Keeping the Olifants River flowing

Collective action during the most severe drought on record

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Table of Contents

Abbreviations

DWS	Department of Water and Sanitation
DSS	Decision Support System
EWR	Ecological Water Requirement
FSC	Full Supply Capacity
KNP	Kruger National Park
LNW	Lepelle Northern Water
LOROC	Lower Olifants River Operations Committee
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
ORWRDP	Olifants River Water Resources Development Project
RESILIM-O	Resilience in the Limpopo Basin - Olifants
WMA	Water Management Area
WReMP	Water Resources Modelling Platform

AWARD series:
Climate change impacts on the Olifants River Catchment

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To support building resilience in support of improved water governance in the Olifants River Catchment

1 Keeping the Olifants River flowing
[Booklet]

Systemic, collective action duringthe most severe drought on record

2 Integrated Water Resources Decision Support System [INWARDS] for the Olifants Catchment

Facilitating real-time monitoring, early warning & systemic decision-making for water resources

3 Overview of Water Quality & Quantity: Olifants River Catchment
[Booklet]

An analysis and review of water quality and quantity of the Olifants River Catchment to provide a systemic picture of the Olifants as a whole in a user-friendly format

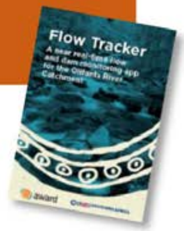
4 Predicted Impacts of Climate Change on Water Resources of the Olifants River Catchment
[Booklet]

A user-friendly overview of an analysis of the effect of climate change on the water resources of the Olifants River Catchment

5 Systemic, Social Learning Approaches to Water Governance & Sustainability
[Booklet]

For water resource practitioners and managers as well as those interested in the theories and practice - or praxis - of systems and social learning approaches --- a different way of thinking that recognises interrelationships and uncertainty and sees people as part of governing water

6 Flow Tracker
[Flyer]



A near real-time flow and dam monitoring app for the Olifants River Catchment

Download the Flow Tracker app from Google Playstore. This flyer describes how to use the app.

7 Turnaround Plan Mopani/Ba-Phalaborwa Municipal Wastewater Treatment Plants
[Brochure]

Set within the Department of Water & Sanitation's requirements and Green Drop certification, this plan focuses on supporting the essential aspects of wastewater treatment in the Phalaborwa, Lulelani, and Namakgale treatment plants.

8 Water Conservation & Water Demand in the Olifants Catchment: A Pilot Project
[Technical Report 15]

Support and capacity development for Maruleng and Ba-Phalaborwa local municipalities for water demand and water conservation management

9 Historical Trends & Climate Projections for Local Municipalities
[Technical Reports 25-29]

Insights based on localised climate analysis to support planning at the municipal scale. Available for Mopani District:
25] Ba-Phalaborwa
26] Maruleng
27] Greater Tzaneen
28] Elias Motsoaledi, Sekhukhune District Municipality
29] Lepelle-Nkumpi, Capricorn District Municipality

The Olifants Catchment: The broader context

The Olifants River Catchment falls within the Limpopo River Basin, which is part of an international drainage basin that stretches across South Africa, Mozambique, Zimbabwe and Botswana. The Olifants River contributes nearly 40% of the water that flows in the Limpopo River making it important for the basin as a whole. Currently, the Olifants River is the only tributary that sustains flows of the Limpopo River in the dry season.

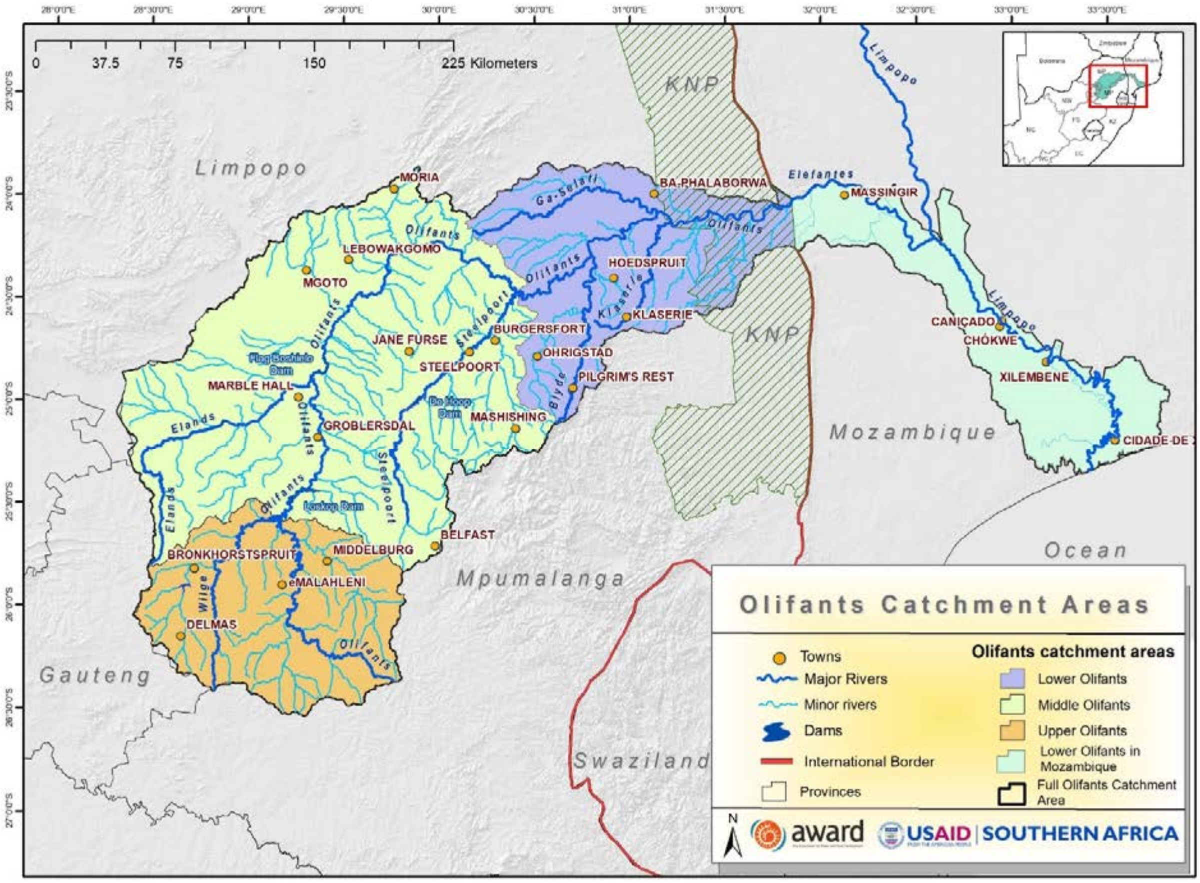


Figure 2: Map of the Olifants River Catchment showing the upper, middle and lower regions of the catchment and the lower Limpopo Basin after the confluence between the Olifants and Limpopo

The Olifants River is a vital artery that flows for 560 km through South Africa and into Mozambique, where it is known as the Rio dos Elefantes. This mighty river originates in South Africa's Highveld, traversing three provinces (Gauteng, Mpumalanga and Limpopo) before flowing through the iconic Kruger National Park and into Mozambique before reaching the Indian Ocean near Xai Xai, just north of Maputo. The Olifants Catchment occupies an area almost 55 000 square kilometres and is home to about 3.5 million people in South Africa and 0.7 million people in Mozambique.

