DAM ENGINEERING AND SOCIO-ECOLOGICAL SYSTEMS INSTITUTIONAL AND FINANCIAL REPORT

W. Enright, J van Zyl, L Lodenkemper, S Jugwanth

National Dam Siltation Management Programme

water & sanitation

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NATIONAL DAM SILTATION MANAGEMENT PROGRAMME (NATSILT)

DAM ENGINEERING AND SOCIO-ECOLOGICAL SYSTEMS

INSTITUTIONAL AND FINANCIAL REPORT

Report to the

Water Research Commission

By

W. Enright, J van Zyl, L Lodenkemper, S Jugwanth

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Private Bag X03
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Acronyms and Abbreviations

Term	Definition
ARC	Agricultural Research Council
BGCMA	Breede-Gouritz Catchment Management Agency
CARA	Conservation of Agricultural Resources Act
CBO	Community-Based Organisations
CMA	Catchment Management Agency
DALRRD	Department of Agriculture, Land Reform and Rural Development
DALRRD	Department of Agriculture, Land Reform and Rural Development
DEFF	Department of Environment, Forestry and Fisheries
DMRE	Department of Mineral Resources
DOA	Department of Agriculture
DWS	Department of Water and Sanitation
EPIP	Environmental Protection and Infrastructure Programmes
IAP	Invasive alien plant
IB	Irrigation Board
IUCMA	Inkomati-Usuthu Catchment Management Area
KOBWA	Komati Basin Water Authority
MPRDA	Mineral and Petroleum Resources Development Act
NatSilt	National Dam Siltation Management Strategy
NEMA	National Environmental Management Act
NGO	Non-Governmental Organisations
NRM	Natural Resource Management
NW&SMP	National Water and Sanitation Master Plan
NWA	National Water Act
NWRIB	National Water Resources Infrastructure Branch
NWRS	National Water Resource Strategy
ORASECOM	Orange-Senqu River Commission
SAAFWUA	South Africa Federation for Water User Associations
SALGA	South African Local Government Association
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SANRAL	South African National Roads Agency SOC Ltd
SMME	Small Medium and Micro Enterprises
SP	Sub-project
TCTA	Trans-Caledon Tunnel Authority
WfW	Working for Water
WMA	Water Management Area
WRC	Water Research Commission
WUA	Water Users Association

Glossary of Terms

Basin	The dam basin is that area or volume behind a dam wall that can be filled with water. It is often interchangeably used with “reservoir”. Note that the word “basin” in American English, is also often used as being synonymous with “catchment area” but that is not the case in the text.
Catchment	A region of area of land where all water drains naturally to a single stream, river or dam.
Dam	An artificial structure or wall used to impound water or regulate flow.
Reservoir	A large natural or artificial basin or lake in which a large quantity of water can be stored
Sedimentation	The termination of the process whereby sediment is deposited or settled out of a water body in which they are entrained.
Siltation	Sediment related pollution referring to the increased concentration of suspended sediment and the increased accumulation of fine sediment of water bodies.

Note: The words “siltation” and “sedimentation” are used interchangeable in this report. It is, however, noted that the project brief makes regular reference to the word “siltation” even though the more correct term to describe the process is called “sedimentation”.

1 Introduction

1.1 Assignment overview

The Water Research Commission (WRC) appointed Zutari (Pty) Ltd for the National Dam Siltation Management Strategy (NatSilt), Sub-Project 2 (SP2): Dam Engineering and Socio-Ecological Systems. Funding for the project was provided by the Department of Water and Sanitation (DWS) who is also the end client and main beneficiary of the study.

1.1. Project context

The overall aim of the NatSilt programme as a whole is to develop a strategy for the control and management of dam sedimentation in South Africa. Most dams have a limited viable lifespan due to sedimentation. Typical global estimates of storage losses due to sedimentation range from 0.3% per year to 1% per year as referenced in literature (ICOLD, 2009).

The overarching objective of the NatSilt programme is to produce tools and know how to arrest the situation and mitigate future increases in sedimentation through the deployment of social, economic, technological, engineering and management tools and systems."

The programme's objectives are as follows:

1. Development of a Sedimentation Management Strategy and related tools for dams;
2. Piloting of the draft Strategy, Models and Tools for finalisation; and
3. Review and revision towards a final Strategy, with relevant models and tools.

Within the overall programme, four sub-projects are being delivered, integrated and managed to meet the desired objectives.

1. Sub-project 1 (SP1): Strategy development
2. Sub-project 2 (SP2): Dam Engineering and socio-ecological systems
3. Sub-project 3 (SP3): Sustainable Dam Dredging
4. Sub-project 4 (SP4): Training and Capacity Development

Sub-project 2 specifically aims to develop a set of tools and guidelines to be used by dam sedimentation managers in future to control the impact of sedimentation. The main premise is to expand the footprint of dam management to encompass all upstream activities. This sub-project is sub-divided into the following main tasks:

- Task 1: Project inception
- Task 2: Literature review
- Task 3: Dam storage classification
- Task 4: Dam operations model
- Task 5: Institutional and finance guidelines
- Task 6: Pilot testing
- Task 7: Reporting
- Task 8: Project management

1.2. Report objective

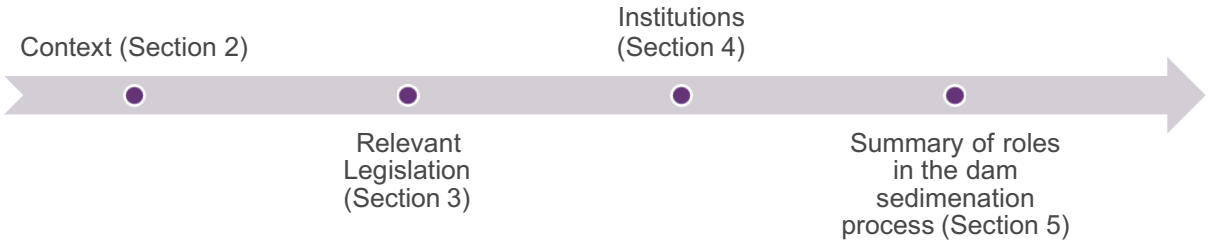
This report constitutes one of the deliverables under SP2 and specifically relates to Task 5 above. It aims to address institutional and financial arrangements in South Africa in relation to dam sedimentation.

The operational link between dam operations and the activities taking place in its catchment must be implemented in coordination with the various institutions who have authority in their respective fields.

The purpose of this report is to identify and assess the various institutions that have a definitive role to play in land use planning and those that have a keen interest in the quality of water and assurance of water supply that can be affected by sedimentation.

The role of the respective institutions and the responsibility for compliance monitoring and enforcement will be outlined and workshopped to develop best practice guidelines and set out related actions.

The report layout is indicated below. Firstly, the context and need for a programme such as NatSilt is explored in order to inform an understanding of which legislation would be relevant. The legislation, in turn, identifies and enables the institutions identified in this study. The report then closes with a summary of roles and responsibilities, conclusions and recommendations.



2 Background to sedimentation in storage dams

The landscape is naturally eroding, with the sediment cycle being closely linked to the hydrological cycle. By trapping sediment in dams, they interrupt the continuity of sediment transport through rivers, which results in the loss of storage and reusable life for the reservoir, as well as depriving downstream reaches of sediment essential for channel form and aquatic habitats (Kondolf et al., 2014).

Although the traditional discourse on sediment problems has been on increased erosion and sediment loads from poor land use (Walling, 1999), most rivers have shown a decrease in sediment loads because of trapping by upstream dams (Walling and Fang, 2003). In line with the global trends, many storage reservoirs in South Africa have experienced ongoing loss of capacity as a consequence of high sediment yields within their catchment areas. This is a major environmental and economic concern as it intensifies water management problems in the water-scarce semi-arid regions of the country. As South Africa already allocates most available water for strategic, industrial, domestic and agricultural use, the loss of storage capacity in reservoirs and degraded water quality has meant that a reliable water supply is compromised. Regardless of size, sedimentation of dams is likely to significantly affect users at a local level and most drainage regions across the country have dams which experience high rates of annual sedimentation and high to critical levels of loss in storage capacity. From sedimentation monitoring through dam surveys, it is estimated that close to 10 % of the total national storage capacity in dams has been lost to date (CSIR, 2016).

Soil erosion by water is considered to be one of South Africa's major environmental problems (Le Roux et al., 2008), due in part to landscape (i.e. geomorphic history) and soil conditions (i.e. inherent soil erodibility) making many parts of the country susceptible to erosion. Although erosion is a natural process, it is accelerated by human activities. This, linked to the negative impacts of erosion on soil productivity, has meant that there has been significant focus on this issue by the government specifically with regard to erosion as a form of land degradation. However, there is still a limited understanding of the drivers of soil erosion due to the complexity of soil and water processes at larger spatial scales.

Integrated catchment management is one of the primary principles of the South African National Water Act (Act 36 of 1998), which makes provision for managing land use activities and includes the relationship between water quantity and quality to maintain aquatic ecosystems. Integrated catchment management acknowledges that land use occurs locally, with real-world social and economic benefits, while causing ecological degradation across local, regional and global scales (Foley et al. 2005). Appropriate management should include management of landscape structures through the strategic placement of managed and natural ecosystems so that the services of natural ecosystems are available across the landscape mosaic (Van der Waal and Rowntree, 2017). A particular challenge with implementing integrated catchment management in South Africa has been the overlapping mandates of different national departments.

Whilst the National Water Act (Act 36 of 1998) envisioned a decentralised institutional structure where local and regional communities are intricately involved in managing water resources in their area, the reality is that these have been a challenge to implement. One of the stumbling blocks has been overlapping mandates. The Department of Environment, Forestry and Fisheries (DEFF) has a mandate under the National Environmental Management Act (NEMA) (Act 107 of 1998) to protect the environment and has listed activities which require an environmental impact assessment. The Department of Agriculture, Land Reform and Rural Development (DALRRD) is responsible for the conservation of soil and land under the Conservation of Agricultural Resources Act (CARA) (Act 43 of 1983). This has meant that the reduction of sediment yield, or various components of catchment management have been enacted by various role-players in South Africa. Table 2-1 presents the different types of interventions for sedimentation management as well as the potential implementing agents in South Africa. Although at the site of sedimentation in the dam it is clear there is a mandate for DWS to implement the interventions, further up the catchment where the source of erosion occurs the mandate for managing sedimentation is less clear and there are multiple role players.

