	0.000	0	0			
72	W	Q940/01	KATRIVIER DAM	3					Y		8
			Can take RMF + no apron protection	2000	0.049	82	0.8	9.1		Adequate	
			* Improve stability	1000	0.095	82	0.8			Programmed for 2012/3 & 2013/4	
				0	0.000	0	0				
73	W	A220/07	BOSPOORT	3					Y		8
			*Inadequate. Enlarge spillway capacity	200	0.394	20	1	9.0		Programmed for 2008/9 & 2010/1	
			None	1000	0.095	20	1			Programmed for 2008/9 & 2010/1	
			Compile O&MM and update EPP	0	0.000	0	0			Programmed for 2007/8	
74	M	H402/66	MCGREGOR-NUWE DAM	2					Y		8
			None	10000	0.010	8	1	8.9		Adequate	
			None	500	0.181	10	1			Adequate	
			Monitoring	50	0.867	10	1			Ongoing	
75	A	J340/08	EZELJACHT DAM	3					Y		8
			None	100000	0.001	5	0.6	8.9		Adequate	
			*Investigation to determine "safe operating level"	100	0.634	20	0.7			Programmed for 2006/7 & 2007/8	
76	W	B320/01	LOSKOP DAM	3					N		8
			None	10000	0.010	500	0.6	8.9		Adequate	
			*Monitoring essential / Improve drainage	5000	0.020	500	0.6			Adequate	
			Compile	0	0.000	0	0			Outstanding	
77	M	Q800/13	BESTERSHOEK DAM	2							8
				2000	0.049	10	1	8.7			
				50	0.867	10	1				
78	A	A213/52	HIPPO DAM	2					N		8
				50	0.867	10	1	8.7			
				0	0.000	0	0				
79	W	C900/07	BLOEMHOF DAM	3					N		8
			None necessary	10000	0.010	50	0.8	8.3		Adequate	
			None necessary	10000	0.010	50	0.8			Adequate	
			Improve skills and knowledge during emergency (flo	1000	0.095	100	0.8				
80	M	S401/05	KOCH DAM	2					Y		8
			*Recently improved	20	0.994	9	0.9	8.1		Still need to be verified	
			None	1000	0.095	9	0.9			Adequate	

No.	Sector	Loc. No.	Name of dam	Category	PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)
	Major risk aspect		Action to be taken	T(years)							
81	M	D540/01	VANWYKSVLEI	2					Y		8
	Spillway Capacity		None	2000	0.049	5	0.8	8.0		Adequate	
	Structural Stability		None	1000	0.095	10	0.9			Adequate	
	Piping due to animal burrows.		* Maintenance and monitoring	100	0.634	14	0.9			Ongoing	
82	W	D350/02	GARIEP DAM	3					Y		8
	Spillway		Monitoring	100000	0.001	5000	0.8	8.0		Adequate	
	Structure		Monitoring	100000	0.001	5000	0.8			Adequate	
83	S	B800/25	LORNA DAWN DAM	2					Y		8
	Spillway capacity		Monitor erosion	2000	0.049	9	1	7.9		Ongoing	
	Structural stability		Monitor seepage	2000	0.049	9	1			Ongoing	
	Strong leak at RF		Repair	50	0.867	9	1			Programmed for...?	
84	A	D320/01	KRIEGERSPOORT	2							8
	Spillway Capacity			200	0.394	20	1	7.9			
	Structural Stability			0	0.000	0	0				
	O & MM			0	0.000	0	0				
85	A	B501/17	UPPER GOMPIES DAM	2					N		8
	Spillway		*Investigate / improve	50	0.867	9	1	7.9		Programmed for 2007	
	Structure		None	2000	0.049	9	1			Adequate	
	No O&MM and EPP		Compile	0	0.000	0	0			Outstanding	
86	M	B100/16	KRUGER DAM	2					Y		8
	Spillway Capacity		Improve	50	0.867	8	1	7.9		Programmed for...?	
	Structural Stability (Toe are wet)		Berm + subsurface toe drain	50	0.867	8	1			Programmed for...?	
87	W	W120/01	GOEDERTROUW DAM	3					Y		8
	Spillway capacity		Monitor erosion	5000	0.020	400	0.5	7.8		Adequate	
	Structural stability			5000	0.020	400	0.5			Adequate	
88	M	C221/26	HAMBERG	2					Y		8
	Spillway Capacity		Raise crest by 300mm	50	0.867	9	1	7.8			
				0	0.000	0	0				
89	W	B502/06	LEPELLANE DAM	2					N		8
	Spillway		Improve	200	0.394	9	1	7.8			
	Structure		Install Toe Drain	500	0.181	9	1				
	Outlet Pipe out of order		Seal Outlet Pipe	100	0.634	9	1				
90	O	C221/70	FLEURHOF DAM	2							8
	Spillway Capacity			100000	0.001	12	1	7.6			
	Structural Stability		* Investigate and improve	100	0.634	12	1				
	O & MM			0	0.000	0	0				