From both an aquatic and terrestrial perspective, the Olifants Catchment is a rich and diverse landscape. It is home to areas of endemism and high biodiversity. Declining water quality and decreased flows threaten aquatic systems along the entire Olifants River within South Africa and to the Xai Xai estuary in Mozambique. Intact river systems are limited to the Blyde and some tributaries of the Steelpoort and the lower Olifants. In Mozambique, the estuarine area is a *National Maritime Ecosystem Priority* area.

Unchecked pollution, inappropriate land and resource use, poor enforcement of regulations and poor protection of habitats and biodiversity impact on the livelihoods of all the catchment's residents.

Background

In 2005, the Olifants River stopped flowing within the Kruger National Park (KNP) despite the massive legislative changes of 1998. The same seemed set to happen in 2016 with the onset of the worst drought on record in the Olifants Catchment.

Figure 3: Flows in the lower reaches of the Olifants River in Kruger National Park at the height of the rainy season, when one would expect to see the entire river channel flowing.

Terminology

In accordance with global terminology, instead of using the term the Reserve, we often refer to Environmental Water Requirements or EWRs. Since the Reserve determination takes into account water for basic human needs as well as the ecological component, we prefer the term Socio-environmental Water Requirements [SEWRs].

The 2005 experience showed how no flows in the river greatly compromised domestic water supplies and other economic sectors and alarmingly, also meant that cross-border flows to Mozambique ceased for 78 days. While most of the ecological components of a river are quite resilient to low flows, a cessation of flow can have devastating impacts on the ecosystem. In recognition of this, the South African National Water Act (1998) specifies an amount of water of a certain quality that is needed to maintain the ecological integrity of river systems (known as the ecological water requirement or EWR) and to meet basic human needs.

In South Africa, these two components are known as *the Reserve*. As part of integrated water resources management (IWRM), the Reserve is being determined for all major rivers in South Africa as part of a strategy known as Resource Directed Measures. The reserve forms part of gazetted ‘benchmarks’ for sustainability, known as RQO’s or Resource Quality Objectives. In legal terms, the *Reserve* must be determined and secured before any water allocations are made.

The kinds of impacts that result from not maintaining these flows are interlinked and complex and ultimately impact directly on human health and well-being. The environment - if in a healthy functioning state - provides many goods and services to us as people, such as maintaining healthy fish populations that provide much-needed food for inhabitants across the catchment.

Given this, it is clear that calculating the *Reserve* for a river provides a benchmark for ensuring the sustainability of the system so that it can provide goods and services to people. Thus it ensures that we are building resilience into our system. Not meeting the Reserve (*non-compliance*) is therefore an indicator of increasing vulnerability.

Through the RESILIM-Olifants Program, supported by USAID, both AWARD and SANParks have been monitoring the Reserve in the Olifants Catchment for a number of years using the AWARD-developed, real-time monitoring system (*see Resources 6: Flow Tracker & Resource 2: Integrated Water Resources Decision Support System [INWARDS] for the Olifants Catchment).*[1] This has indicated that we are regularly non-compliant with the requirements of the Reserve or SEWRs. This is particularly concerning during the dry season when the system is under stress in any event and when the threat of a repetition of 2005 is greatest.

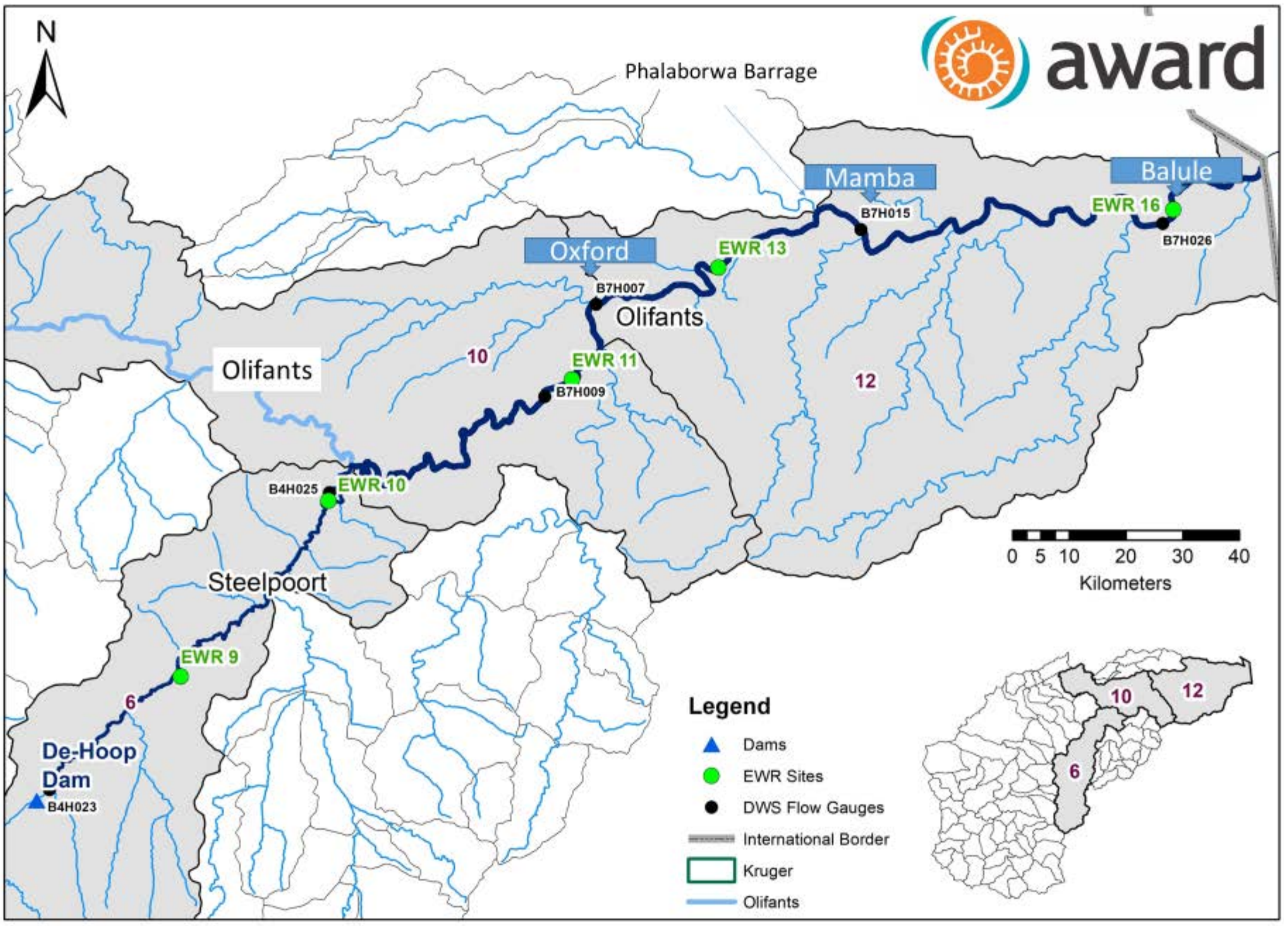


Figure 4: The Lower Olifants River Basin. The key EWR sites that are near a gauge station are indicated.