Table 2-1: The potential implementing agents for the different types of interventions related to sedimentation management

Zone	Aim	Intervention type	Potential implementing agent in South African context
Source	Improve vegetation cover	Veld management	Meat naturally
		Conservation agriculture	ARC
		Rainwater harvesting	ARC
		Agroforestry	DEFF
		Natural grassland management	SANBI
		Wetland rehabilitation	Working for Wetlands
		Clearing of alien invasive plants	Working for Water
	Reduce rill erosion	Contour ridging	Working for Land, LandCare
		Vegetation rows	Working for Land, LandCare
Transfer	Reduce gully erosion	Gully prevention	Working for Land, LandCare
		Stone check dams	Working for Land, LandCare
		Brushwood check dams	Working for Land, LandCare
		Vegetation barriers	Working for Land, LandCare
		Gully reshaping	Working for Land, LandCare
		Roadside management	SANRAL
	Reduce river bank erosion	Re-establish meandering rivers	DWS
		Stream/riverbank management	Working for Water, BRIP, Municipalities, DWS
		Reconnect river and floodplain	Working for Wetlands, DWS
	Trap sediments upstream of dam	Small dams	DWS
		Vegetation screens	DWS
		Sabo dams	DWS
Sink	Route sediments	Sediment bypass	DWS
		Sediment pass through	DWS
	Sediment removal	Flushing or sluicing	DWS
		Pressure flushing	DWS
		Empty flushing	DWS
		Dry excavation	DWS
		Dredging	DWS
	Adaptive strategies	Redistribute sediment	DWS
		Reallocate storage	DWS
		Modify infrastructure	DWS
		Adjust to reduce benefits	DWS
		Repurpose or decommission	DWS

The DWS is mainly a service-driven department, focusing on the delivery of water supply and sanitation services across the country. The department is envisaged to shoulder the responsibility of management of available water resources to balance the spatially and temporally variable availability of water resources for sustainable development. This is hampered by a large number of aging reservoirs experiencing steadily growing sedimentation problems. This underscores the need to analyse the sedimentation status and management potential for all reservoirs, and to begin aggressive

implementation of technologies to sustain reservoir function. In a South African context, the lack of national guiding principles on sedimentation management is seen as a challenge to the implementation of an Integrated Sediment Management Framework, and it is therefore recommended that as a first step South Africa should develop high-level policies to guide the various organs of the state in managing sediments sustainably.

3 Legislation

According to the Bill of Rights in the South African Constitution every South African has "*the right to an environment that is not harmful to their health or well-being; and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."* This means that the government has a mandate to protect and manage natural resources. These constitutional imperatives, combined with the national water and sanitation policy papers, the National Water Act and the Water Services Act, provide the mandate to the water sector to:

- Provide universal and equitable access to reliable water supply and sanitation services
- Protect, manage and develop the nation's water resources in a manner that supports justifiable and ecologically sustainable economic and social development
- Transform access to water to redress the racial imbalances created by apartheid.

Other government departments are also mandated to manage soil and water through various Acts explored below. Although sedimentation management is not the primary priority of these departments, improved sedimentation management will result in direct and indirect benefits towards their mandates.

3.1 National Water Act

3.1.1 Purpose and Institutional reform

The purpose of the National Water Act, Act 36 of 1998, (NWA) is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account, amongst other factor:

(a) meeting the basic human needs of present and future generations;

(b) promoting equitable access to water;

(c) redressing the results of past racial and gender discrimination;

(d) promoting the efficient, sustainable and beneficial use of water in the public interest;

(e) facilitating social and economic development;

(f) providing for growing demand for water use;

(g) protecting aquatic and associated ecosystems and their biological diversity;

(h) reducing and preventing pollution and degradation of water resources;

(i) meeting international obligations;

(j) promoting dam safety; and

(k) managing floods and droughts,

and for achieving this purpose, to establish suitable institutions and to ensure that they have appropriate community, racial and gender representation.

To achieve the Act's purpose, the NWA establishes institutions like catchment management agencies, water user associations, advisory committees and bodies established to implement international agreements relating to water. By providing for these institutions, the NWA envisages a decentralised institutional structure where local and regional communities are intricately involved in managing water resources in their area.

The NWA initiated a large-scale reform of South Africa's institutional water structure to align with constitutional values. It introduced a legislative shift away from the centralised governance framework established by the Water Act of 1956 by directing the establishment of water institutions aimed at decentralising water resource governance. These institutions, when properly constituted and fully functional, would promote the sustainable use of water for the benefit of all users – the ultimate aim of water resource management – and encourage community participation.

Amongst other measures, this requires that Catchment Management Agencies (CMAs) must be set up to compile and implement catchment management strategies to promote and ensure the protection, use, development, conservation, management and control of water resources within its Water Management Area (WMA).

Typically, the strategic considerations for which measures and actions are formulated comprise the following:

(a) Protecting for People and Nature

This primarily focuses on management of streamflow, water quality, habitat and riparian zones related to riverine, wetland, estuarine and groundwater resources, to maintain important ecosystem goods and services and biodiversity.

(b) Sharing for Equity and Development

This primarily focuses on the management of water use from surface and groundwater resources through the operation of infrastructure, in order to provide water for productive and social purposes within and outside of the WMA.

(c) Cooperating for Compliance and Resilience

This primarily focuses on the management of institutional aspects to enable and facilitate the protection and sharing of water, including the more cooperative stakeholder, partnership, information, disaster risk and adaptation elements of the strategy.

3.1.2 Specifics in Act related to sediment management

All water uses require authorisations, i.e. either declaration of existing lawful water uses (Section 32, 33), general authorisations (for smaller users) (Section 39) or licences (Section 41).

Authorisations are required for the following water uses (NWA Section 21):

a. *"taking water from a water resource;*
b. *storing water;*
c. *impeding or diverting the flow of water in a watercourse;*
d. *engaging in a stream flow reduction activity contemplated in Section 36; (commercial forestry)*
e. *engaging in a controlled activity identified as such in Section 37(1) or declared under Section 38(1); (irrigation with water containing waste)"*

It is important to note the following definition as included in Chapter 1 of the National Water Act, Act 36 of 1998, (NWA):

"Waste includes any solid material or material that is in suspension, dissolved or transported in water ***(including sediment)*** *and which is spilled or deposited on land or into a water resource in such volume, composition or manner as to cause, or to be reasonably likely to cause, the water resource to be polluted."*

Section 21 of the NWA includes the following waste-related activities under water use:

"21. For the purposes of this Act, water use includes—

f. *discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit:*

g. disposing of waste in a manner which may detrimentally impact on a water resource;

h. disposing in any manner of water which contains waste from. or which has been heated in. any industrial or power generation process;"

Furthermore, Section 21 (i) refers to some of the activities that can cause or enhance sedimentation, and should thus also be considered in the management of sedimentation:

i. "altering the bed, banks, course or characteristics of a watercourse."

In addition to Section 21 that pertains to the different kinds of water use activities, Section 26 of the Act allows the Minister to make regulations on the use of water as follows:

a. limiting or restricting the purpose, manner or extent of water use;

b. requiring that the use of water from a water resource be monitored, measured and recorded;

e. regulating the design, construction, installation, operation and maintenance of any waterwork, where it is necessary or desirable to monitor any water use or to protect a water resource;

g. regulating or prohibiting any activity in order to protect a water resource or instream or riparian habitat;

It should be noted that there is no ownership of water and thus no legislation governing it. Water can only be used, as defined in Section 21 of the NWA. It includes taking of water (abstraction) as well as storing of water. The Act does not control or manage infrastructure. A dam structure can be constructed but water cannot be stored in it or water taken from the dam without an authorisation.

Where storage dams exceed 50 000 m³ in volume and a wall height of 5 m, dam safety authorisations are also required. Dam ownership resides with the property owner or in terms of applicable agreements.

Existing storage dams are declared as existing lawful water uses (for the time being). Compulsory licensing can be done in future in terms of Section 43 and can restrict the taking of water or the volume of stored water to the following:

a. to achieve a fair allocation of water from a water resource in accordance with Section 45:

i. which is under water stress; or

ii. when it is necessary to review prevailing water use to achieve equity in allocations;

b. to promote beneficial use of water in the public interest;

c. to facilitate efficient management of the water resource; or

d. to protect water resource quality.

3.2 National Environmental Management Act

The National Environmental Management Act, Act 107 of 1998, (NEMA) intends:

- to provide for co-operative, environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state

The principles of national environmental management stated in the NEMA serve as the general framework within which environmental management and implementation plans must be formulated. Section 4 (a) of Chapter 2 states that waste should be avoided or where it cannot be altogether avoided, minimised and re-used or recycled where possible and otherwise disposed of in a responsible manner (NEMA, 1998).

Section 4(b) states that environmental management must be integrated - acknowledging that all elements of the environment are linked and inter-related - and that it must take into account the effects

of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option (WRC, 2013). NEMA prescribes/forbids the following measures:

- Before any listed development activities can be undertaken, an environmental impact assessment must be undertaken and an environmental authorisation obtained.
- The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil of more than 10 cubic metres from a watercourse; but excluding where such infilling, depositing, dredging, excavation, removal or moving is for maintenance purposes undertaken in accordance with a maintenance management plan.
- The clearance of an area of 3 hectare or more of indigenous vegetation, except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan (NEMA, 1998).

Water User Associations play an important role in the developing and implementation of these maintenance management plans.

In addition, the NEMA regulates certain listed activities:

- The construction of: (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; or (xi) infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse.
- The construction of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50000 cubic metres or more.
- The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from (i) a watercourse;
- The transformation of undeveloped, vacant or derelict land to- (ii) residential, retail, commercial, recreational, industrial or institutional use, outside an urban area and where the total area to be transformed is bigger than 1 hectare but less than 20 hectares;
- The expansion of (i) canals; (ii) channels; (iii) bridges; (iv) weirs; (v) bulk storm water outlet structures; within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse.

3.3 National Environmental Management: Biodiversity Act

The National Environmental Management: Biodiversity Act, Act 10 of 2004, intends:

- to provide for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act, 1998;
- the protection of species and ecosystems that warrant national protection;
- the sustainable use of indigenous biological resources;
- the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources;
- the establishment and functions of a South African National Biodiversity Institute; and for matters connected therewith.

Management of ecosystems in catchment areas must be focused around biodiversity when mandated by this Act.

3.4 National Environmental Management: Protected Areas Act

The National Environmental Management: Protected Areas Act, Act 57 of 2003 intends:

- to provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes;
- for the establishment of a national register of all national, provincial and local protected areas;
- for the management of those areas in accordance with national norms and standards;
- for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.

Management of land within protected areas, or land considered to be of conservation importance are considered under this Act.

3.5 National Environmental Management: Waste Act

National Environmental Management: Waste Act, Act No. 59 of 2008, reforms the law regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution; provides for national norms and standards for regulating the management of waste by all spheres of government; and provides for the licensing and control of waste management activities.

The release of sediment into a water body is considered under the NEMA: Waste Act.

3.6 National Forests Act

The National Forests Act, Act 84 of 1998 intends to:

- promote the sustainable management and development of forests for the benefit of all;
- create the conditions necessary to restructure forestry in State forests;
- provide special measures for the protection of certain forests and trees;
- promote the sustainable use of forests for environmental, economic, educational. recreational, cultural, health and spiritual purposes;
- promote community forestry;
- promote greater participation in all aspects of forestry and the forest products industry by persons disadvantaged by unfair discrimination.

Management of land with natural forests, woodlots or commercial forests will need to consider this Act.

3.7 National Veld and Forest Fire Act

The National Veld and Forest Fire Act, Act 101 of 1998 intends to:

- prevent and combat veld, forest and mountain fires throughout South Africa.

As fires remove vegetation cover and expose the soil to erosion, this act is an important consideration in terms of land management.

3.8 Mountain Catchment Areas Act

In terms of Section 2 of the Mountain Catchment Areas Act, 1970, as amended by the Mountain Catchment Areas Amendment Act, Act 76 of 1981, the Minister of Environment Affairs may proclaim any private area of which the water yield is of great importance to be a mountain catchment area.

3.9 Conservation of Agricultural Resources Act

The national Agriculture Department is responsible for implementing the Conservation of Agricultural Resources Act, Act 43 of 1983, (CARA), which stipulates, among other things, that:

- Virgin soil cannot be cultivated without written permission.

- Land with a slope of more than 12% cannot be cultivated without written permission.
- Cultivated land must be protected effectively against water and wind erosion.
- The veld on the farm must be effectively protected against deterioration and destruction. (CARA, 1983).