No.	Sector	Loc. No.	Name of dam	Category	PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)
	Major risk aspect		Action to be taken	T(years)							
91	M	G400/21	MOSSEL RIVER DAM	3					Y		8
	Spillway		*Increase spillway capacity	500	0.181	50	0.8	7.6		Investigation to start 6/2000	
	Structure		None	3000	0.033	20	0.8			Adequate	
92	O	A215/61	EASTERN PLATINUM MIN	2					N		8
	Spillway Capacity		None	200	0.394	31	0.6	7.3		Adequate	
	Structural Stability		None	10000	0.010	6	0.6			Adequate	
	O & MM		Compile	0	0.000	0	0			Programmed for 2006	
93	W	L820/01	KOUGA DAM (PAUL SAU)	3					Y		8
	Spillway		None	10000	0.010	100	0.7	7.3		Adequate	
	Structure		None	1000	0.095	100	0.7			Ongoing monitoring	
94	W	B501/14	MAHLANGU DAM	2					N		8
	Spillway		None	2000	0.049	8	1	7.1		Adequate	
	Structure		Monitor	1000	0.095	8	1			Adequate	
	Pipeline burried in damwall		*Relocate / monitor	50	0.867	8	1			Programmed for 2006 - 2008	
95	W	C700/05	WELTEVREDE DAM	2					N		8
	Spillway		*Investigate	50	0.867	9	0.8	7.1		Programmed for ...?	
	Structure		*Leakage along RHS pipe	50	0.867	9	0.8			Programmed for ...?	
	No O&MM and EPP		Compile	0	0.000	0	0			Programmed for ...?	
96	A	E201/CL	KLOOF DAM	2							8
	Spillway Capacity		Remove sandbags	10	1.000	7	1	7.0			
	Structural Stability			0	0.000	0	0				
	O & MM			0	0.000	0	0				
97	W	A804/04	NWANEDZI	3					N		8
	Spillway		Investigate erosion potetial during overtopping	2000	0.049	50	1	7.0		Programmed for 2007/8	
	Structure		*Do structural and foundation analysis	1000	0.095	50	1			Programmed for 2007/8	
	No O&MM and EPP		Compile	0	0.000	0	0			Outstanding	
98	A	G200/06	BLUEGUM DAM	3					Y		8
	Spillway		None necessary	5000	0.020	100	0.6	6.9		Adequate	
	Structure		None necessary	2000	0.049	200	0.6			Adequate	
99	M	C212/46	KLEINFONTEIN DAM	2					N		8
	Spillway		None	50	0.867	8	1	6.9		Adequate	
	Structure		None	2000	0.049	2	0.6			Adequate	
	No O&MM and EPP		Compile	0	0.000	0	0			Programmed for ???	
100	W	B501/11	FLAG BOSHIELO	3					Y		8
	Spillway capacity		None	10000	0.010	500	0.7	6.9		Adequate	
	Structura stability		None	10000	0.010	500	0.7			Adequate	

APPENDIX B2 (Update of Appendix B1 and only dams not complying with basic standards)

No.	Sector	Loc. No.	Name of dam	Category	EPP					Status/Progress	DSI Interval (years)
					T(years)	PF	LL	AL	EL(total)		
	Major risk aspect		Action to be taken								
1	M(W)	N120/01	NQWEBA DAM	3	0	0.000	0	0	310.5		5
	Structural Stability		Feasibility study to rehabilitate	200	0.394	1125	0.7			DWA to take over Dam	
2	W	W440/01	PONGOLAPOORT DAM	3						N	5
	Spillway Capacity		Investigate further. Operate at reduced FSC(66%).	5000	0.020	6600	0.7	181.2		Programmed for 2009	
	Structural Stability		Investigate	5000	0.020	6600	0.7			Programmed for 2010	
3	M	B100/04	WITBANK DAM	3						Y	5
	Spillway		* Investigate and improve (gated spillway)	200	0.394	350	1	177.7		Programmed for...?	
	Structure		Monitor pendulums, cracking, concrete corrosion.	1000	0.095	350	1			Programmed for...?	
	Poor O&MM		Improve O&MM	1000	0.095	350	1			Programmed for...?	
5	W	H800/03	DUIVENHOKS DAM	3						Y	5
	Spillway capacity		None necessary	2000	0.049	100	1	126.8		Adequate	
	Structural stability		(a) Investigate stability (b) Stabilize left abutment	100	0.634	200	1				
9	W	A210/01	ROODEKOPJES DAM	3						N	5
	Spillway gate malfunction		Regular Mechanical Maintenance	1000	0.095	500	1	80.1			
	Structure			2000	0.049	900	0.8				
14	A	G401/AM	SPIOENKOP	3						Y	5
	Spillway Capacity		None necessary	10000	0.010	20	0.8	52.0		Adequate	
	Structural Stability		* Repair cracking	50	0.867	40	0.9			Programmed for...?	
	Piping		Permanent monitoring	50	0.867	60	1				
16	W	N230/01	DARLINGTON DAM	3						Y	6
	Spillway		Investigate and improve	250	0.330	60	1	44.5			
	Structure - stability			2000	0.049	608	0.9				
17	W	E100/02	CLANWILLIAM DAM	3						Y	6
	Spillway		None	10000	0.010	76	0.8	40.8		Adequate	
	Structure		Rehabilitation	1000	0.095	76	0.8			Inadequate. Programmed for 2015-17	
	No O&MM and EPP		Compile and improve EPP	0	0.000	0	0			Programmed for 2017	
	Spillway gate operation (human error)		Remove spillway gates - rehabilitation.	100	0.634	76	0.8			Programmed for 2015-17	
19	W	R300/01	NAHOON DAM	3						Y	6
	Spillway		None	2000	0.049	400	0.7	39.0		Adequate	
	Structure		None	1000	0.095	400	0.7			Adequate	
21	M	C221/45	ORLANDO POWER STAT 2							Y	6
	Spillway			200	0.394	9	1	35.8			
	Structure		Rehabilitate NOC & Slopes	20	0.994	9	4				