[1] See list of AWARD Resources on page 2

The drought, increasing stress and the start of collective action

In 2015 it became apparent that we were entering a drought as a result of the *El Nino* conditions. By September flows had decreased dramatically in the lower Olifants and, exacerbated by very high temperatures, concerns were raised about flow cessation in the lower reaches of the Olifants River.

This brochure provides an overview of the approach used and outcomes to successfully maintain flows during the most extreme drought on record which continued through to late 2019. At the time of writing, it is still unclear if the drought is over. In any event, the river may take some time (years) to show signs of hydrological recovery.

By January 2016 – at the height of the rainy season - the flows for the Olifants River at Mamba Weir in the Kruger National Park had dropped to 4 times less than what was required - even under drought conditions (Figure 3). Thus, the river system was in stress with a high risk of compromising the ecological functioning of the river and sustainable water management in the Olifants Catchment. Unfortunately, institutional uncertainty within DWS around the status of the Olifants CMA (the body tasked to manage the Olifants Catchment) compounded the problem of finding a suitable strategic response. Thus, as a matter of urgency, staff from the KNP and AWARD initiated efforts to ensure that the lower Olifants would continue flowing in accordance with the Reserve.

A detailed overview is given in Appendix A and in other technical documents. For the purposes of this story, the following summary is important.

Flows at the height of the rainy season in 2016

During January 2016 (at the height of the wet season), the flows for the Olifants River at Mamba Weir (B7H015) in the KNP dropped to **$1 m^3/s$** for significant periods. This was despite the drought requirement for an Environmental Water Requirement of **$4.3 m^3/s$** (drought requirement at 99th percentile).

This situation posed serious risks of flow cessation and also risks for Lepelle Northern Water (LNW) which is already constrained by limited storage capacity. LNW supplies bulk water to users from the Phalaborwa Barrage, and has to operate the barrage in such a way that the SEWR is maintained downstream into the Kruger National Park and Mozambique (see Figure 1).

In order to understand the strategy proposed to DWS,
it is important to understand:

Water Balance	How much water is there?
Water Demand	Who uses what & from where?
Operating Rules	How is the system operated to meet the demands?
Monitoring Results	Are we compliant?

Water balance in the Lower Olifants: How much water is there?

The studies that determine the water balance of a catchment (known as Reconciliation of Water Resources studies) point to a 'surplus' of water in the lower Olifants. However, these studies are over 10 years old and out-of-date. They do not take into account:

- The massive expansion in agriculture, particularly along the main stem of the Olifants (see Figure 5);
- Water for the Reserve, remembering that it is a legal requirement to meet the EWRs (or SEWRs) before other uses;
- The fact that LNW has yet to take up its full allocation;
- The domestic needs that are still not being met of the extensive rural communities along the foothills of the escarpment (Sekororo, the Oaks area); and
- The predicted impacts of climate change on water resources, which are severe in the Lowveld. *(see Resource 4: Predicted Impacts of Climate Change on Water Resources of the Olifants River Catchment).*

So, while on paper there appears to be a surplus, in practice the above factors and the constant low flows and near-cessation of flows point to a different reality – that we are a ***closed sub-catchment***. There is an urgent need to re-do the reconciliation study.

Water demand: Who uses what and from where?

The main water users in the lower Olifants are domestic supply, irrigation and mining. The EWR for the Kruger National Park, that also accounts for transboundary flows into Mozambique, is not a consumptive use but is a demand that must be accounted for. The biggest demand is for irrigated agriculture. The figure given in the reconciliation study (Table 1) is an underestimate given the expansion of undocumented irrigated agriculture of about 400 ha since 2013. Most of the water allocation is met from the Blyde Dam with some inputs from the Olifants River.

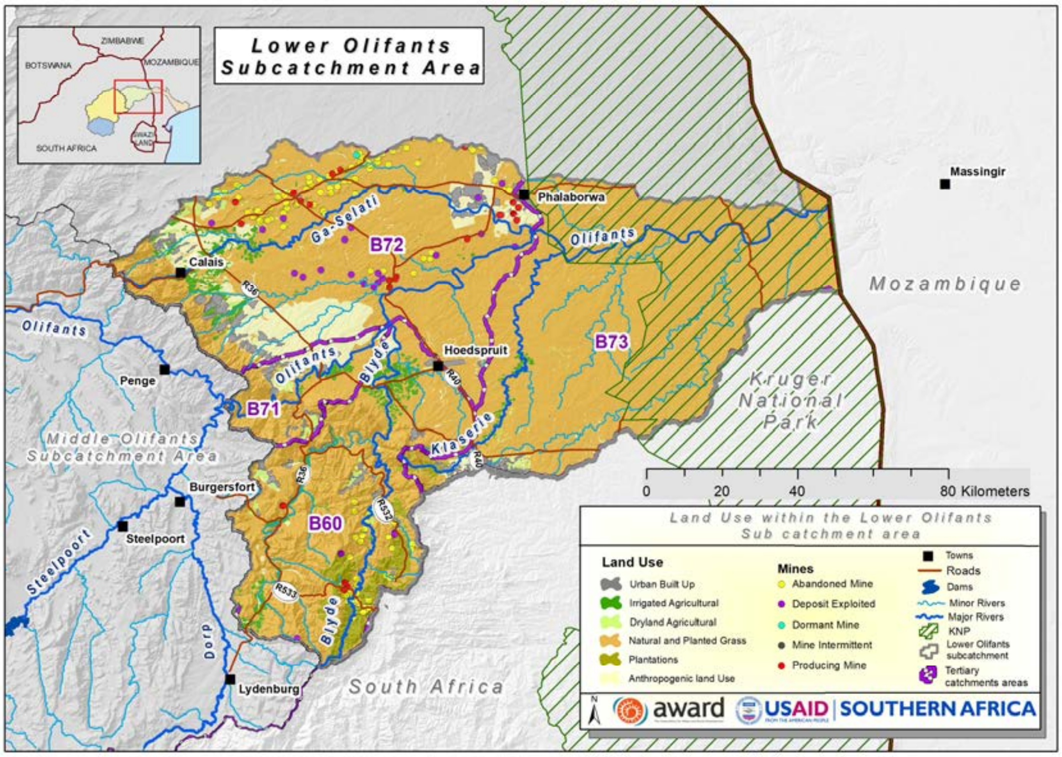


Figure 5: Map showing land use in the lower Olifants

TABLE 1: WATER BALANCE BASED ON 2010 FIGURES (DWS 2011).
(These figures are now out-of-date.)