The above-mentioned permissions must be granted by the DALRRD.

3.10 Mineral and Petroleum Resources Development Act

Removing sand from a watercourse or dam will require a mining right authorisation from the Department of Mineral Resources (DMRE). A mining right may not exceed a period of 30 years. A mining right is granted if:

- the mineral can be mined optimally
- you have the funds and expertise to conduct the proposed mining operation optimally
- the financing plan is compatible with the intended mining operation and for the duration thereof
- no unacceptable pollution or damage to the environment will occur as a result of the mining operation
- you have made financial and other provisions for the prescribed social and labour plan
- you are not contravening the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA)
- the operation is in line with the Mining Charter.

3.11 Spatial Planning and Land Use Management Act

The Spatial Planning and Land Use Management Act, Act 16 of 2013 (SPLUMA) define development principles that apply to spatial planning, land development and land use management. Clause 7 (c) (ii) stipulates the principle of efficiency, whereby:

7 (c) (ii) decision-making procedures are designed to minimise negative financial, social, economic or environmental impacts.

7 (d) the principle of spatial resilience, whereby flexibility in spatial plans, policies and land use management systems are accommodated to ensure sustainable livelihoods in communities most likely to suffer the impacts of economic and environmental shocks; and

Such environmental impacts or shocks referred to above would include impacts related to erosion in catchments and sedimentation of dams. Sediment management, especially on a catchment scale, must give consideration to proper spatial planning and land use.

4 Institutions

According to the National Water and Sanitation Master Plan (NW&SMP) (DWS, 2018) the state water and sanitation sector currently comprises a large number of institutions with a complex suite of functions divided amongst them, creating an overly complex value chain. The DWS is the executive arm of national government responsible, amongst other things, for water and sanitation policy, regulation of water supply and sanitation provision, oversight of water sector institutions, water resources planning, operation and maintenance of 323 large dams (current count) and associated bulk infrastructure, regulation of water use and the collection and assessment of water data. Management of dam sedimentation, inclusive of the catchment sediment sources, spans a number of independent institutions, hence institutional co-operation is imperative for an integrated approach to be successful (WRC 2064/1/13). Key role players enacting the above-mentioned legislation are outlined in the sections below.

Table 4-1 matches the legislation related to sediment management (explored in Section 3) to its relevant national governing department (detailed further in this section). The legislation is also linked to the different types of sedimentation management interventions (Table 4-2).

Table 4-1: The relevant national departments and legislation related to sedimentation management

DWS	DEFF	DALRRD	DMRE
Water and Sanitation	**Environment, Forestry and Fisheries**	**Agriculture, Land Reform and Rural Development**	**Mineral Resources and Energy**
National Water Act, 1998 (Act No 36 0f 1998)	National Environmental Management Act (NEMA), 1998, with amendments (Act No. 107 of 1998)	Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)	Mineral and Petroleum Resources Development Act (Act 28 of 2002)
Water Services Act (Act 108 of 1997)	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004),		
	National Environmental Management: Protected Areas Act, 2003, with amendments (Act No. 57 of 2003),		
	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)		
	National Forests Act, 1998 (Act No. 84 of 1998)		
	National Veld and Forest Fire Act, 1998 (Act No. 101 of 1998)		
	Mountain Catchment Areas Amendment Act 76 of 1981		

Table 4-2: The potential implementing agents for the different types of interventions related to sedimentation management and associated legislation may be triggered by the intervention

Zone	Aim	Intervention type	Potential implementing agent in South African context	Triggering legislation
Source	Improve vegetation cover	Veld management	Meat naturally	Conservation of Agricultural Resources Act 43 of 1983. National Environmental Management Act 107 of 1998.
		Conservation agriculture	ARC	National Veld and Forest Fire Act 101 of 1998.
		Rainwater harvesting	ARC	Conservation of Agricultural Resources Act 43 of 1983.
		Agroforestry	DEFF	National Forests Act 84 of 1998. National Veld and Forest Fire Act 101 of 1998
		Natural grassland management	SANBI	NEMBA regulations for Invasive Species. National Environmental Management: Biodiversity Act 10 of 2004. National Veld and Forest Fire Act 101 of 1998.
		Wetland rehabilitation	Working for Wetlands	National Environmental Management Act 107 of 1998. National Water Act 36 of 1998. National Veld and Forest Fire Act 101 of 1998.
		Clearing of alien invasive plants	Working for Water	National Environmental Management: Biodiversity Act 10 of 2004. Agricultural Pests Act 36 of 1983. Conservation of Agricultural Resources Act 43 of 1983
	Reduce rill erosion	Contour ridging	Working for Land, LandCare	National Environmental Management Act 107 of 1998. National Water Act (NWA) 36 of 1998. Mountain Catchment Areas Act 63 of 1970.
		Vegetation rows	Working for Land, LandCare	
Transfer	Reduce gully erosion	Gully prevention	Working for Land, LandCare	National Environmental Management Act 107 of 1998. National Water Act 36 of 1998. Conservation of Agricultural Resources Act 43 of 1983
		Stone check dams	Working for Land, LandCare	
		Brushwood check dams	Working for Land, LandCare	
		Vegetation barriers	Working for Land, LandCare	National Water Act 36 of 1998. Conservation of Agricultural Resources Act 43 of 1983
		Gully reshaping	Working for Land, LandCare	National Environmental Management Act 107 of 1998. National Water Act 36 of 1998. Conservation of Agricultural Resources Act 43 of 1983.
		Roadside management	SANRAL	National Environmental Management Act 107 of 1998. National Water Act 36 of 1998.

	Reduce river bank erosion	Re-establish meandering rivers	DWS	National Environmental Management Act 107 of 1998. National Water Act 36 of 1998.
		Stream/riverbank management	Working for Water, BRIP, Municipalities, DWS	
		Reconnect river and floodplain	Working for Wetlands, DWS	
	Trap sediments upstream of dam	Small dams	DWS	National Environmental Management Act 107 of 1998. National Water Act 36 of 1998.
		Vegetation screens	DWS	
		Sabo dams	DWS	
Sink	Route sediments	Sediment bypass	DWS	National Environmental Management Act 107 of 1998. National Water Act 36 of 1998.
		Sediment pass through	DWS	
	Sediment removal	Flushing or sluicing	DWS	
		Pressure flushing	DWS	
		Empty flushing	DWS	
		Dry excavation	DWS	
		Dredging	DWS	
	Adaptive strategies	Redistribute sediment	DWS	
		Reallocate storage	DWS	
		Modify infrastructure	DWS	
		Adjust to reduce benefits	DWS	
		Repurpose or decommission	DWS	

4.1 Department of Water and Sanitation

The Department of Water and Sanitation (DWS), acting through the Minister of Water and Sanitation, is the custodian of water in South Africa. It is ultimately responsible for ensuring that water as a resource from rivers, lakes and dams is allocated equitably and used beneficially in the public interest, while promoting environmental values. Therefore, DWS must develop water sector regulatory and policy frameworks and ensure that water resources are protected, used, developed, conserved, managed and controlled effectively. It should be noted that the DWS is a National Government Department. There are no provincial departments for water management as such. The regional offices are only acting as sub-offices of the National DWS.

The DWS must also ensure that water resources are properly protected. Unless this is done effectively, there will be little purpose in regulating their use, development, conservation, management or control. The Minister must therefore (i) develop a water resource classification system; (ii) develop resource quality objectives; and (iii) determine the Reserve for all water resources. In determining the Reserve for each water resource, the Minister must take into account the quantity and quality of water required (i) for basic needs and water supply and (ii) to protect aquatic ecosystems. The Department must also ensure that water is used beneficially in the public interest.

The NWA makes provision for the recovery of costs for services rendered by the DWS to water users. To manage the recovery, the Water Trading Entity was created within the DWS. It consists of two components – water resources management and infrastructure management. The water resources management component deals with water quality, conservation and allocating water through CMAs, while the infrastructure management component is responsible for the operation, maintenance and development of infrastructure.

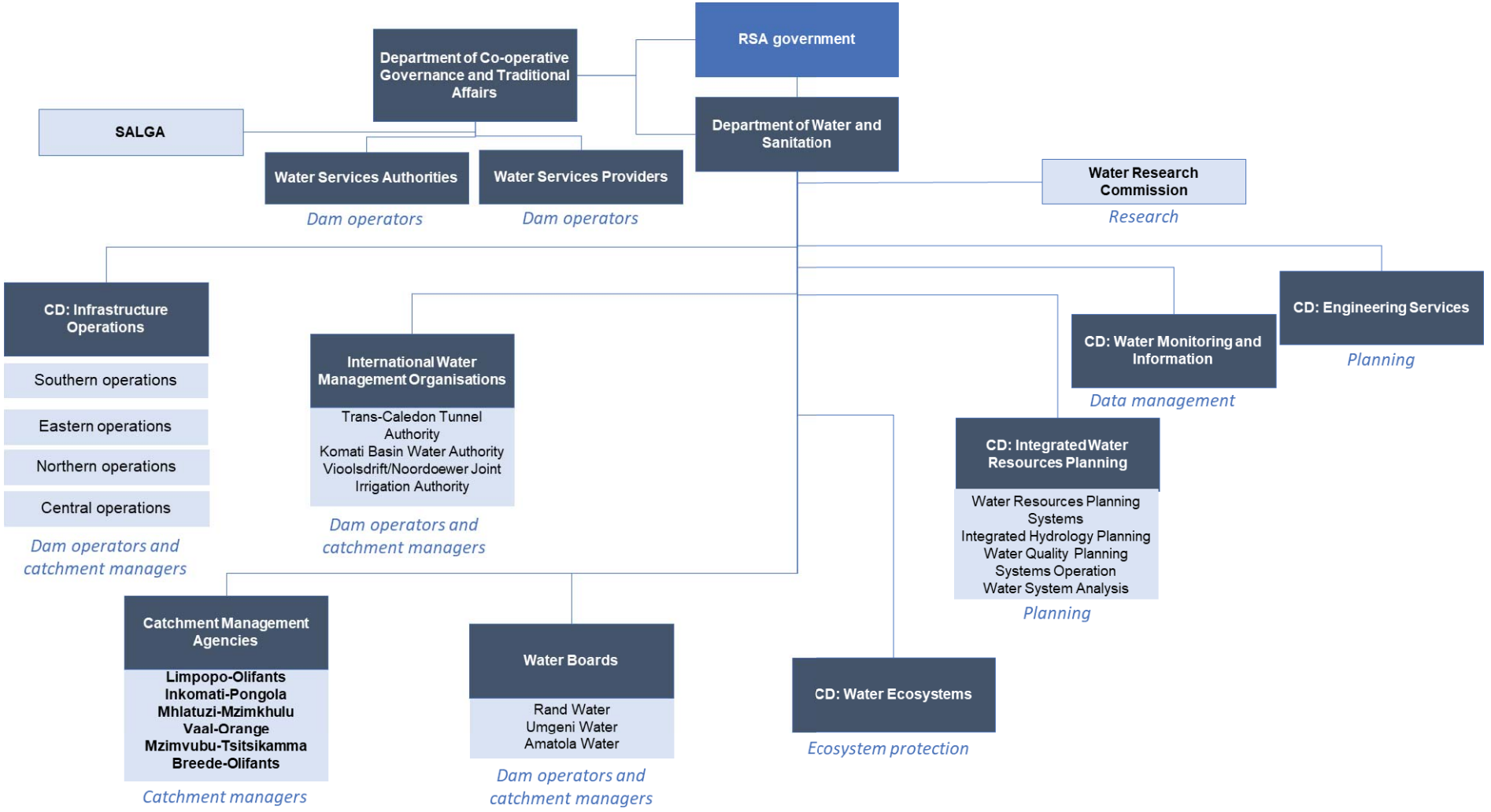


Figure 4-1: Institutional profile of the DWS, with relevance to sedimentation management

The NW&SMP summarises the top priority issues confronting the water and sanitation sector in South Africa and comprises three volumes: Call to Action (Volume 1), Plan to Action (Volume 2) and Schedule to Action (Volume 3). The status quo for water demand and increasing supply indicates that agriculture is by far the largest water user in South Africa (Figure 4-2), followed by municipal use. There is opportunity to reduce water use in these sectors, which will have a significant effect on total water requirements (DWS, 2018).