No.	Sector	Loc. No.	Name of dam	Category					EPP		DSI Interval
	Major risk aspect		Action to be taken	T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
22	S	X103/50	MBAMBISO DAM	3					Y		6
	Spillway		Confirm / analyse spillway discharge capacity.	5000	0.020	40	1	34.9		Adequate	
	Structure		Maintenance must be done.	5000	0.020	40	1			Adequate	
	Relocate water supply pressure pipeline or		Investigate and relocate.	50	0.867	40	1			Programmed for ...?	
24	W	A900/03	ALBASINI DAM	3					Y		6
	Spillway		Must be improved.	200	0.394	100	0.8	33.9		Programmed for 2012	
	Structure		Post-stressed cables must be monitored,investigate	2000	0.049	100	0.8			Programmed for ...?	
26	W	R101/03	MNYAMENI DAM	3							6
	Spillway Capacity		* Improve	200	0.394	80	1	31.5			
	Structural Stability			0	0.000	0	0				
	O & MM		Compile manual and improve O&M	0	0.000	0	0				
27	M	C601/01	BLOEMHOEK DAM	3					Y		6
	Spillway			6000	0.017	300	0.9	29.7			
	Piping		Monitor drainage system.	1000	0.095	300	0.9				
30	W	B402/35	DER BROCHEN DAM	3					Y		6
	Spillway capacity: Cavities beneath crest		Improve spillwal against erosion	50	0.867	30	1	26.2		Programmed for...?	
	Structural stability		Monitoring essential	2000	0.049	30	1			Adequate	
31	W	A210/02	HARTBEESPOORT DAM	3					Y		6
	Spillway		Routed flood that can be handled before overtopping	1000	0.095	323	0.7	23.6		Programmed for ...?	
	Structure		None	10000	0.010	323	0.7			Adequate	
32	M	D200/18	SMITHFIELD DAM	3							6
	Spillway Capacity			200	0.394	60	0.9	21.3			
	Structural Stability			0	0.000	0	0				
	O & MM		Compile	0	0.000	0	0				
33	M	A600/06	DONKERPOORT DAM	3					Y		6
	Spillway capacity		Investigate + improve	200	0.394	100	0.5	21.2		Programmed for ...?	
	Structural stability		Investigate	2000	0.049	100	0.5			Programme for...?	
35	W	B800/02	EBENEZER DAM	3					Y		6
	Spillway		*Investigate further.	200	0.394	43	0.5	20.6		Programmed for ...?	
	Structure		*Install safe seepage monitoring system.	1000	0.095	43	0.5			Programmed for ...?	
	Potential clogging of shaft spillway.		*Install structure to prevent clogging.	50	0.867	43	0.5			Programmed for ...?	
36	A	H402/AC	STETTYN NO. 5 DAM	3							6
	Spillway Capacity			500	0.181	12	1	20.5			
	Structural Stability			500	0.181	112	1				
	O & MM		Compile								