Availability and use	Mm^3	Comment
Water resources	**248**	Does not account for the impacts of climate change on dam yields and stream flow (estimated to decrease by 60% on the eastern border of South Africa
Water requirements		
Urban	29	LNW is already struggling to meet the demand in Phalaborwa and surrounds
Rural	4	This figure is likely to be an underestimate
Mining	31	
Irrigation	152	Does not take into account expansion, and undocumented agriculture along the main stem
The Reserve		Not included in the study despite legal requirement to meet this
Sub-total	216	
Losses	5	
Balance	**27**	**Does not take into account expansion in use (especially agriculture), the lack of water supply to rural areas and climate change impacts**

Governance: Operating the 'system' to meet the demand

There are currently 'operating rules' for the lower Olifants. According to the 2016/17 operating rules (OLLI Forum July 2016[2]), Blyde Dam releases should meet demands for:

- Domestic needs (100%; both for LNW and Maruleng Local Municipality),
- Agriculture (95% assurance; this does not take into account agricultural expansion) and
- EWRs (for the Blyde EWR and to make contributions to sites on the Olifants (EWR 13 and 16).

Non-compliance with flows (EWR): Increasing vulnerability for the river

As the protracted drought continued with no signs of abatement, flows in the lower Olifants decreased to - and remained at - critically low levels, flouting our own national policies. As noted above, there was regular non-compliance with requirements of the Reserve or SEWRs, as shown in Figure 6. For KNP this raises a management response associated with a 'level of concern' which, by September 2016, was regarded as high (i.e. needing immediate and strategic action).

[2] Development of Operating Rules for water supply and drought management for stand-alone dams and schemes; DWS (WRPS)

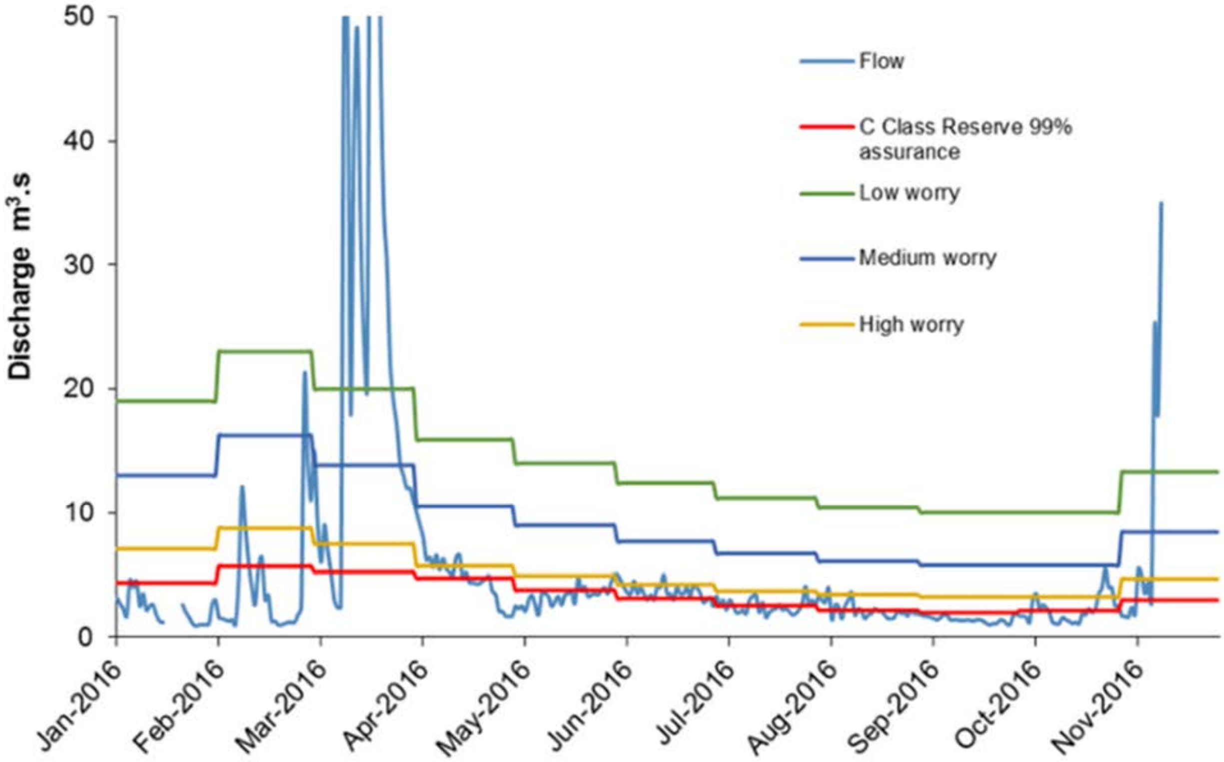


Figure 6: Unverified flows plotted together with the KNP management response thresholds and the Reserve for Mamba Weir (B7H015) in Kruger National Park (Riddell et al. 2016)

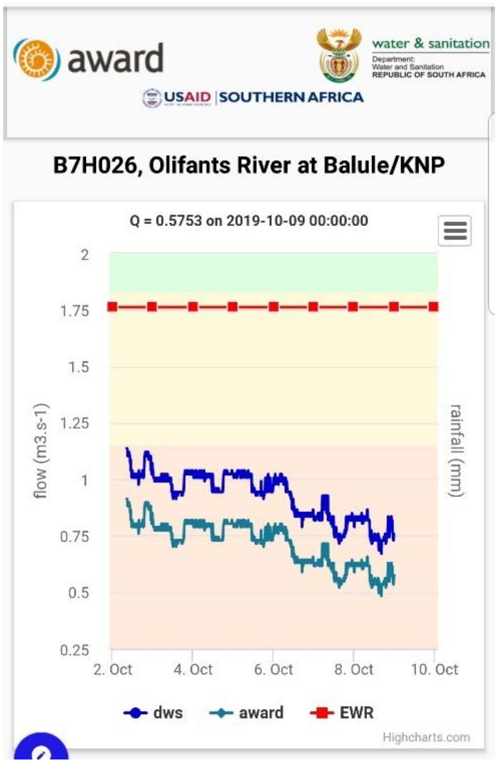


Figure 7: Outputs from FlowTracker: Flows at Balule gauge in the KNP in early October 2016

At the same time, AWARD was using the real-time FlowTracker to monitor flows, which were also indicating extreme levels of concern (Figure 7).

State of the dams

Through the use of our InWaRDS decision support system, we were able to analyse, in real time, the levels of the major dams in the Olifants. Almost all of these were reaching precariously low levels by November 2016 (Figure 8).