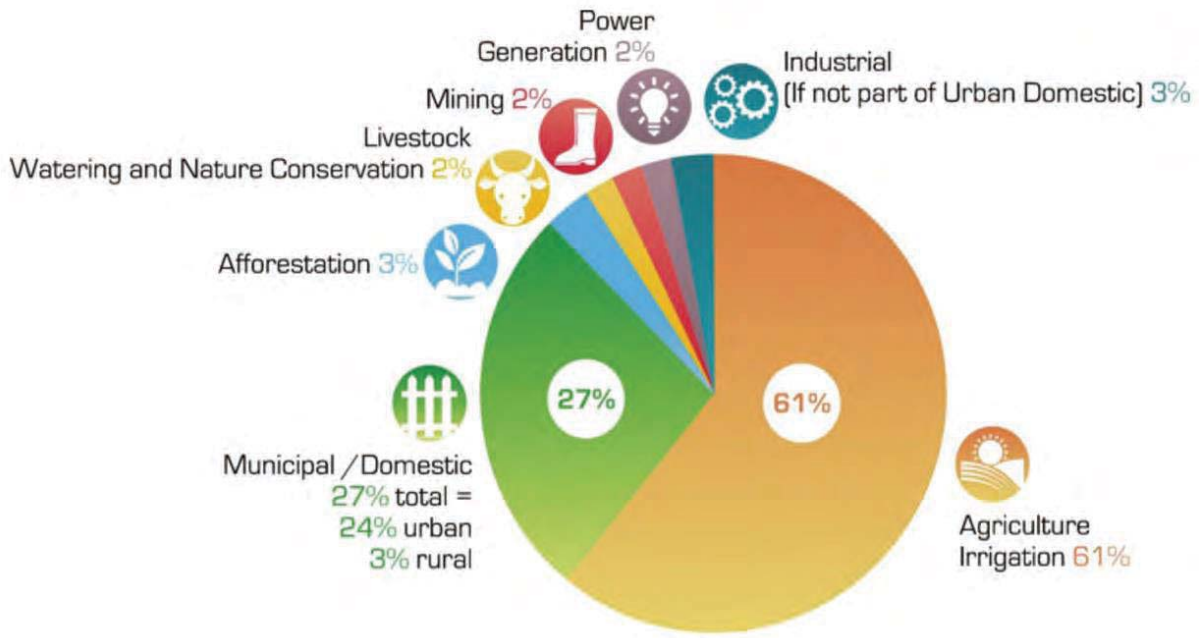


Figure 4-2: Current water use by sector (DWS, 2018)

The challenge of balancing requirements and supply means that South Africa will need to reduce water demand, whilst at the same time increasing supply for a growing population and economy. Drivers of a projected gap between requirements and supply are low tariffs, inadequate cost recovery, over-consumption, inefficient use, wastage, leakage, inappropriate infrastructure choices, inadequate planning and implementation, as well as population and economic growth (DWS, 2018). Additional challenges include declining water availability and raw water quality due to degradation of aquatic ecosystems, poor land use practices, high levels of water pollution and the influence of climate change. Opportunities for reducing user requirements and increasing supply include the following:

- improving efficiency, adopting new technologies, and reducing losses, especially in the agricultural and municipal sectors, through water awareness, and strict regulation, cost recovery and incentives. This is inclusive of looking at the potential for rainwater harvesting in low income areas.
- optimising the water mix by including groundwater use, re-use of effluent from wastewater treatment plants, water reclamation, as well as desalination and treated acid mine-drainage.

These opportunities must be considered when developing a sediment management plan as there may be associated benefits for sediment management if certain projects are implemented. The drive to protect and restore ecological infrastructure must also be considered, although this has mainly been assessed in terms of system yield. Broadening the understanding of ecological infrastructure benefits in terms of sediment retention capacity will be important, particularly for the Strategic Water Source Areas and wetlands.

4.1.1 National and regional level sedimentation management

(a) National Water Resources Infrastructure Agency (proposed)

Developing and managing national water resources infrastructure also forms part of the DWS's functions. This will be done through the National Water Resources Infrastructure Branch. In accordance with the current DWS restructuring proposals, a National Water Resources Infrastructure Agency will be established. In the State of the Nation address on 11 February 2021 the President mentioned that this process will be accelerated.

(b) Chief Directorate: Infrastructure Operations

The current development and management of national water resources infrastructure is done through the Infrastructure Operations Chief Directorate. The core services provided include:

- Construction Management
- Engineering Services
  - Civil Engineering Services
  - Hydrological Engineering Services
  - Mechanical and Electrical Engineering Services
  - Integrated Environmental Engineering Services
- Infrastructure Operations and Maintenance
  - Operational clusters
  - Strategic Asset Management
- Infrastructure Development
  - Project Planning, Development and Management

The National Water Resources Infrastructure Branch (NWRIB) is responsible to ensure that, in relation to water resources development at a national level, the required national water resources infrastructure is developed efficiently and effectively in a sustainable, equitable and reliable manner in order to make water available to water users and to water management institutions for further distribution. As such the NWRI is overall responsible for the management and maintenance of all Government Water Schemes including dams owned by the DWS.

The NWRIB is organised into four clusters, with associated water resources management schemes and dams:

- Southern Operations

  Western Cape and Eastern Cape Province
- Eastern Operations

  Kwa-Zulu Natal Province
- Northern Operations

  North West, Northern Mpumalanga and Limpopo
- Central Operations

  Gauteng, Mpumalanga, Northern Cape and Free State

These clusters manage the larger DWS dams within each cluster, but in certain cases the operation and maintenance of schemes are delegated to other local-level institutions such as Water Users Associations (WUAs) and Irrigation Boards (IBs) and Local Authorities where applicable. The dams are generally managed by an operational manager and in most cases there will be a catchment manager.

(c) DWS Directorates indirectly related to sedimentation management

There are various national and regional DWS offices that are indirectly related to sedimentation management. These include:

- Chief Directorate: Water Monitoring and Information

  Involved in assurance of compliance to water use regulations in mining, institutions, agriculture and forestry sectors; industrial sector, assurance of compliance to dam safety regulations. Also manages the spatial information for the Department. An updated version of this is the National Integrated Water Information System (www.dws.gov.za/niwis2/) with the purpose of providing information products, in the form of dashboards, to facilitate efficient analysis and reporting across the water value chain in South Africa.

- Chief Directorate: Integrated Water Resources Planning

  Involved in planning of water quality and quantity systems.

- Chief Directorate: Water Ecosystems

  Involved in water ecosystem protection.

(d) International Water Management Organisations

The NWA gives the Minister the authority to establish bodies, or institutions, for purposes of implementing international agreements that deal with the management and development of shared water resources. International water management bodies are considered under Section 10 of the NWA. These include the Trans-Caledon Tunnel Authority (1986), the Komati Basin Water Authority (1992), the Vioolsdrift/Noordoewer Joint Irrigation Authority (1992) and the Orange-Senqu River Commission (2000).

Control of resources common to independent authorities requires a high degree of co-operation to overcome difficulties in water apportionment, runoff management, erosion control, reservation sedimentation, flow regulation, diminution of flood damage risk and pollution control (WR RSA p3.3).

i. TCTA - Trans-Caledon Tunnel Authority

The Trans-Caledon Tunnel Authority (TCTA) was originally established as a special purpose vehicle to fulfil South Africa's treaty obligations in respect of the Lesotho Highlands Water Project. Its establishment was in line with government policy and practice to seek off-balance-sheet funding options for infrastructure projects, which can recover their costs through the end-user tariffs. The purpose of constructing works off-budget is twofold: to ensure that the cost of the infrastructure is paid for by the benefitting end consumer and not by the entire tax base; and to reduce government borrowing requirements.

TCTA is a state-owned entity charged with financing and implementing bulk raw water infrastructure projects. TCTA assists the government in its pursuit of water security for South Africa and in realising its constitutional obligation of ensuring universal access to this essential resource for all citizens. The mission of the TCTA is to plan, finance and implement sustainable and accessible water resource infrastructure.

Several dams have been built under the auspices of TCTA, namely Katse and Mohale Dams in Lesotho, Spring Grove Dam on the Mooi River and the Berg River Dam. This model could be investigated further in how to execute certain dam sedimentation interventions.

The TCTA may be merged with the National Water Infrastructure Branch of the DWS to form the National Water Resources Infrastructure Agency.

ii. Komati Basin Water Authority

The Komati Basin Water Authority (KOBWA) is a bi-national entity formed in 1993 through the Treaty on the Development and Utilization of the Water Resources of the KOMATI River Basin which was signed in 1992. The agreement was between the Kingdom of Eswatini and the

Republic of South Africa The purpose of KOBWA was to implement Phase 1 of the Komati River Basin Development Project.

KOBWA is responsible for financing, developing, operating and maintaining the water resources infrastructure in the basin, comprising Driekoppies Dam on the Lomati River and Maguga Dam on the Komati River.

iii. Vioolsdrift/Noordoewer Joint Irrigation Authority (1992)

This authority manages the joint use of water on both flanks of the lower reaches of the Orange River in the vicinity of the Vioolsdrift border post between South Africa and Namibia. The proposed Vioolsdrift Dam may also fall under the remit of this authority.

iv. Orange-Senqu River Commission (2000)

The Orange-Senqu River Commission (ORASECOM) was established to promote the equitable and sustainable development of the resources of the Orange-Senqu River. ORASECOM provides a forum for consultation and coordination between the riparian states to promote integrated water resources management and development within the basin. Its goals are to develop a comprehensive perspective of the basin; study the present and planned future uses of the river system, and determine the requirements for flow monitoring and flood management.

(e) Water Boards

The primary activities of Water Boards as declared in Section 29 of the Water Services Act (Act 108 of 1997), are to provide water services (water supply and sanitation services) to other water services institutions in its service area.

In addition, Section 30 of the Water Services Act (Act 108 of 1997), enables Water Boards to undertake other activities, provided these do not impact negatively on the entity's ability to perform its primary activity. These include providing Catchment Management Services to or on behalf of the responsible authority.

Currently, the three largest water boards in South Africa that are also involved in catchment management activities are Rand Water, Umgeni Water and Amatola Water.

i. Rand Water

The Rand Water network comprises of three primary systems for raw water abstraction and treatment (two treatment stations), one southerly sub-system and four main booster systems for bulk distribution

Raw water is drawn primarily from the Vaal River System via two treatment stations: Zuikerbosch and Vereeniging.