No.	Sector	Loc. No.	Name of dam	Category					EPP		DSI Interval
	Major risk aspect		Action to be taken	T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)
37	W	A601/42	VAALKOP NO.II-DAM	2					N		7
	Spillway Structure		*Improve	100	0.634	20	1	20.0		Programmed for ...?	
			*Improve	20	0.994	20	1			Programmed for ...?	
38	A	G401/65	GEELBOS DAM	2					Y		7
	Spillway Structure		Improve	50	0.867	20	1	19.0			
			Monitor	100	0.634	20	1			Adequate	
39	A	G402/79	HOUMOED DAM	2							7
	Spillway Capacity		Increase spillway capacity	50	0.867	20	1	18.4			
	Structural Stability			200	0.394	20	1				
	O & MM		Compile	0	0.000	0	0				
40	W	B800/29	MIDDEL LETABA DAM	3					N		7
	Spillway capacity		Investigate by model study	1000	0.095	100	0.7	18.2		Programmed for ???	
	Structural stability		Re-evaluate stability and improve monitoring	500	0.181	100	0.7			Programmed for ???	
43	M	C212/44	MIDDLE LAKE DAM	2					Y		7
	Spillway capacity .		Investigate/Improve	150	0.488	20	1	17.2			
	Structure stability.			1000	0.095	20	1				
	Lack of maintenance.		Improve	100	0.634	20	1				
52	M	B100/09	ATHLONE DAM	2					Y		7
	Spillway Structure		Improve	50	0.867	15	1	14.3			
				100	0.634	15	1				
53	M	U401/08	LAKE MERTHLEY	2					N		7
	Spillway Structure		Investigate & wall stability	1000	0.095	21	1	14.0		Programmed for ???	
			* Investigate integrity of post stressed cables	100	0.634	21	1			Programmed for ???	
55	M	B100/12	PIENAAR DAM	2					Y		7
	Spillway capacity		Improve	100	0.634	15	1	13.0		Programmed for...?	
	Structurural stability			100	0.634	15	1			Adequate	
56	W	H200/07	ROODE ELSBERG DAM	3					N		7
	Spillway Structure		None	10000	0.010	50	0.6	12.9		Adequate	
			Structural analysis & risk analysis	2000	0.049	50	0.6			Programmed for 2010	
	Internal erosion.Leaching sand from found		Monitor	200	0.394	50	0.6			Ongoing	
57	W	L300/01	BEERVLEI DAM	3					N		7
	Spillway Structure		Investigate	200	0.394	41	0.7	12.2		Adequate	
			None	2000	0.049	41	0.7			Adequate	

No.	Sector	Loc. No.	Name of dam	Category						EPP	Status/Progress	DSI Interval
	Major risk aspect		Action to be taken	T(years)	PF	LL	AL	EL(total)	(Y/N)		(years)	
60	A	J250/02	CALITZDORP DAM	3					Y		7	
	Spillway		None necessary	2000	0.049	50	1	11.6				
	Structure		Investigate stability	1000	0.095	100	1					
61	A	G101/AH	PARYS DAM	3					Y		7	
	Spillway Capacity		None	500	0.181	20	0.8	11.3		Adequate		
	Structural Stability		None	10000	0.010	30	0.8			Adequate		
	O & MM		Improve	0	0.000	0	0					
	Erosion of spillway lining (reo mattresses)		* Repair	100	0.634	20	0.8			Programmed for 2006/7		
64	W	A901/42	DAMANI DAM	3					N		7	
	Spillway		Adequate	1000	0.095	60	1	10.9		Adequate		
	Structure		Adequate	1000	0.095	60	1			Adequate		
	No O&MM and EPP		Compile	0	0.000	0	0			Outstanding		
65	A	U700/11	BEAULIEU DAM	3					N		7	
	Spillway capacity		Reinstate NOCL	500	0.181	62	0.5	10.2		Programmed for...?		
	Structural stability		Monitoring essential	500	0.181	62	0.5			Adequate		
67	M	Q920/04	ANDREW TURPIN DAM	2					Y		8	
	Spillway		Investigate and Increase.	20	0.994	10	1	9.9				
	Structure			10000	0.010	6	0.9					
68	A	B401/33	LEEUKWKLIP DAM	2					N		8	
	Spillway		*Enlarge / abandon	50	0.867	10	1	9.8		Programmed for 2004 Outstanding		
	Structure		*Improve / abandon	50	0.867	10	1			Programmed for 2004 Outstanding		
	No O&MM and EPP		Compile	0	0.000	0	0			Programmed for 2004 Outstanding		
71	M	D120/02	KLOOF DAM	3							8	
	Spillway Capacity		Improve	100	0.634	15	1	9.5				
	Structural Stability			0	0.000	0	0					
	O & MM		Improve	0	0.000	0	0					
72	W	Q940/01	KATRIVIER DAM	3					Y		8	
	Spillway Capacity		Can take RMF + no apron protection	2000	0.049	82	0.8	9.1		Adequate		
	Structural Stability		* Improve stability	1000	0.095	82	0.8			Programmed for 2012/3 & 2013/4		
75	A	J340/08	EZELJACHT DAM	3					Y		8	
	Spillway		None	100000	0.001	5	0.6	8.9		Adequate		
	Structure		*Investigation to determine "safe operating level"	100	0.634	20	0.7			Programmed for 2006/7 & 2007/8		
77	M	Q800/13	BESTERSHOEK DAM	2							8	
	Spillway Capacity		None	2000	0.049	10	1	8.7				
	Structural Stability		Invetigate/improve	50	0.867	10	1					