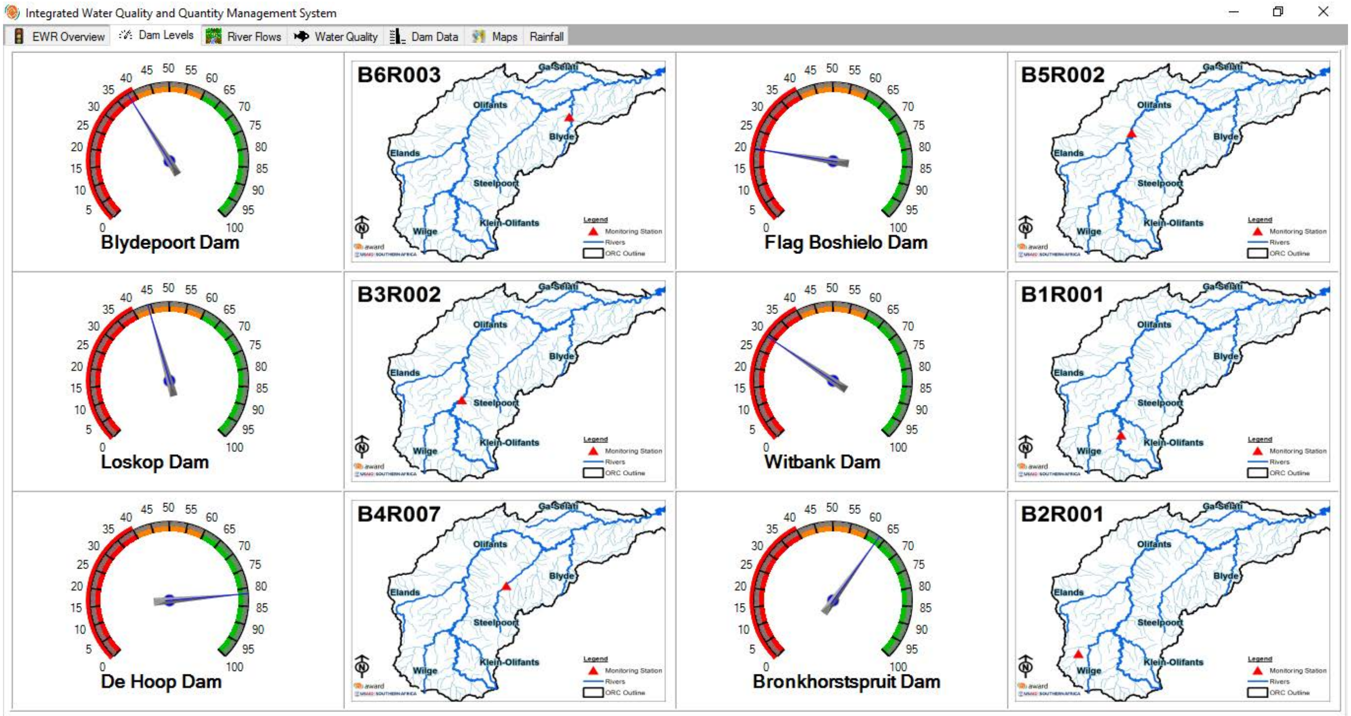


Figure 8: Output from the AWARD InWaRDs dashboard showing dam capacity in November 2016

Emerging problems, risks & impacts

Given the above background, it soon became apparent that there were problems. Using September 2016 as an example, the release from Blyde Dam was 0.85 m^3/s. Based on static releases, the aforementioned requirements were not being met in 2016 and 2017. The requirement for the EWR and domestic demands alone totalled 1.38 m^3/s – a shortfall of 0.53 m^3/s - and this did not even take into account the agricultural demand. It was clear that flows from the middle Olifants could not be assured due to the lack of integrated operating rules and the reliance on Blyde Dam alone was putting the entire lower region at risk.

Under extreme drought, the main problem of meeting domestic needs and the needs of KNP and Mozambique (i.e. which Lepelle Northern Water is required to do) from the Blyde Dam is that, as a relatively small dam, the drawdown is very quick. Dropping below 25% poses key risks at which stage no water delivery would be possible through the network and 100% restrictions would effectively apply. Ultimately this would put commercial agriculture and the associated jobs at risk (an estimated 10,000 permanent and seasonal workers) as well as all users in the lower Olifants.

Apart from the extreme stress of the drought, there was no integrated approach to managing or 'operating' the catchment as a whole, and no facility for running simulations of different options.

Integrated operating rules

An integrated approach for operating rules means ensuring sufficient flows in the river and water in dams all along the river system to meet flows at the bottom of the catchment. This was not happening, nor was the new De Hoop Dam being considered as part of the catchment water resources system.

Restrictions play an important role droughts. However, aside from sector specific restrictions[3] these were not implemented, a situation which seemed to reflect the lack of communication between water resources management (located in Nelspruit) and water supply (located in Polokwane). This highlights the pressing need for integrated institutional arrangements such as those that would emerged from decentralisation and management the catchment's water as a whole through a CMA.

The need for an integrated approach

An integrated approach to managing the catchment as a whole is not just a technical exercise of developing 'integrated operating rules'. It needs to consider social, economic, environmental and institutional components *(see Resource 5: Systemic, Social Learning Approaches to Water Governance & Sustainability)*. This would be part of a longer-term strategy for the catchment – or Water Management Area – in question. However, under the emergency conditions imposed by the protracted and worsening drought, the collective had to act quickly. We recognised the need to ensure a combination of institutional support, mainly from the National DWS, stakeholder buy-in from the users and our technical support to address interim, operating procedures.

To address the challenges above, we noted the need to:

- Develop Interim integrated operating rules;
- Simulate flows and losses in the long stretches of ungauged Olifants River (about 250 km);
- Be able to run scenarios (such as reducing inputs from the Blyde Dam and increasing contributions from de Hoop Dam);
- Understand the percentage drawdown from the dams making the releases;
- Ensure that DWS (National and regional), water providers, stakeholders and users understood the constraints and requirements of the law; and
- Provide support for integrated institutional arrangements.

[3] Voluntary restrictions had already been applied by the Lower Blyde Water Users by reducing irrigation rates from 0.66 l/s/ha to 0.4 l/s/ha (20% restriction). Drakensig Airforce Base also applied restrictions.

Defining the needs for interim, integrated operating rules for the Olifants System to ensure continued flows in the lower Olifants

Ensuring flows or water in dams is essential to meet the demands of the catchment. In the lower Olifants this means:

- Ensuring sufficient water in the Blyde Dam to make the required releases;
- Ensuring sufficient water in the Loskop Dam in the middle Olifants to make the required releases for flows to reach Flag Boshielo Dam (a distance of about 90km);
- Ensuring sufficient water in the Flag Boshielo Dam in the middle Olifants to make the required releases to reach Oxford Weir and the KNP border (a distance of about 163 km).

In total, water from the middle Olifants needs to meet the demands in the middle Olifants as well as losses and downstream requirements. This means operating the system as an integrated unit, planning 'back' from the needs at Oxford and Balule gauges and considering contributions from the Blyde system. In the simplest sense, this would be part of the set of integrated operating rules.

The river stretch from Loskop to Oxford is about 250 km with no flow monitoring equipment whatsoever. This makes managing the system extremely difficult.

Collective action & recommendations

The Lower Olifants River Operations Committee (LOROC) - established in February 2016 in response to the growing crisis - took action to resolve these water supply issues amongst key sectors in the lower Olifants catchment. With no sign of the drought lifting, and indeed potentially continuing into the wet season, emergency plans were discussed.

Through the LOROC, recommendations were made to the Director-General of DWS to utilise products being developed through the RESILIM-O program to implement a series of emergency actions for the drought period.

The proposal made was to shift some - or all - of LNW's demand[4] from the Blyde Dam to De Hoop Dam in extreme circumstances. At the time (September 2016), the Blyde Dam was at 53% capacity which was concerning given the seasonal forecast showing late rains.

Indeed by November, Blyde Dam had decreased to 35% capacity at a time when it should be filling. In order to reduce the pressure on the Blyde Dam, the focus of the recommendation to DWS was that the allocation for domestic demand for LNW[5] from the Blyde Dam be shifted to the de Hoop Dam as an interim, emergency measure.