Rand Water has entered into partnerships with various government departments to implement a number of alien plants removal projects.

ii. Umgeni Water

Water quality risks associated with Umgeni Water's raw water supplies can arise from various catchment and impoundment issues. The effects of these issues in turn relate to raw water treatability, chemical usage and other cost implications. Elevated turbidity is caused by poor agricultural practices upstream of various dams.

Catchment Water Quality Management Plans include engaging in catchment management activities to achieve Resource Quality and Quantity Objectives that will balance environmental objectives and safeguard consumer health.

Umgeni Water participates in catchment management activities and related forums and contributing to the wider water-related information base, including collection and provision of water quality data. This influences decisions on catchment land use activities and more sustainable development.

Research projects undertaken internally by Umgeni water include the role of ecological infrastructure in securing water supply in the uMgeni Catchment - to investigate the status of catchment land-use, and its impact on resource water quality and the financial implications of ecosystem infrastructure degradation. (Umgeni Water, 2019)

iii. Amatola Water

Amatola Water started providing water services primarily to municipalities, under the provisions of the Water Services Act (Act 108 of 1997). The current area of operation covers a tract of the central Eastern Cape Province, encompassing most of the Amathole and Chris Hani District Municipalities together with lesser portions of the Joe Gqabi and Sarah Baartman Districts.

(f) Local Authorities

In terms of Section 84 of the Municipal Structures Act, Act 117 of 1998, the responsibility for providing water services rests with district and metropolitan municipalities. However, the Act allows the Minister of Provincial and Local Government Affairs to authorise a local municipality to perform these functions or exercise these powers. The district (or authorised local) municipality constitutes the Water Services Authority as defined in the Water Services Act, Act 108 of 1997.

Some local municipalities are also delegated to manage and operate state dams such as Beaufort West Municipality (Gamka Dam), Plettenberg Bay Municipality (Roodefontein Dam), Kannaland Municipality (Tierkloof Dam), etc.

Municipalities also often obtain water from various state dams for distribution in their areas of jurisdiction. The water quality and assurance of supply from the state dams are especially important for management of purification costs and long-term planning for water supply.

The South African Local Government Association (SALGA) advises the local authorities on various aspects of their operation.

4.1.2 Local level sedimentation management

(a) Catchment Management Agencies

Pursuant to the overarching goal of decentralising water resource management, the Minister may progressively establish Catchment Management Agencies (CMAs) and Water User Associations (WUAs).

These institutions form the primary means of ensuring that local communities actively participate in water resources management. CMAs should comply with national policy and the National Water Resource Strategy (NWRS). Where no functional CMA exists in a Water Management Area, the Minister must fulfil the functions of a CMA in that area.

The NWA provides for the progressive establishment of CMAs to undertake water resources management at a regional or catchment level. The role of CMAs is to ensure that water resources are managed in accordance with national policies, guidelines and standards in their jurisdiction and to ensure the involvement of local communities in water resources management.

Broadly, the role of a CMA is articulated in the Act as:

- managing water resources in a water management area,
- co-ordinating the functions of other institutions involved in water related matters, and
- involving local communities in water resource management.

CMAs are established to ensure that water resources are managed effectively at regional or catchment level where local community involvement is most effective. It is here where local communities are envisaged to actively participate in the decision-making processes and are encouraged to promote equitable access to water, ensuring that usage meets basic human needs and facilitates social and economic growth in the area.

Viability assessments with respect to water resources management, funding, capacity, skills and expertise, and regulation and oversight recommended the consolidation of CMAs into six proposed CMAs for the following Water Management Areas: Limpopo-Olifants; Inkomati-Pongola; Mhlatuzi-Mzimkhulu; Vaal-Orange; Mzimvubu-Tsitsikamma; and Breede-Olifants.

Figure 4-3 indicates the boundaries of the restructured Catchment Management Agencies.

Figure 4-3: Six Catchment Management Agency areas

Once a CMA is established and becomes operational it obtains general powers inherent to its establishment, including advising interested persons on handling water resources in the area, promoting community participation in water resource management and coordinating activities between water users and water management institutions within its designated area. A CMA must develop a catchment management strategy for its area which it must implement in line with the NWRS.

Only two fully operational CMAs have been established since the enactment of the NWA more than twenty years ago. The boundaries of the two existing CMAs will be extended to the above. Where CMAs are not formally established or operational, the Regional Offices of DWS are acting as proto-CMAs. The two existing CMAs are described below:

i. Inkomati-Usuthu Catchment Management Agency

The Vision of the Inkomati-Usuthu Catchment Management Area (IUCMA) is to supply sufficient, equitable and quality water resources for all in the Inkomati-Usuthu Water Management Area. The Mission of the IUCMA is to efficiently manage water resources by empowering stakeholders in the quest to contribute towards transformation by promoting equal access to water and protecting the environment.

The IUCMA supports the cooperative management of the Inkomati basin as an internationally shared watercourse. The IUCMA manages the resources adaptively, cooperatively and

progressively to achieve social, economic and environmental justice, and promote healthy living. (IUCMA, 2019).

The operational area of the IUCMA will be extended to include the Pongola Catchment. It will be renamed the Inkomati-Pongola CMA.

ii. Breede-Gouritz Catchment Management Agency

The Breede-Gouritz Catchment Management Area (BGCMA) is responsible for the management of water resources in the Breede-Gouritz Water Management Area. The BGCMA ensures that water resources management services are brought to stakeholders at a local level with their participation and involvement (BGCMA, 2019).

There are 28 DWS dams in the operational area of BGCMA. A number of them are manged in part by irrigation boards and water user associations. Catchments of the dams are managed in terms of water use related activities.

(b) Water User Associations

WUAs are water management institutions established by the Minister that operate at a local level. WUAs provide the institutional structure necessary for individual water users to cooperate and pool their resources – allowing them to carry out water-related activities more effectively. The objective is to provide services to the benefit of all its members, especially for productive water uses.

A number of WUAs and Irrigation Boards (IBs) are managing schemes on behalf of the DWS. Duties include releases of water from state dams and management of the use of the water in accordance with water allocations that were declared as existing lawful water uses.

Under the NWA, IBs are to be transformed into WUAs. WUAs have representation of all water users from a specific water resource including irrigation farmers, municipalities, industrial users and emerging farmers. Areas of operation include the supply areas from the dams and in some cases also parts of the catchments above the dams. The WUAs or IBs have a special interest in the sedimentation of the respective dams in their area of operation as it directly affects the yield of the dam, water quality and assurance of water supply.

The South Africa Federation for Water User Associations (SAAFWUA), acting as the coordinating body for WUAs and IBs, represent the associations in liaison with the DWS and other organisations.

A list of state dams that are operated to a certain extent or water supplied to the respective WUA or Irrigation Boards is recorded in Annexure A.

(c) Catchment Stakeholder Forums

Several catchment stakeholder forums are active in various parts of the country and particularly in Water Management Areas and in areas where CMAs are more active. Forum activities include coordination between stakeholders, water quality monitoring, operation of water supply from dams, long term strategic planning of water resources, input in licence applications and assisting in compliance monitoring of unauthorised water use activities.

Membership typically comprise municipalities, irrigation boards and water user associations, government departments, non-governmental organisations (NGOs) and community-based organisations (CBOs).

4.1.3 Public entities reporting to the DWS

(a) Water Research Commission

The Water Research Commission (WRC) has a vital role in water research by establishing needs and priorities, stimulating and funding research, promoting the transfer of information and technology, and enhancing knowledge and capacity building in the water sector.

It also focuses on water resources management, water-linked ecosystems, water use and waste water management as well as water use in agriculture.

4.2 Department of Environment, Forestry and Fisheries

The mission of the Department of Environment, Forestry and Fisheries (DEFF) is to provide leadership in environmental management, conservation and protection towards sustainability for the benefit of South Africans and the global community. The DEFF manages the National Environmental Management Act (NEMA), 1998, with amendments (Act No. 107 of 1998), that provides for co-operative environmental governance by establishing principles for decision making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state, while also providing for certain aspects of the administration and enforcement of other environmental management laws.

NEMA (Act No 107 of 1998) states that before any listed development activities can be undertaken, an environmental impact assessment must be undertaken and an environmental authorisation obtained.

The listed activity that relates to cultivation of virgin land is "*the transformation or removal of indigenous vegetation of 3ha or more, or of any size where the transformation or removal would occur within a critically endangered or an endangered ecosystem listed in terms of section 52 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)*". This includes:

- Transformation or removal of indigenous vegetation on land that has been transformed over 10 years ago.
- Any phased transformation or removal of indigenous vegetation.
- Removal or transformation of indigenous vegetation with, for example, a bulldozer to create firebreaks, roads or tracks.

Evidence of illegal cultivation is collected by mapping the ploughed sites and overlaying the maps on a time series of aerial photographs, which are available for the whole country.

Other acts of relevance for biodiversity is the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003). Sediment may be considered a waste product when released into a waterbody under the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). Forests are managed under the National Forests Act, 1998 (Act No. 84 of 1998) and National Veld and Forest Fire Act, 1998 (Act No. 101 of 1998).

The DEFF Strategic Plan for 2019/20 - 2023/24 (DEFF, 2020) indicates that although the DEFF has had successes in rehabilitation and restoring degraded ecosystems, land degradation and soil erosion are still serious challenges that undermines the productive potential of the land. The Plan indicates that over 70% of the South African land surface has been intensely affected by a variety of soil erosion and that over 0.7 million ha of land is currently degraded and left bare by soil erosion (sheet and gully erosion). Under the Environmental Programmes Branch the strategy for the next five years is to increase the hectares of degraded land under rehabilitation (including riparian areas) from a baseline of 101 760 ha to 142 200 ha.