No.	Sector	Loc. No.	Name of dam	Category						EPP	Status/Progress	DSI Interval
	Major risk aspect		Action to be taken	T(years)	PF	LL	AL	EL(total)	(Y/N)		(years)	
78	A	A213/52	HIPPO DAM	2						N		8
	Spillway capacity				50	0.867	10	1	8.7			
	Structural Stability				0	0.000	0	0				
80	M	S401/05	KOCH DAM	2						Y		8
	Spillway		*Recently improved		20	0.994	9	0.9	8.1		Still need to be verified	
	Structure		None		1000	0.095	9	0.9			Adequate	
83	S	B800/25	LORNA DAWN DAM	2						Y		8
	Spillway capacity		Monitor erosion		2000	0.049	9	1	7.9		Ongoing	
	Structural stability		Monitor seepage		2000	0.049	9	1			Ongoing	
	Strong leak at RF		Monitor/Repair		50	0.867	9	1			Programmed for...?	
85	A	B501/17	UPPER GOMPIES DAM	2						N		8
	Spillway		*Investigate / improve		50	0.867	9	1	7.9		Programmed for 2007	
	Structure		None		2000	0.049	9	1			Adequate	
	No O&MM and EPP		Compile		0	0.000	0	0			Outstanding	
86	M	B100/16	KRUGER DAM	2						Y		8
	Spillway Capacity		Improve		50	0.867	8	1	7.9		Programmed for...?	
	Structural Stability (Toe are wet)		Berm + subsurface toe drain		50	0.867	8	1			Programmed for...?	
88	M	C221/26	HAMBERG	2						Y		8
	Spillway Capacity		Raise crest by 300mm		50	0.867	9	1	7.8			
					0	0.000	0	0				
89	W	B502/06	LEPELLANE DAM	2						N		8
	Spillway		Improve		200	0.394	9	1	7.8			
	Structure		Install Toe Drain		500	0.181	9	1				
	Outlet Pipe out of order		Seal Outlet Pipe		100	0.634	9	1				
90	O	C221/70	FLEURHOF DAM	2								8
	Spillway Capacity				100000	0.001	12	1	7.6			
	Structural Stability		* Investigate and improve		100	0.634	12	1				
	O & MM		Compile/Improve		0	0.000	0	0				
91	M	G400/21	MOSSEL RIVER DAM	3						Y		8
	Spillway		*Increase spillway capacity		500	0.181	50	0.8	7.6		Investigation to start 6/2000	
	Structure		None		3000	0.033	20	0.8			Adequate	
93	W	L820/01	KOUGA DAM (PAUL SAU)	3						Y		8
	Spillway		None		10000	0.010	100	0.7	7.3		Adequate	
	Structure		Investigate/Improve		1000	0.095	100	0.7			Ongoing monitoring	

No.	Sector	Loc. No.	Name of dam	Category		PF	LL	AL	EL(total)	EPP (Y/N)	Status/Progress	DSI Interval (years)	
				T(years)	Action to be taken								
94	W	B501/14	MAHLANGU DAM	2	None	2000	0.049	8	1	7.1	N	8	
					Monitor	1000	0.095	8	1		Adequate		
					*Relocate / monitor	50	0.867	8	1		Adequate Programmed for 2006 - 2008		
95	W	C700/05	WELTEVREDE DAM	2	*Investigate	50	0.867	9	0.8	7.1	N	8	
					*Leakage along RHS pipe	50	0.867	9	0.8		Programmed for ...?		
					Compile	0	0.000	0	0		Programmed for ...?		
96	A	E201/CL	KLOOF DAM	2	Remove sandbags	10	1.000	7	1	7.0	N	8	
					Structural Stability	0	0.000	0	0				
					O & MM	0	0.000	0	0				
97	W	A804/04	NWANEDZI	3	Investigate erosion potetial during overtopping	2000	0.049	50	1	7.0	N	8	
					*Do structural and foundation analysis	1000	0.095	50	1				Programmed for 2007/8
					Compile	0	0.000	0	0				Programmed for 2007/8 Outstanding
99	M	C212/46	KLEINFONTEIN DAM	2	Investigate/Improve	50	0.867	8	1	6.9	N	8	
					None	2000	0.049	2	0.6				Adequate
					Compile	0	0.000	0	0				Programmed for ???