Recommendations to DWS DG

- Develop scenarios for the Implementation of the Operating Rules to Integrate the Blyde system with the Olifants River System, and
- Promote development and implementation of emergency Operating Rules for the De Hoop Dam.

[4] LNW has an annual demand of 51 Mm^3/annum from the Blyde system (DWA 2011)

[5] LNW based on a 50 Mm^3/a allocation (from Blyde and Flag Boshielo) to LNW, their abstraction would be 1.63 m3/s

This would also provide a buffer for the commercial agricultural sector along the Blyde River for the 2016-2017 growing season (Box 1), and water supply to Maruleng Local Municipality at a high level of assurance (a relook at the management options was deemed crucial since the Blyde Dam is also required to initiate a portion of the environmental water requirements to the lower Olifants).

Additionally, the team recommended:

The use of the near real-time EWR Model and the InWaRDS De Hoop Release Model, which had already been developed through RESILIM-O to provide operational support for releases from the De Hoop dam for multiple users downstream.	The establishment of a technical team to track a short controlled release (slug pulse) from De Hoop dam to examine the effectiveness of controlled releases for meeting downstream targets (Phalaborwa Barrage, KNP, International Flows) in times of need.

Fortunately, the LOROC received a positive response from the DG's office on 15 July 2016, to do the following:

Shift LNW's demand to De Hoop Dam in times of stress to ensure meeting domestic needs and the needs of the EWR in the lower Olifants. The caveat was that this should not compromise storage in the De Hoop Dam at the start if the water year (April), and that the water should not be taken up by commercial agriculture in the lower Olifants.	Use AWARD's Decision Support System (InWaRDS,) developed through RESILIM-O, to do this.

Further actions taken in support of emergency measures

Plan of action

In order to initiate successful implementation of the proposed 'Release Model' of INWARDS (see below), the following actions were planned in a phased approach:

1. An initial briefing session with the key stakeholders regarding the emergency drought situation including the various directorates at National DWS, the DWS regional office/ OCMA, LNW, Olifants farmers and the municipalities.

2. As a priority, maintain the DWS Oxford gauge on the telemetric system (and utilise double-up stations installed by RESILIM-O at B7H009, B7H007, B7H015, B7H026), as well as to utilise manual readings of gauges where necessary.

3. Document decisions - such as the KNP river management log (see Riddell et al. 2018) which includes results of model runs, acknowledged releases (duration and volume by DWS Infrastructure Branch), and hydrological response received (LNW & KNP).

4. Follow-up DSS technical training to include the following personnel: DWS System Operations (Head Office); Olifants-Letaba CMA River Operations Manager; DWS Infrastructure Branch (Mpumalanga and Limpopo); Lepelle Northern Water Phalaborwa Barrage Scheme Manager; Kruger National Park; Water User Associations and Maruleng municipality.

5. Concurrently with the above, to try to ensure that the Blyde Water User Association and other farmers on the Olifants mainstem provide validated water use and are compliant during release periods.

Development & use of an integrated, interim model for drought operations

In order to successfully respond to the DWS DG's approval for implementing the EWR and releases from the De Hoop Dam, we identified the technical, institutional and social interventions required.

In terms of technical support, it was clear that we needed reliable real-time flow data and a good knowledge of water uses along the Olifants downstream of the De Hoop Dam. Fortunately, the InWaRDS system had already been established to download DWS data and to be able to track flows in real time. Given the delay in verifying data, we had also installed parallel data loggers and flow probes at three sites to support and enhance monitoring (Figure 9). This also allowed us to track and adapt the releases made from De Hoop Dam *(see Resource 2: Integrated Water Resources Decision Support System [INWARDS] for the Olifants Catchment).*

In summary, we developed and used a near real-time EWR model accompanied by a release model component built into InWaRDS (known as '*the De-Hoop Release Model*). Readers are referred to other technical outputs *(see Resource 2: Integrated Water Resources Decision Support System [INWARDS] for the Olifants Catchment)* and the associated technical report (Riddell et al. 2016) for further details. Training modules in the use of the model and technical documents were also developed as part of the tools and protocols to support the dam releases and to ensure that the attempt was a success from the start.

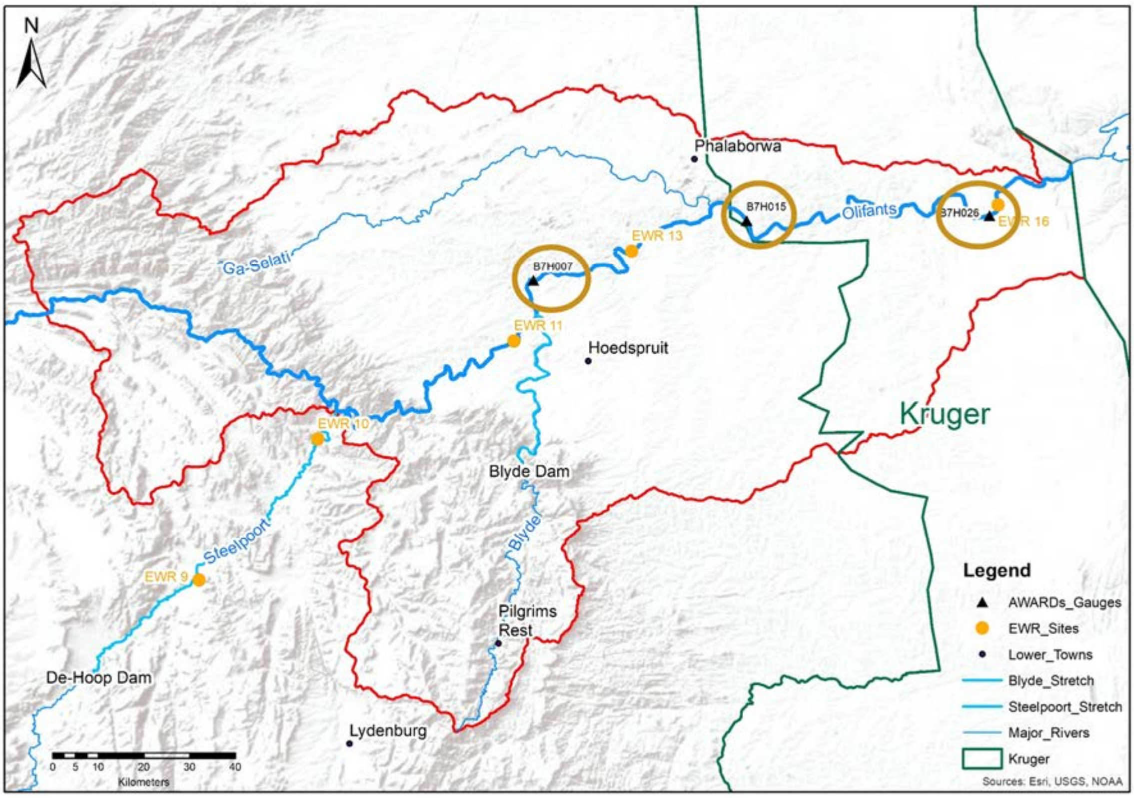


Figure 9: Map of the lower Olifants showing sites of AWARD's parallel flow monitoring network

Stakeholder engagement

In addition to the technical support, a great deal of liaison with stakeholders was needed, including the DWS Regional Office (acting as an interim CMA), water users and various forurms (the LOROC and Catchment Management Forum). A first step was to meet with the farmers to ascertain why the initial releases were not reaching Oxford weir. This was due to some farmers increasing their uptake and also because of the expansion of irrigated agriculture (as described in the following section). In response, most farmers agreed to implement a rotational system of water use from the Olifants. Engagements were held throughout 2017–2019 to update stakeholders on the situation. This culminated in two shared learning sessions - one for the lower Olifants in 2018, and one for the middle and lower Olifants in 2019.