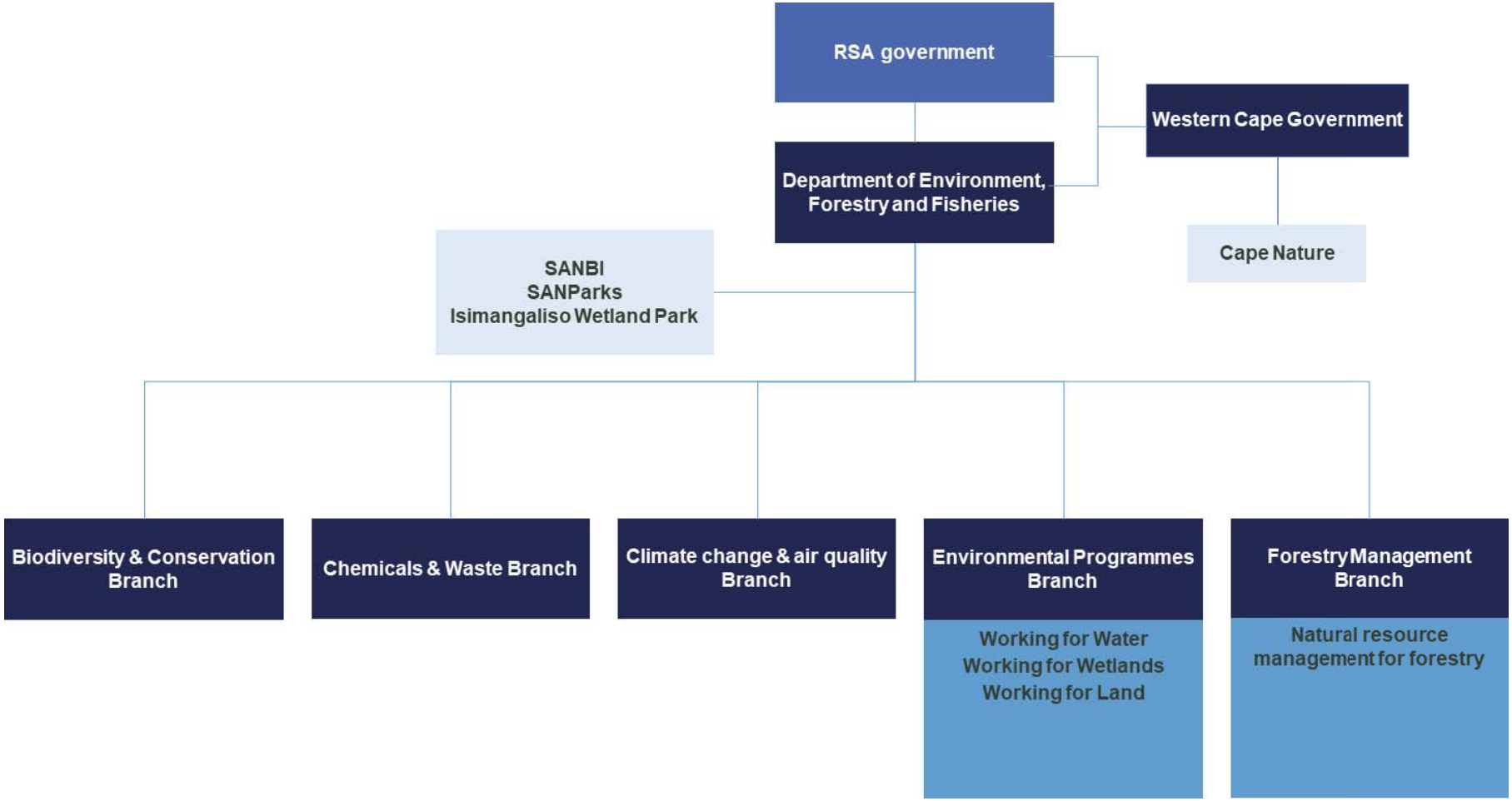


Figure 4-4: Institutional profile of the DEFF, with relevance to sedimentation management

4.2.1 National level sedimentation management

DEFF Branches involved in land management are the following:

(a) Regulatory Compliance and Sector Monitoring branch

The focus is to promote the development of an enabling legal regime, licensing/ authorization system that will promote enforcement and compliance. This is done through continued implementation of various interventions, one of them being the integrated environmental licences inclusive of Water Use Licence Authorisations (from DWS) and mining permits (from DMRE).

(b) Biodiversity and conservation branch

The focus of the biodiversity and conservation branch is on the regulation and management of all biodiversity, heritage and conservation matters in a manner that ensures equitable and sustainable use, conservation, management and, where necessary, the restoration of this resource base as well as to mitigate threats to them as a basis for sustainable and inclusive socio-economic development facilitates sustainable economic growth and development. Within this framework the branch is involved in restoration of the “resource base”, in certain cases land and water ecosystems which are considered biodiversity priorities. Ecosystems within strategic water source areas are a priority.

(c) Chemicals and waste branch

The focus of the chemicals and waste branch are to manage and ensure chemicals and waste management policies and legislation are implemented and enforced in compliance with chemicals and waste management authorizations, directives and agreements. As sediment may be considered a waste product, sedimentation management is of interest to this branch in an indirect way. What is of more importance is the likelihood of sediment storage zones (i.e. dams) also being chemical or waste sinks as the chemical or nutrient may be bound to the sediment.

(d) Climate change and air quality branch

The focus of the climate change and air quality branch is to improve air and atmospheric quality, lead and support, inform, monitor and report efficient and effective international, national and significant provincial and local responses to climate change. The branch is not involved in sedimentation management, but as rainfall is an important driver of erosion the branch will require climate change scenarios to be considered in future sedimentation management.

(e) Environmental programmes branch

The focus of the environmental programmes branch is to alleviate poverty and uplift households especially those headed by women through job creation, skills development, and use of Small Medium and Micro Enterprises (SMMEs) whilst at the time contributing to the achievement of the departmental mandate. The funded projects need to always bring about the balance between the social, economic and environment for sustainable living. The branch consists of two chief directorates who are involved in sedimentation management projects at the local level. These are the Environmental Protection and Infrastructure Programmes (EPIP) and Natural Resource Management (NRM).

(f) Forestry management branch

The purpose and functions of the forestry management branch are to provide strategic direction and leadership to the department with regard to the promotion of the sustainable management, use and protection of forests and natural resources to achieve social and economic benefits and to promote development. The Natural Resources Management programme facilitates the development of infrastructure and the sustainable use of natural resources through an enabling framework for the sustainable management of woodlands and indigenous forests, the efficient development and revitalisation of irrigation schemes and water use. It facilitates climate change mitigation and adaptation, risk and disaster management, as well as promotes, regulates and coordinates the sustainable use of natural resources (land and water).

4.2.2 Provincial sedimentation management

(g) Provincial Departments

The provincial Departments are mandated to oversee the socio-economic development of the province. The Environmental Departments are mainly concerned with compliance monitoring, enforcement and developing policies and laws for the province in adherence with the Constitution.

4.2.3 Local level sedimentation management

Local level land management includes programmes such as the following:

(a) Environmental Protection and Infrastructure

The EPIP programmes focus on infrastructure related projects that contribute towards the environmental protection, conservation and sustainability, whilst creating work opportunities, and providing skills development to enable beneficiaries to secure permanent employment.

(b) Natural Resource Management

NRM Programmes ensure that South Africa addresses its responsibilities relating to water resource management, biological diversity and the functioning of natural systems whilst ensuring meaningful livelihood opportunities are supported for those employed on these programmes. These projects have in the past been funded and implemented in partnership with the DWS due to the significant water resource benefits.

This process originated with the Working for Water Programme (WfW), launched in 1995 and administered previously through the DWS and now the DEFF. The WfW Programme focuses on the fact that invasive woody alien plants in the mountain catchment areas needed to be eradicated since they had an impact on indigenous flora and water yields. Invasive alien plants (IAPs) pose a direct threat not only to South Africa's biological diversity, but also to water security, the ecological functioning of natural systems and the productive use of land. They intensify the impact of fires and floods and increase soil erosion. IAPs can divert enormous amounts of water from more productive uses.

The WfW Programme works in partnership with local communities, to whom it provides jobs, and also with Government departments, research foundations and private companies.

The general objectives of these projects are to:

- Enhance water security by regaining control over invasive alien plants,
- Improve ecological integrity of invaded natural systems,
- Maximize social benefits, and
- Promote appropriate use of land that is cleared.

The success of the Programme is largely attributed to it being mainly funded as a poverty-relief initiative, although water users also contribute through their water use charges.

4.2.4 Public entities reporting to the DEFF

The public entities that report to the DEFF are as follows:

(a) South African National Biodiversity Institute

The South African National Biodiversity Institute (SANBI) was established in 2004 in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004). The mandate of SANBI is to play a leading role in South Africa's national commitment to biodiversity management, now and into the future. SANBI leads the biodiversity research agenda and engages in ecosystem restoration and rehabilitation programmes to manage biodiversity.

Projects involved in sedimentation management include the uMngeni Ecological Infrastructure Partnership (UEIP); CAPE Programme; Succulent Karoo Programme (SKEP); Land User Incentive; Freshwater Programme Wetland Inventory; Grasslands Programme; and the Biodiversity Mainstreaming Toolbox for Land Use Planning and Development.

(b) South African National Parks

South African National Parks (SANParks) was established in 2003 in terms of the National Environmental Management: Protected Areas Act (Act 57 of 2003). The mandate of SANParks is to oversee the conservation of South Africa's biodiversity, landscapes and associated heritage assets through a system of national parks.

(c) Cape Nature

CapeNature is responsible for biodiversity conservation in the Western Cape. It works to establish a successful conservation economy for all through the promotion of nature. CapeNature plays a crucial role in ensuring the Western Cape has a sustainable supply of clean, fresh and potable water to support our population and a growing economy.

CapeNature use an integrated approach in the management of the Western Cape's catchment areas, which "catch" rainfall runoff. The catchment areas managed by CapeNature provide up to 60% of the potable water used in the province.

Integrated catchment management is holistic, focusing on both water and land management, as the two are inextricably connected. A change to the broader environment may have a profound effect on a water cycle. CapeNature efficiently manages natural water resources to ensure a sustainable water supply for communities, balancing the need to protect this precious resource with the needs of industry and agriculture.

As part of catchment management, CapeNature works to control fires and invasive alien species to protect the ecosystems surrounding catchment areas, while guiding land-use planning and development. Integrated catchment management allows CapeNature to establish and strengthen partnerships with municipalities, fire associations and non-government organisations and public-sector programmes.

4.3 Department of Agriculture, Land Reform and Rural Development

The Department of Agriculture, Land Reform and Rural Development (DALRRD) is responsible for implementing the Conservation of Agricultural Resources Act (CARA, 1983), which stipulates, among other things, that:

- Virgin soil cannot be cultivated without written permission.
- Land with a slope of more than 12% cannot be cultivated without written permission.
- Cultivated land must be protected effectively against water and wind erosion.
- The veld on the farm must be effectively protected against deterioration and destruction

The DALRRD Vision for the 2020-2025 period is to provide equitable access to land, integrated rural development, sustainable agriculture and food security for all. This vision moves beyond agriculture to include land reform as a catalyst for rural development and improving agricultural production to stimulate economic development and food security. The DALRRD is therefore mandated to pursue natural resource management as a means for improving socio-economic conditions of South African citizens.