APPENDIX B3 (As Appendix B2 but showing only DWS dams)

No.	Sector Major risk aspect	Loc. No.	Name of dam Action to be taken	Category T(years)	PF	LL	AL	EL(total)	EPP	Status/Progress	DSI Interval (years)	
									(Y/N)			
1	M(W) Spillway Capacity Structural Stability	N120/01	NQWEBA DAM Feasibility study to rehabilitate	3	0	0.000	0	0	310.5		DWA to take over Dam	5
					200	0.394	1125	0.7				
2	W Spillway Capacity Structural Stability	W440/01	PONGOLAPOORT DAM Investigate further. Operate at reduced FSC(66%). Investigate	3	5000	0.020	6600	0.7	181.2	N	Programmed for 2009 Programmed for 2010	5
					5000	0.020	6600	0.7				
5	W Spillway capacity Structural stability	H800/03	DUIVENHOKS DAM None necessary (a) Investigate stability.(b) Stabilize left abutment	3	2000	0.049	100	1	126.8	Y	Adequate	5
					100	0.634	200	1				
9	W Spillway gate malfunction Structure	A210/01	ROODEKOPJES DAM Regular Mechanical Maintenance	3	1000	0.095	500	1	80.1	N		5
					2000	0.049	900	0.8				
16	W Spillway Structure - stability	N230/01	DARLINGTON DAM Investigate and improve	3	250	0.330	60	1	44.5	Y		6
					2000	0.049	608	0.9				
17	W Spillway Structure No O&MM and EPP Spillway gate operation (human error)	E100/02	CLANWILLIAM DAM None Rehabilitation Compile and improve EPP Remove spillway gates - rehabilitation.	3	10000	0.010	76	0.8	40.8	Y	Adequate Inadequate.Programmed for 2015-17 Programmed for 2017 Programmed for 2015-17	6
					1000	0.095	76	0.8				
					0	0.000	0	0				
					100	0.634	76	0.8				
19	W Spillway Structure	R300/01	NAHOON DAM None None	3	2000	0.049	400	0.7	39.0	Y	Adequate Adequate	6
					1000	0.095	400	0.7				
24	W Spillway Structure	A900/03	ALBASINI DAM Must be improved. Post-stressed cables must be monitored,investigate	3	200	0.394	100	0.8	33.9	Y	Programmed for 2012 Programmed for ...?	6
					2000	0.049	100	0.8				
26	W Spillway Capacity Structural Stability O & MM	R101/03	MNYAMENI DAM * Improve Compile manual and improve O&M	3	200	0.394	80	1	31.5			6
					0	0.000	0	0				
					0	0.000	0	0				
30	W Spillway capacity: Cavities beneath crest Structural stability	B402/35	DER BROCHEN DAM Improve spillwal against erosion Monitoring essential	3	50	0.867	30	1	26.2	Y	Programmed for...? Adequate	6
					2000	0.049	30	1				

No.	Sector	Loc. No.	Name of dam	Category						EPP		DSI Interval
	Major risk aspect		Action to be taken	T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)	
31	W	A210/02	HARTBEESPOORT DAM	3					Y		6	
	Spillway Structure		Routed flood that can be handled before overtopping None	1000 10000	0.095 0.010	323 323	0.7 0.7	23.6		Programmed for ...? Adequate		
35	W	B800/02	EBENEZER DAM	3					Y		6	
	Spillway Structure		*Investigate further. *Install safe seepage monitoring system.	200 1000	0.394 0.095	43 43	0.5 0.5	20.6		Programmed for ...? Programmed for ...?		
	Potential clogging of shaft spillway.		*Install structure to prevent clogging.	50	0.867	43	0.5			Programmed for ...?		
37	W	A601/42	VAALKOP NO.II-DAM	2					N		7	
	Spillway Structure		*Improve *Improve	100 20	0.634 0.994	20 20	1 1	20.0		Programmed for ...? Programmed for ...?		
40	W	B800/29	MIDDEL LETABA DAM	3					N		7	
	Spillway capacity		Investigate by model study	1000	0.095	100	0.7	18.2		Programmed for ???		
	Structural stability		Re-evaluate stability and improve monitoring	500	0.181	100	0.7			Programmed for ???		
56	W	H200/07	ROODE ELSBERG DAM	3					N		7	
	Spillway Structure		None	10000	0.010	50	0.6	12.9		Adequate		
			Structural analysis & risk analysis	2000	0.049	50	0.6			Programmed for 2010		
	Internal erosion.Leaching sand from found		Monitor	200	0.394	50	0.6			Ongoing		
57	W	L300/01	BEERVLEI DAM	3					N		7	
	Spillway Structure		Investigate None	200 2000	0.394 0.049	41 41	0.7 0.7	12.2		Adequate Adequate		
64	W	A901/42	DAMANI DAM	3					N		7	
	Spillway Structure		Adequate	1000	0.095	60	1	10.9		Adequate		
			Adequate	1000	0.095	60	1			Adequate		
	No O&MM and EPP		Compile	0	0.000	0	0			Outstanding		
72	W	Q940/01	KATRIVIER DAM	3					Y		8	
	Spillway Capacity		Can take RMF + no apron protection	2000	0.049	82	0.8	9.1		Adequate		
	Structural Stability		* Improve stability	1000	0.095	82	0.8			Programmed for 2012/3 & 2013/4		
89	W	B502/06	LEPELLANE DAM	2					N		8	
	Spillway Structure		Improve	200	0.394	9	1	7.8				
			Install Toe Drain	500	0.181	9	1					
	Outlet Pipe out of order		Seal Outlet Pipe	100	0.634	9	1					
93	W	L820/01	KOUGA DAM (PAUL SAU)	3					Y		8	
	Spillway Structure		None	10000	0.010	100	0.7	7.3		Adequate		
			Investigate/Improve	1000	0.095	100	0.7			Ongoing monitoring		