"Missing water" – understanding losses

After the initial release was made it was clear that the volume of water reaching Oxford was significantly less than what was simulated. From stakeholder engagements it was clear that the model parameters did not account for the expanded agriculture in the lower Olifants from 2013 onwards. Indeed the Reconciliation Study (and WR2012) had been based on the assumption that there were be no further expansion of irrigated agriculture. An analysis of land use was undertaken, which indicated an undocumented expansion of irrigated agriculture of about 400 ha (*Figure 10*). This amounted to an additional uptake of 0.2 m^3/s or 200 l/s.

This information was used to update the model by adding an additional parameter to account for additional losses.

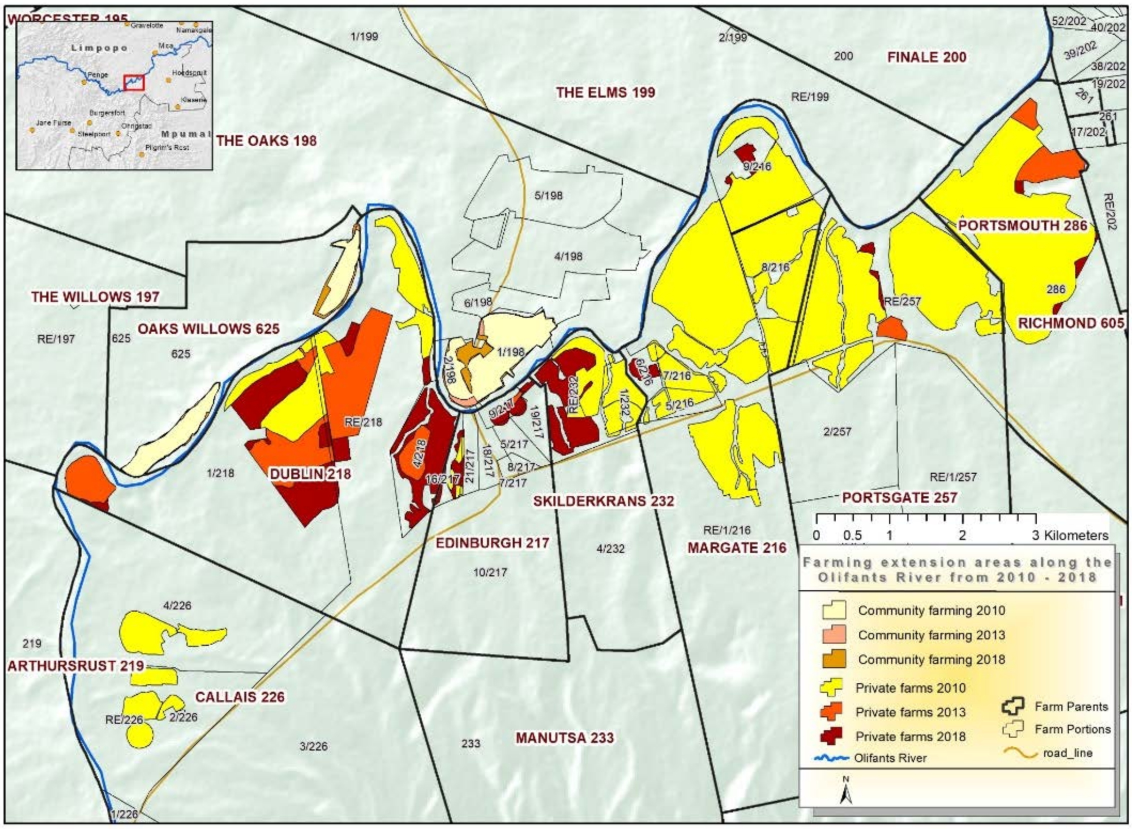


Figure 10: Map indicating expansion in irrigated agriculture along the main stem of the lower Olifants River from 2010 to 2018

Implementation of flow releases & outcomes

A number of releases were made (and maintained) between 2016 and December 2019 as indicated in Table 2 below. After the first success and engagements, sufficient trust was built so that AWARD was tasked with monitoring the flows and running the RESILIM-O De Hoop Release Model (as it became known) whenever necessary, to recommend a flow release from De Hoop Dam until the drought ended.

TABLE 2: OVERVIEW OF THE RELEASES MADE BASED ON THIS WORK

YEAR	RELEASES
2016	The first De Hoop dam releases were made on the 23rd September 2016 which resulted in the Environmental Water Requirement (EWR) being compliant for extended periods of time in Kruger National Park.
2017	The above releases continued into early 2017.
2018	In January 2018, AWARD and the Kruger National Park with support from DWS National secured releases from De Hoop Dam which prevented the river from drying up. This had to be repeated again in September 2018 when flows fell some 50% below the recommended minimum.
2019	Releases were made from De Hoop by dam operations in response to user requests for water. AWARD then ran the model to track the drawdown of De Hoop Dam and to adjust releases according to inflow. Releases were made in October and continued until the start of the rains in late December 2019.

Tracking improvements in river health

Monitoring of riverine health before and after the first release in September 2016 indicated that it was a major success in a time of drought. Not only was the EWR being met for the first time in the drought period at the Mamba weir in KNP, but river health data (SASS) showed a significant improvement. As can be seen from, the change in actual volume – or water level – in the channel was barely perceptible, so we are not talking about much water.

Figure 11: Flows in the lower Olifants before and after the first release

Continued vulnerability through the protracted drought

By 2019, the drought still showed no signs of abatement. In fact what distinguished this drought from the last one in the early 1990s was the occurrence of significantly more 'hot days' (above 40^0 C; Dr E. Riddell, 2018 internal report).

On 9 October 2019 AWARD sent an email to all stakeholders laying out urgent actions and responsibilities to mitigate the situation and ensure continued flow. The emphasis was on the fact that these were 'interim' procedures that could not be viewed as a permanent solution to growing water scarcity.

Both SANParks and AWARD stressed the need to adopt integrated water resources management and to address the growing water governance and institutional issues. Additional actions were also recommended. These included:

- AWARD to run the De Hoop release model (as done several times over the past three years);
- DWS to implement emergency restrictions and communicate these to stakeholders (some users had already applied voluntary restrictions);
- DWS to take action on unlawful use;
- DWS to oversee immediate inclusion of the Olifants mainstem farmers into the Blyde Water User Association (since they currently do not fall under a WUA);
- DWS and SANParks to work with Lepelle Northern Water on restrictions and releases from the Phalaborwa Barrage;
- AWARD and SANParks to continue to monitor river health status.