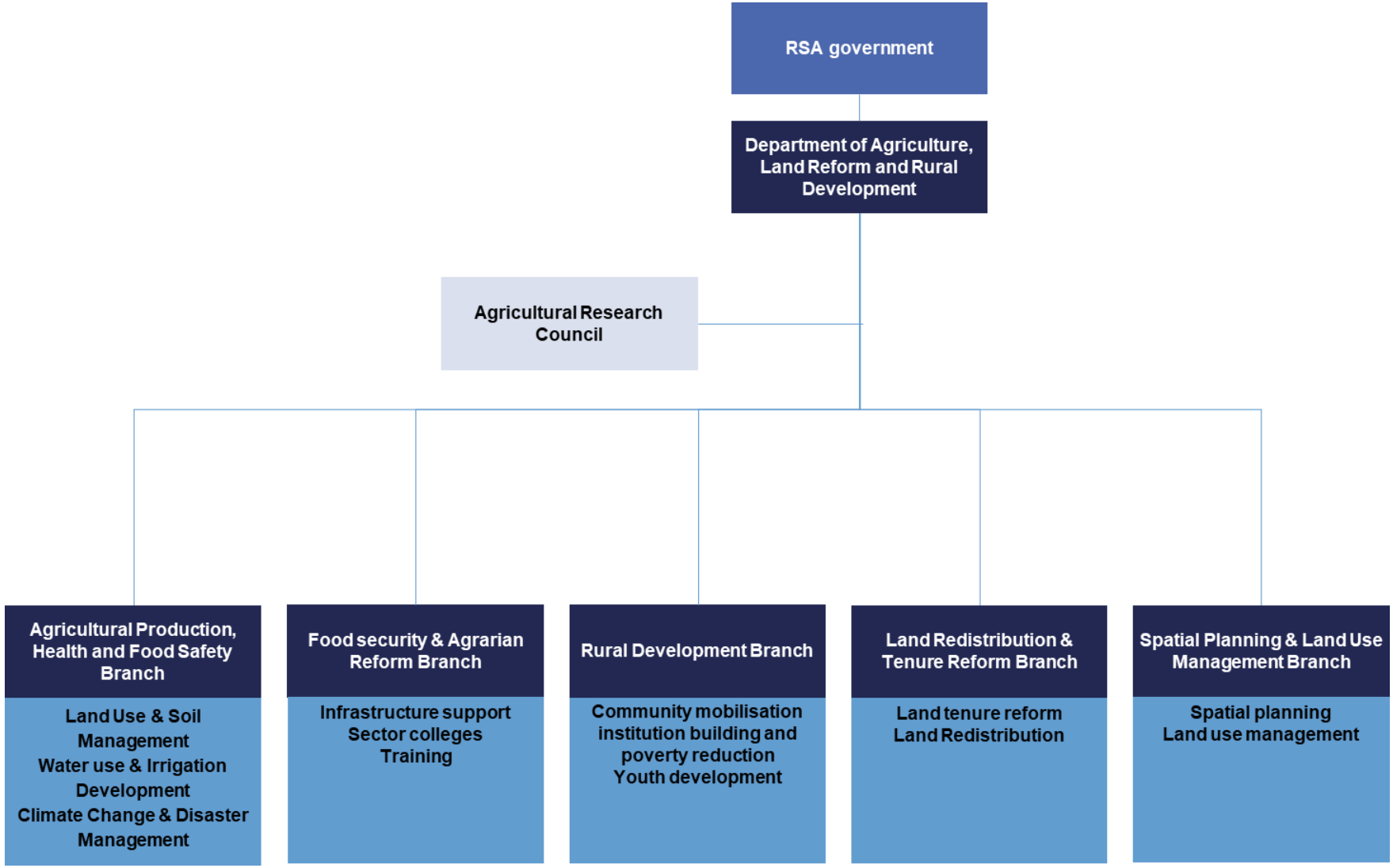


Figure 4-5: Institutional profile of the DALRRD, with relevance to sedimentation management

Although South Africa represents one of the largest economies on the African continent, it has experienced marginal growth and has been outcompeted by other emerging African economies. From 2014 to 2018 the Gross Domestic Product (GDP) has been growing at less than 1.1% (DALRRD, 2020). While the impact of uncertain global economic conditions has contributed to this stagnation, other key contributors include policy uncertainty, energy crises, and low investor sentiment. The Agriculture, Forestry and Fisheries sector is the second smallest contributor to the South African economy, contributing only 2,47%. The sector has also been experiencing relatively stagnant growth over the past five years, at 0,6%. The economic stagnation has increased the state of inequality and unemployment, with youth unemployment being related to relatively low education levels.

Within this macro-environment, the DALRRD is specifically mandated to support rural South Africa (approximately 33% of the population). In South Africa, rural areas have the highest poverty concentration, with 60% of the population living below the poverty line (Figure 4-6). Although there are underlying drivers for this concentration, the disconnected nature of rural areas is a key factor. Historical socio-political drivers are also a key consideration as most rural areas fall within the "homelands" system during colonialism and Apartheid, emphasising a historical exclusion from service delivery. This lack of services has also influenced the rapid rate of rural to urban migration, which has more than doubled in the last twenty years.

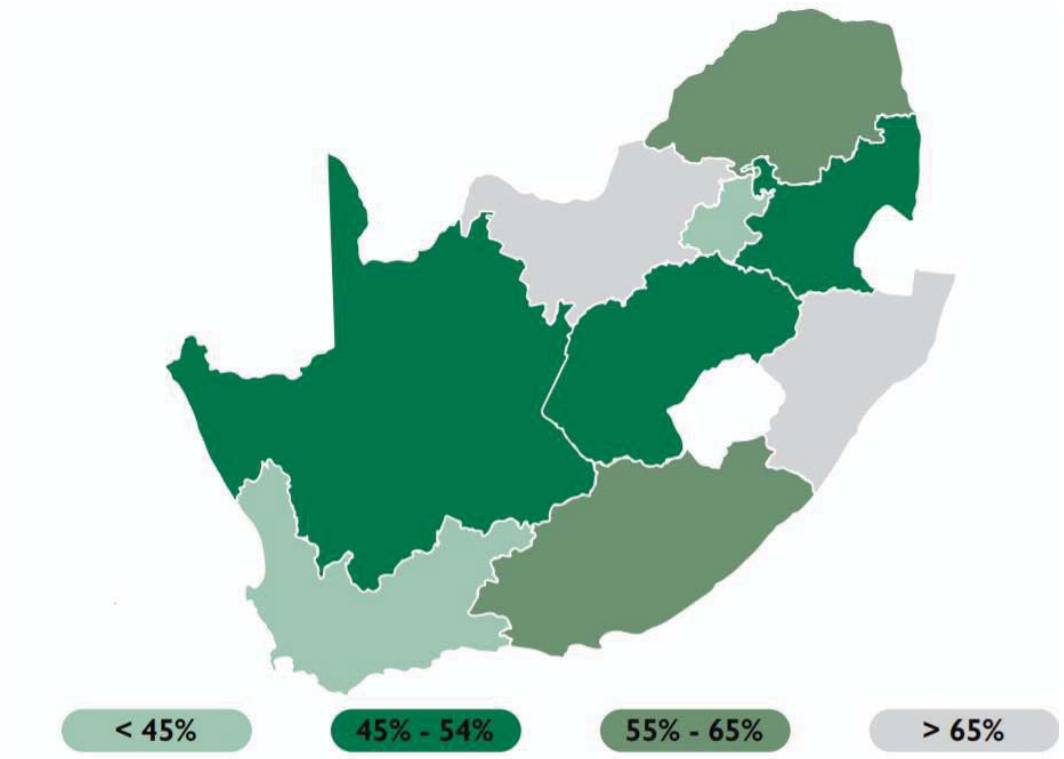


Figure 4-6: Provincial poverty levels (DALRRD, 2020)

The rural economy has traditionally been thought to encompass agriculture and mining as the main contributors, but it is worth noting that subsistence agriculture plays an important role of meeting the needs of communities. Social grants play an important role in supporting the social infrastructure of rural economies. Social grants are provided to 44% of households in South Africa, most of which are in rural areas (Figure 4-7). The rural economy is thus propped up by shrinking resources and the DALRRD needs to focus its efforts on improving this status. The strategic intention for the Department is thus a focus on the rural economy and improved livelihoods.

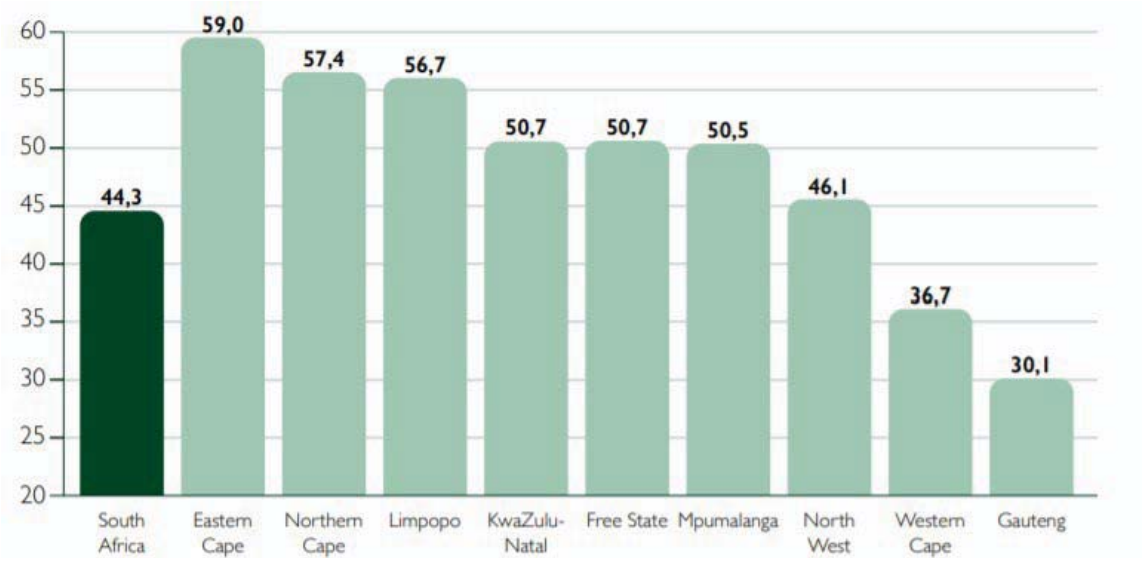


Figure 4-7: Percentage of households benefitting from social grants by province, 2018 (DALRRD, 2020)

4.3.1 National level sedimentation management

The relevant branches in the DALRRD for sediment management are as follows:

(a) Agricultural production, health and food security

The Directorates relevant to sedimentation management are as follows:

- Climate Change and Disaster Management

  Focuses on a national response to climate change and disaster management for the sector.

- Land Use and Soil Management

  Focuses on promoting, regulating and co-ordinating the sustainable use of natural resources (land and soil).

- Water use and Irrigation Development

  Focuses on the efficient development and revitalization of irrigation schemes and water use

(b) Food security and agrarian reform

The Directorates relevant to sedimentation management are as follows:

- Infrastructure support

  Infrastructure support inclusive of soil conservation measures.

- Smallholder producers and subsistence farming

  Assist smallholder producers and subsistence farmers through the provision of implements and infrastructure.

(c) Land redistribution and tenure reform

Although not directly related to sedimentation management it will be important to take not of the land redistribution and land tenure policies.

(d) Spatial planning and land use management

Provides spatial information.

4.3.2 Provincial level sedimentation management

(a) Provincial Departments

The provincial Departments are mandated to oversee the socio-economic development of the province. The provincial agriculture departments provide a wide range of development, research and support services to the agricultural community. The agricultural sector stimulates economic growth in the province and plays a major role in creating sustainable job opportunities.

4.3.3 Local level sedimentation management

The relevant local level programmes in the DALRRD for sediment management are as follows:

(a) LandCare

The National LandCare Programme is a government-supported community-based initiative, which is active throughout the country. Driven by both the public and private sectors through partnerships and cooperation, it seeks to:

- conserve natural resources
- use them in a sustainable way
- create a conservation ethic through education and awareness
- create jobs and address poverty by launching various natural resource rehabilitation, improvement and conservation projects.

Serious concerns about land and water degradation are identified in each province and specific projects address these issues.

Projects have been implemented in all nine provinces through the LandCare Conditional Grant, whereby ring-fenced funding is transferred to provinces. Four subprogrammes, namely WaterCare, VeldCare, SoilCare and JuniorCare, are all part of the LandCare Programme.

4.3.4 Public entities reporting to the DALRRD

(a) Agricultural Research Council

The Agricultural Research Council (ARC) is a public entity established under the Agricultural Research Act (Act 86 of 1990, as amended). The ARC has a primary mandate to drive research and development in order to promote agriculture and related industries; contribute to a better quality of life; facilitate or ensure natural resource conservation; and alleviate poverty. In terms of sedimentation management, ARC focuses on soil, climate and water through an agro-meteorological network, land type surveys, satellite image databases for natural resource and disaster management; and plant protection through national collections. The Research and Innovation Systems division of the ARC supports the strategic goal of enhancing and conserving natural resources.