No.	Sector	Loc. No.	Name of dam	Category						EPP		DSI Interval
	Major risk aspect		Action to be taken	T(years)	PF	LL	AL	EL(total)	(Y/N)	Status/Progress	(years)	
94	W	B501/14	MAHLANGU DAM	2					N		8	
	Spillway		None	2000	0.049	8	1	7.1		Adequate		
	Structure		Monitor	1000	0.095	8	1			Adequate		
	Pipeline burried in damwall		*Relocate / monitor	50	0.867	8	1			Programmed for 2006 - 2008		
95	W	C700/05	WELTEVREDE DAM	2					N		8	
	Spillway		*Investigate	50	0.867	9	0.8	7.1		Programmed for ...?		
	Structure		*Leakage along RHS pipe	50	0.867	9	0.8			Programmed for ...?		
	No O&MM and EPP		Compile	0	0.000	0	0			Programmed for ...?		
97	W	A804/04	NWANEDZI	3					N		8	
	Spillway		Investigate erosion potetial during overtopping	2000	0.049	50	1	7.0		Programmed for 2007/8		
	Structure		*Do structural and foundation analysis	1000	0.095	50	1			Programmed for 2007/8		
	No O&MM and EPP		Compile	0	0.000	0	0			Outstanding		

APPENDIX C: PHOTOGRAPHS OF SELECTED DAMS

Botterkloof Dam Under Construction For Hydropower Purposes on the Ash River in Free State

(Owner: Department of Water and Sanitation) (Photos provided by Aurecon)



The Botterkloof Dam is to stabilise the outflow from the Lesotho Highlands Water Project (LHWP) into the Ash River.

The proposed Stormemelk Hydropower Station is located on the left bank of the existing concrete spillway of the Botterkloof Dam.



Power station about 13 m deep from the existing ground level to house the turbine and generator.



Tailrace channel discharging onto the existing stilling basin of Botterkloof Dam



Casting of blinding concrete onto intake works foundation

Bedford Dam (Owner: ESKOM)
Completed in 2011, form the upper storage reservoira component of the Ingula Pumped Storage Scheme near Ladysmith in Kwa-Zulu Natal.



Bedford Dam is a 41m high Concrete Face Rockfill Dam (CFRD) with a storage capacity of 22,557 million m³.

(Photo provided by Knight Piésold)



Downstream face showing access roadway down to outlet works



Constructed Ibis
Roosting Nests
upstream of the
Bedford Dam



Outlet works

Energy dissipating
chutes with radial gate
control room and sleeve
valve control room on
left platform.

Bramhoek Dam (Owner: ESKOM)
Forms the lower storage reservoir of the Ingula Pumped Storage Scheme near Ladysmith in
Kwa-Zulu Natal
(Photos provided by Knight Piésold)



Bramhoek Dam is located on the Braamhoekspruit in the upper catchment of the Klip River