Concluding comments

"From Blyde and especially the Agricultural sector in the area the releases from De Hoop had the effect that farmers could produce a crop for the coming citrus and mango season. Without the releases, taking into account the level of the Blyde dam since September 2015, no water would have been available for agricultural use. The resulting loss of income for the farming and labour sector would have had a devastating effect on the social and economic welfare in the region."

(Message from member of the commercial agricultural sector)

In the immediate term, the interventions through this collaborative effort to secure flows have been successful. The interventions were systemic in nature representing a mix of social, institutional and technical responses. The use of an integrated model and the AWARD gauges (in the absence of a fully functional DWS network) were key. Furthermore, AWARD played a key mediating role when we met with farmers in the lower Olifants to ensure they do not take up the water meant for augmentation downstream.

A significant indicator of progress in terms of governance has been the reduced time needed to secure drought releases from De Hoop dam, compared with the lengthy process followed in 2016. This suggests that there is confidence in the recommendations made by AWARD and SANParks and the process of determining the release scenarios. This paves the way for the future where quick implementation is key to managing a system in real-time to ensure compliance.

However, whilst it is true to say that many stakeholders noted the benefits of the releases, many challenges remain. Such responses are temporary 'Band-Aids' and the underlying causes require examination. For this reason, AWARD has focused its efforts on supporting the DWS regarding the need for a CMA, and on *unlawful use*, together with *compliance monitoring and enforcement* and the need to consider *broader management measures and strategies*. On the water demand side, our research revealed extremely high water consumption figures in both Hoedspruit and Phalaborwa and we have worked both with municipalities and water users to conscientise and plan for *water conservation and demand management* measures *(See Resource 7: Turnaround Plan Mopani/Ba-Phalaborwa Municipal Wastewater Treatment Plants & Resource 8: Water Conservation & Water Demand in the Olifants Catchment: A Pilot Project).*

Building *networks amongst stakeholders* for integrated water resources management has also been a key strategic focus for AWARD.

We have also developed a picture of water resources under *climate change* conditions *(See Resource 4: Predicted Impacts of Climate Change on Water Resources of the Olifants River Catchment & Resource 9: Historical Trends & Climate Projections for Local Municipalities).* The conditions seen during the drought provide a window into the uncertain future under a changing climate. And whilst climatic drivers will lead to future vulnerabilities, the deep structural drivers that continue to contribute to the greater water insecurity need to be addressed. These are summarised below.

Key strategies

Water governance:

- Adopt a systemic, social learning approach to IWRM and water governance *(see Resource 5: Systemic, Social Learning Approaches to Water Governance & Sustainability)*
- Decentralised, solid and tenable institutional arrangements are urgently needed through a CMA which integrates water resources management and water supply
- A catchment's water needs to be managed internally first so as to ensure the catchment is in balance and all residents are supplied with water, particularly the needs of the rural poor and EWRs must be met before water is transferred out
- Plan proactively, not reactively
- Understand risks

Operations:

- Planning documents need to be updated as a matter of urgency (as detailed above, taking into account climate change)
- Integrated operating rules for the catchment are needed
- Monitoring is under threat - gauges must be maintained

Use:

- Urgent need to update and finalise Validation & Verification (V&V)
- Urgent need for compliance monitoring and enforcement (CME) of unlawful use
- Have clear protocols for restrictions in times of stress
- Water allocations need to ***appraised systemically*** – not in a vacuum

Stakeholder involvement:

- Solid institutional arrangements
- Stakeholder engagement linked to *clear action* is imperative
- Urgent need for a communication plan – most stakeholders are in the dark about laws, policies and institutional change amongst other things

Appendix A

Overview of demand and conventional operating rules for the lower Olifants River

Water balance and demand

The main water users in the lower Olifants are domestic supply, irrigation and mining (see Table 1). Much of the water demand / allocation is met from the Blyde Dam.

Lepelle Northern Water (LNW) has an allocation of 87 million m^3/a. Of this allocation, 36 million m^3/a is from the Olifants while the remaining 51 million m^3/a is from the Blyde Dam. This is used to supply domestic use (24.5 m^3/a) and Phalaborwa Mining Complex (32 m^3/a). They must also release EWRs to KNP, which is not included in the DWS reconciliation study. The irrigation allocation is from the Blyde. The EWR on the Blyde is met from Blyde Dam releases; at Finale and Oxford by a combination of flows from the Steelpoort, Olifants mainstem and Blyde.

Whilst on paper there appears to be a surplus, and also LNW has an allocation that is not utilised, in practice the constant low flows and near-cessation of flows point to a different reality and the need to re-do the reconciliation study. As the Water Services Authority, LNW regularly struggles to supply sufficient water to users with a major constraint being capacity at the Phalaborwa Barrage. Communities at the foothills of the escarpment (known variously as Sekororo or The Oaks area) are still without sufficient, regular water supply and still need to take up their allocation.

Thus it is clear that the aforementioned figures are incorrect and there is an urgent need for validation and verification as well as an updated reconciliation study that takes account of:

- The reconciliation study assumes no increase in irrigated agriculture which is not the case in reality (see Figure 10). This water use is undocumented.
- If LNW were to take up its full allocation, the system would be out of balance.
- Rural communities have yet to take up their allocation and should be a priority.
- The EWR and cross-border flows are unaccounted for.

Operating rules and the Blyde Dam

According to the 2016/17 operating rules (OLLI Forum July 2016[6]), Blyde Dam releases should meet demands for:

- Domestic needs (100%; both for LNW and Maruleng Local Municipality),
- Agriculture (95% assurance) and
- EWRs (Blyde and contribute to EWR 13 and 16).
- Drought Sept 2016 ORs that could not be met
- EWR: 0.74 m^3/s (under drought conditions, absolute minimum based on EWR 12 (September drought RQOs and annual dam allocation of ~30.5 Mm^3/a)
- Domestic: 0.64 m^3/s (DWS 2016. Draft Sekhukhuene Water Supply System 2016/17 Performance Report)

[6] Development of Operating Rules for water supply and drought management for stand-alone dams and schemes; presented by DWS (Directorate: Water Resource Planning Systems)

award

The Association for Water and Rural Development

AWARD is a non-profit organisation specialising in participatory, research-based project implementation. Their work addresses issues of sustainability, inequity and poverty by building natural-resource management competence and supporting sustainable livelihoods. One of their current projects, supported by USAID, focuses on the Olifants River and the way in which people living in South Africa and Mozambique depend on the Olifants and its contributing waterways. It aims to improve water security and resource management in support of the healthy ecosystems to sustain livelihoods and resilient economic development in the catchment.

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About USAID: RESILIM-O

USAID: RESILIM-O focuses on the Olifants River Basin and the way in which people living in South Africa and Mozambique depend on the Olifants and its contributing waterways. It aims to improve water security and resource management in support of the healthy ecosystems that support livelihoods and resilient economic development in the catchment. The 5-year programme, involving the South African and Mozambican portions of the Olifants catchment, is being implemented by the Association for Water and Rural Development (AWARD) and is funded by USAID Southern Africa.

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