4.4 Department of Minerals, Resources and Energy

The Department of Minerals, Resources and Energy (DMRE) is mandated to develop a mineral resources and energy sector that promotes economic growth and development, social equity and environmental sustainability. The Department is mandated under the Mineral and Petroleum Resources Development Act (Act 28 of 2002). Although mining itself may create environmental degradation and increase sedimentation in dam catchments, the removal of sand from a watercourse or dam is also regulated under this Act.

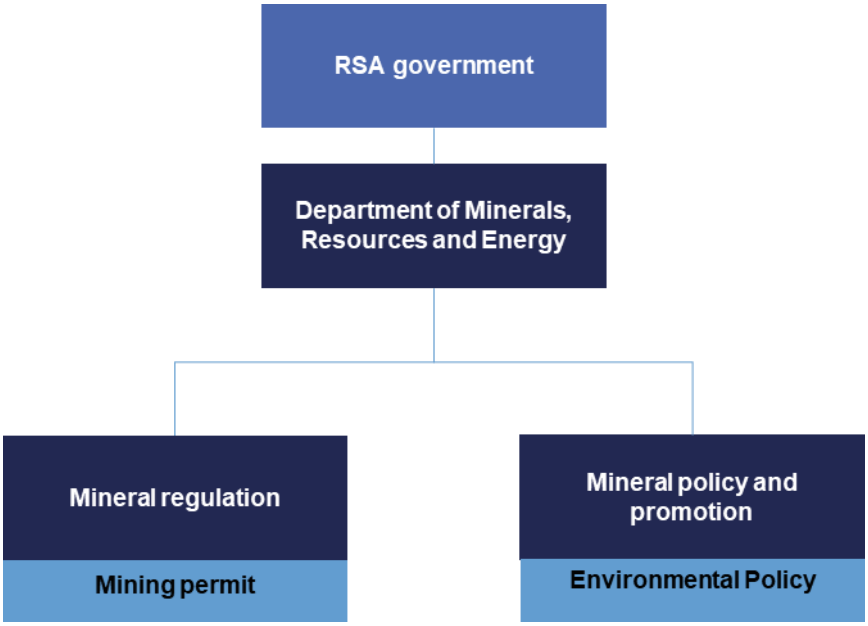


Figure 4-8: Institutional profile of the DMRE, with relevance to sedimentation management

4.4.1 National level sediment management

The relevant branches in the DMRE relevant to sedimentation management are as follows:

- Mineral regulation

  Mineral Regulation is responsible for the administration of prospecting rights, mining rights, mining permits and compliance with the Mineral and Petroleum Resources Development Act (Act 28 of 2002), including environmental management. The current process for applying for a mining permit (i.e. for sand removal) is through an online system.

- Mineral policy and promotion

  The Environmental Policy Directorate undertakes research to develop, communicate and promulgate environmental policy, legislation, norms, standards and strategies under the Mineral and Petroleum Resources Development Act 2002, Act 28 of 2002.

5 Recommendations & Conclusion

A number of institutions are involved in the management of state dams as well as catchment management and land management upstream of the dams that influence sedimentation of dams or are affected by the quality of water from the dams or the decreasing assurance of water supply due to loss of storage as a consequence of sedimentation.

In addition to the institutions, the role of the broader society and community (e.g. in the form of Citizen Scientist) should not be underestimated. There is a wealth of knowledge amongst scientist that are not necessarily associated with institutions, but who can contribute significantly to the collective effort in South Africa (and internationally) in managing the sedimentation of dams. It is recommended that a platform be created for such scientists where they can contribute and share knowledge.

Table 5-1 summarises the roles that these institutions play / or should play in dam sedimentation management.

We propose that representatives from the following institutions be invited to a Workshop to deliberate, taking into account the respective mandates, in order to inform and aid future dam sedimentation managers to carry out their role.

- DWS:
    - DWS: National Water Infrastructure Branch – National office and cluster offices
    - DWS: Proto CMAs in Provincial offices where CMAs are not established yet
    - Existing CMAs (Inkomati-Usutu and Breede-Gouritz)
    - SAAFWUA to represent Irrigation Boards and Water User Associations
    - SALGA to represent municipalities
    - Trans-Caledon Tunnel Authority
    - Komati Basin Water Authority
    - Water Boards
    - Water Research Commission
- DEFF:
    - DEFF: Environmental Programmes Branch – National office
    - NRM: Working for Water; Working for Land; Working for Wetlands, Working in Fire
    - CapeNature
- DALRRD:
    - DALRRD
    - LandCare unit
- ESKOM
- Broader Society and Community

Table 5-1: Roles of institutions in the dam sedimentation management process

Institution	Level	Organisation	Role	Scope in sediment pipeline	Catchment	Regulations	Compliance	Enforcement	Dam Opps &	Financing
DWS	National	Infrastructure Operations	Custodian water resources,	Dam construction, operation & maintenance					X	X
DWS	National	TCTA (to be NWRIA)	Dam construction, operation & maintenance	Dam construction, operation & maintenance	X				X	X
DWS	National	Umgeni Water	Umgeni water management	Catchment management, dam operation	X		X		X	X
DWS	National	Rand Water	Rand water management	Catchment management, dam operation	X		X		X	X
DWS	National	Amatola Water	Amatola water management	Catchment management, dam operation	X		X		X	X
DWS	National	Water Ecosystem	Custodian water resources,	Authorisations water uses, water courses		X	X	X	X	X
DWS	Local	Breede-Gouritz CMA	Water resource management	Management of river works, water uses			X	X		X
DWS	Local	Inkomati-Usutu CMA	Water resource management	Management of river works, water uses			X	X		X
DWS	Local	SALGA	Coordination advising Local Government	Manage dams, regulate land use		X	X	X	X	X
DWS	Local	SA Federation for Water User Associations (SAAFWUA),	Coordination WUAs and Irrigation Boards	Catchment management, water use management		X	X	X	X	
DWS	Local	WUA/IB	Manage dams, regulate land use	Manage dams, regulate land use	X				X	
DEFF	National	Regulatory Compliance and Sector Monitoring	Manage NEMA listed activities	River Maintenance Plans, Dams, wetland encroachment		X	X	X		

DEFF	Local	Environmental programmes branch	Biodiversity and water security	Working for water	X					
DEFF	Local	Environmental programmes branch	Biodiversity and water security	Working for wetlands	X					
DEFF	Local	Environmental programmes branch	Biodiversity and water security	Working for land	X					
DEFF	Public Entity	SANBI	Biodiversity and water security	Ecological infrastructure	X					
DEFF	Public Entity	SANParks	Biodiversity and water security	Catchment management	X					
DEFF	Public Entity	CapeNature	Biodiversity and water security	Catchment management	X					
DALRRD	National		Control	Authorisation for development of virgin land,		X	X	X		
DALRRD	Local		Land management	Land Care Programme	X					
DMRE	National	ESKOM	Energy generation	Hydropower infrastructure maintenance					X	
DMRE	National	Mineral regulation	MPRDA mining permits	Sand mining		X				
DMRE	National	Mineral policy and promotion	Environmental policy	Environmental management			X	X		

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Annexure A: Irrigation Boards and Water User Associations

Name of Dam	River	WUA / IB	Province
Darlington Dam	Sundays River	Lower Sundays River WUA	Eastern Cape
Grassridge dam	Fish River	Great Fish River WUA	Eastern Cape
Korhaans Drift Weir	Sundays River	Lower Sundays River WUA	Eastern Cape
Kouga dam	Gamtoos River	Gamtoos IB	Eastern Cape
Scheepersvlakte Dam	Lower Sundays River	Lower Sundays River WUA	Eastern Cape
Allemanskraal Dam	Sand River	Sand-Vet WUA	Free State
Armenia dam	Leeuw River	Leeuwrivier WUA	Free State
Douglas Weir	Vaal River	Orange Vaal WUA	Free State
Erfenis Dam	Vet River	Sand-Vet WUA	Free State
Kalkfontein dam	Riet river	Kalkfontein	Free State
Krugersdrift Dam	Modder River	Lower Modderrivier WUA	Free State
van der Kloof dam	Orange River	Orange Riet WUA	Free State
Klipdrif dam	Loop Spruit	Klipdrift IB	Gauteng
Olifantsnek dam	Hex River	Olifantsnek IB	Gauteng
Goedertrouw Dam	Mhlatuze River	Nkwaleni BR	Kwa Zulu Natal
Letaba dam	Letaba River	Letaba WUA	Limpopo
Mokolo Dam	Mokolo River	Mokolo WUA	Limpopo
Blyderivierpoort dam	Blyde River	Lower Blyde River WUA	Mpumalanga
Jan Wassenaar dam	Klaserie River	Klaserie River IB	Mpumalanga
Loskop dam	Olifants River	Loskop IB	Mpumalanga
Loskop dam/Hereford weir	Olifants River	Hereford IB	Mpumalanga
Low' Creek dam	Low's Creek River	Laer Kaap IB	Mpumalanga
Rust de Winter dam	Elands River	De Rust IB	Mpumalanga
Sterkspruit dam	Sterkspruit	Kaalrug IB	Mpumalanga
Witklip Dam	Sand Spruit	Sand River IB	Mpumalanga
Bon Accord Dam	Apies River	Bon Accord IB	North West
Hartbeespoort Dam	Crocodile River	Hartbeespoort IB	North West
Klipvoordam	Pienaars River	Krokodilrivier-wes IB	North West
Olifantsnek dam	Hex River	Olifantsnek IB	North West

Name of Dam	River	WUA / IB	Province
Roodekopjesdam	Krokodil River	Krokodilrivier-wes IB	North West
Boegoeberg dam	Orange River	Boegoeberg WUA	Northern Cape
Neusberg Weir	Orange River	Kakamas WUA	Northern Cape
Ben Etive Dam	Valsch River	Warm Bokkeveld	Western Cape
Berg River Dam	Berg River	Berg River Main IB	Western Cape
Buffeljagts Dam	Buffeljagts River	Buffeljagts IB	Western Cape
Bulshoek Dam	Olifants River	Lower Olifants River WUA	Western Cape
Clanwilliam Dam	Olifants River	Clanwilliam WUA	Western Cape
Duivenhoks Dam	Duivenhoks River	Duivenhoks IB	Western Cape
Elandskloof Dam	Elands River	Elandskloof IB	Western Cape
Floriskraal Dam	Buffels River	Buffelsvlei IB	Western Cape
Gamkapoort Dam	Gamka River	Gamkapoort IB	Western Cape
Kamanassie Dam	Kamanassie River	Stompdrift Kamanassie IB	Western Cape
Klipberg Dam	Konings River	Koningsrivier IB	Western Cape
Korentepoort Dam	Korente-Vette River	Korente-Vette IB	Western Cape
Lakenvallei Dam	Sanddrift River	Hexvallei WUA	Western Cape
Leeu-Gamka Dam	Leeu River	Leeu-Gamka IB	Western Cape
Miertjieskraal Dam	Brand River	Brand River IB	Western Cape
Oukloof Dam	Cordiers River	Oukloof IB	Western Cape
Pietersfontein Dam	Keisies River	Baden IB	Western Cape
Poortjieskloof Dam	Kingna River	Kingna IB	Western Cape
Roode-Elsberg Dam	Sanddrift River	Hexvallei WUA	Western Cape
Stompdrift Dam	Olifants River	Stompdrift Kamanassie IB	Western Cape
Theewaterskloof Dam	Riviersonderend	Zonderend WUA	Western Cape
Verkeerdevlei Dam	Touws River	Verkeerdevlei IB?	Western Cape
Voëlvlei Dam	Berg River	Lower Berg River IB	Western Cape