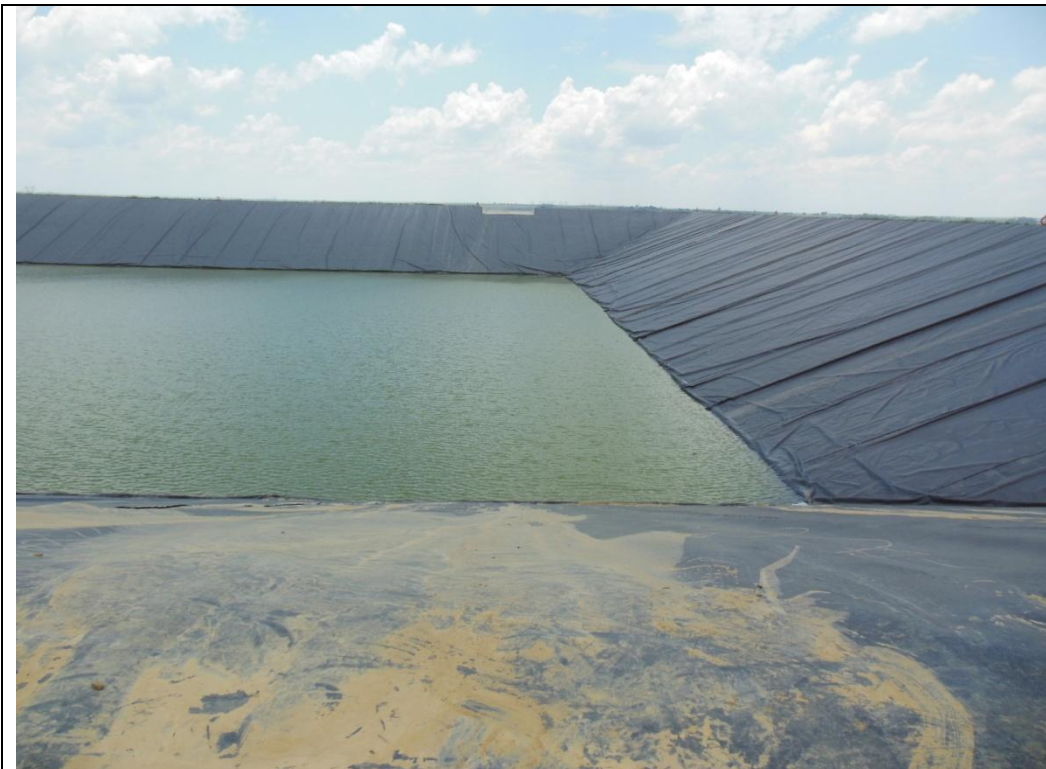


RCC Gravity Wall with a wall height of 32,2m

**Matla Brine Pond (Owner: Matla Coal, a subsidiary of Exxaro (Ltd))
Near Kriel in Mpumalanga**
(Photos provided by Knight Piésold)



These ponds are to contain the brine to be produced from the proposed Reverse Osmosis (RO) treatment of mine water that will be pumped from underground workings to enable the continuation of mining



The pond is about 6.5m below natural ground level and 8.3 m above natural ground level starting to fill

Mndwaka Dam, Owner: Amathole District Municipality



Photo of Mndwaka Dam nearing completion taken from the Cable Way

Photo by:
Sontinga
Consulting
Services



Photo of Mndwaka Dam nearing completion taken from the left flank

Photo by:
Sontinga
Consulting
Services and
ARQ Consulting
Engineers



**Van der Kloof Dam
in the
Orange
River**

Owner:
Department
of Water and
Sanitation



**Gariep Dam
in the
Orange
River**

Owner:
Department
of Water and
Sanitation



Floriskraal Dam near Laingsburg in the Western Cape

Owner:
Department of Water and Sanitation



Grassridge Dam near Middelburg in the Eastern Cape

Rehabilitated Spillway

Owner:
Department of Water and Sanitation



**Keerom Dam
near Worcester
in the Western
Cape**

Owner: Nuy
Irrigation Board



**Poortjieskloof
Dam near
Montagu in the
Western Cape**

Owner:
Department of
Water and
Sanitation



**Rookpoort Dam
near Thabazimbi
in Limpopo**

Owner:
Department of
Public Works

**Invutshane Dam nearing completion near Stanger, Owner: Umgeni Water
(H = 28 m, V = 3,1 million m³, category II)**



Work on the right
flank earthfill wall
in progress,
September 2014

Photo courtesy of
MBB Consulting
Engineers,
Pietermaritzburg..

**Imvutshane Dam nearing completion near Stanger, Owner: Umgeni Water
(H = 28 m, V = 3,1 million m³, category 2)**



Construction as at September 2014.

Right flank earthfill wall in background.

Photo courtesy of MBB Consulting Engineers, Pietermaritzburg.



Another view of spillway.

Note outlet chamber just to the right of stilling basin.

Photo courtesy of MBB Consulting Engineers, Pietermaritzburg.

**Imvutshane Dam nearing completion near Stanger, Owner: Umgeni Water
(H = 28 m, V = 3,1 million m³, category 2)**



View of completed spillway as in February 2015.

Note outlet chamber just to the right of stilling basin.

Photo courtesy of MBB Consulting Engineers, Pietermaritzburg.



View of completed dam in February 2015.

Photo courtesy of MBB Consulting Engineers, Pietermaritzburg.

**De Hoop Dam, completed in 2013 (Owner: Department Water & Sanitation)
Maximum wall height = 74 m, Storage capacity = 347 million m³.**



Dam spilling for first time at end of January 2015.

Photograph by Mr P Duminy of the Infrastructure Branch, DWS.



Close-up picture of spillway. Note outlet works on right bank just downstream of spillway.

Photograph by Mr P Duminy of Infrastructure Branch, DWS.