INKOMATI-USUTHU
CATCHMENT MANAGEMENT AGENCY

Compulsory Licencing in the Kaap River Catchment

Hydrological Scenario Investigation, Development and Curtailment Report

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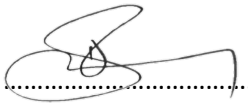

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Executive: Water Resources Management

Executive Summary

This document is a detailed report on compulsory licencing in the Kaap River catchment, a sub-catchment of the Crocodile River catchment, aimed at addressing over-allocation of water resources. It presents updated water allocation scenarios to achieve a fair and equitable distribution of water, protect ecological water requirements (EWR), and improve assurance of supply for various water users, particularly irrigators.

1. Introduction

1.1 Background to Compulsory Licensing

Compulsory licencing, as per Section 43 of the National Water Act (NWA) (Act 56 of 1998), involves reassessing water use licenses to promote beneficial water use, efficient management, and protection of water quality. It is applied in stressed catchments where allocations exceed available resources. The Kaap River catchment was selected due to significant over-allocation after accounting for EWR. The Water Allocation Plan (WAP) suggests several options to improve water balance: Water Conservation and Demand Management, changing crops to those with lower water needs, developing water resources, and reallocating water. Modelling results indicate reallocation is necessary.

1.2 Purpose and Structure of the Report

The report aims to present scenarios to balance water use and availability in the Kaap River catchment and recommend a way forward. It explains the problem, presents scenarios, and concludes with recommendations.

1.3 Hydrology of the Kaap River Catchment

The Kaap River is a major tributary of the Crocodile River. The catchment covers the X23 quaternary catchments, receiving transfers from Lomati and Shiyalongubo dams. Updated hydrology shows a slightly higher natural flow than previous studies due to improved groundwater data. The total catchment area is 1 721.4 km² with a natural mean annual runoff (MAR) of 221.2 million m³/annum.

1.4 Irrigation Boards

Irrigation is the dominant water use, managed by several irrigation boards covering specific quaternary catchments. These boards keep records of members' allocations, which are crucial for water use verification.

2. Problem Statement

2.1 Water Uses

2.1.1 Section 21(a) Water Use

Water abstraction is categorized into domestic, irrigation, industry, and mining sectors. Verified water use totals approximately 6.04 million m^3 for water services, 92.78 million m^3 for irrigation, 0.1 million m^3 for industry, and 3.81 million m^3 for mining annually. Most irrigation water use is within irrigation boards, totalling 88.45 million m^3.

A portion of Lows Creek Irrigation Board water (7.97 million m^3/annum) is supplied from outside the catchment.

2.1.2 Section 21 (d) Water Use (Streamflow Reduction)

Commercial forestry, declared as a streamflow reduction activity, contributes verified streamflow reductions totalling 20.63 million m^3/annum and unverified reductions of 6.25 million m^3/annum, summing to 26.88 million m^3/annum.

2.2 Ecological Water Requirements (EWR)

The EWR has been gazetted for the Kaap River but is not met in upper catchment areas due to uncontrolled water use. The report extrapolates EWRs for each quaternary catchment, ranging from 23.5% to 39.5% of MAR, totalling significant volumes necessary to sustain ecological health.

2.3 Water Availability

Water availability is assessed at different assurance levels, with high assurance users prioritized. The catchment yield at 80% assurance is 51.1 million m^3/annum after accounting for EWR, whereas irrigation allocations subject to compulsory licencing total 84.81 million m^3/annum, indicating over-allocation. Assurance of supply varies widely among irrigation boards, with some as low as 55% with EWR considered.

2.4 Water Balance

Comparing verified water requirements to available yield shows a deficit of approximately 35.6 million m³/annum with EWR included. Without EWR, the deficit is about 20.31 million m³/annum, highlighting the stress on water resources.

2.5 Current Actual Water Use

Actual water use is less than verified allocations due to undeveloped properties by emerging farmers and community associations. This results in higher assurance of supply compared to full allocations but still indicates over-allocation challenges.

3. Water Allocation Scenarios

3.1 Introduction to Scenarios

Several scenarios were modelled to reduce or redistribute water use to match availability, including:

- Status Quo
- Capping streamflow reduction (SFR) due to forestry to 15% natural runoff
- Reducing irrigation requirements in winter months (July to October) by 10%, 20%, 25%, 35%, and 50%
- Reducing unused irrigation allocations by 80%

All scenarios except Status Quo assume full EWR compliance.

3.2 Scenario 0: Status Quo

Current situation with low assurance of supply and unmet EWR justifies compulsory licencing.

3.3 Scenario 1: Cap SFR to 15% of Natural Runoff

Forestry streamflow reductions in headwater catchments exceed sustainable limits. Capping SFR at 15% of the natural MAR reduces runoff losses by 21% in X23A and 39% in X23E, improving assurance of supply modestly.

3.4 Scenarios 2 to 6: Winter Allocation Reductions

Reducing winter irrigation allocations incrementally improves assurance of supply, but the impact is limited because winter water use is only 56% of total allocation. Even a 50% winter reduction only modestly improves supply assurance.

3.5 Scenario 7: Curtail Unused Allocations by 80%

Reducing unused allocations significantly improves assurance of supply, bringing many irrigation boards closer to acceptable levels. Total irrigation allocations reduce from 84.81 to 71.64 million m^3/annum.

3.6 Summary of Results

Reducing winter allocations alone has limited effect; combining measures yields significant but insufficient improvements. Some irrigation boards still face low assurance. Augmentation options like Hilversum Dam and Snymansbult Dam could improve supply.

4. Recommendations and Opportunities

- Curtailing streamflow reduction and winter allocations together significantly reduce water use but do not fully resolve deficits.
- Over-allocation, rather than over-utilization, is the main issue, with about 16 million m^3/annum of irrigation water not currently used.
- Curtaining unused allocations could bring the catchment closer to balance.
- Water augmentation projects in the upper catchment, including proposed dams, could alleviate shortages.
- Farmers could develop off-channel storage to capture water during high flow periods.

5. References and Appendices

The report cites various Department of Water and Sanitation publications and internal studies supporting hydrological data, EWR determinations, and modelling approaches.

This summary captures the key points of the report on compulsory licencing and water allocation scenarios in the Kaap River catchment, emphasizing the over-allocation problem, ecological water needs, modelled scenarios, and recommendations for sustainable water management.

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1. Introduction

1.1 Background to Compulsory Licencing

Section 43 of the National Water Act (NWA) (Act 56 of 1998) allows for compulsory licencing. The idea behind compulsory licencing is to reassess water use licences from first principles and issue licences to achieve a fair and equitable allocation of the water resource. Some of the principles that will be applied to achieve this goal are:

- To promote beneficial use of water in the public interest
- To facilitate efficient management of the water resource, and
- To protect water resources quality.

Compulsory licencing is a mechanism to deal with stressed catchments which have become fully or over-allocated. The process is applied by withdrawing all licences and issuing a notice for all potential water users to apply for water use. The Crocodile catchment is well documented as being stressed in that the water allocation exceeds the available resource, and compulsory licencing is a possible solution to this problem. The Kaap River catchment, a sub-catchment of the Crocodile River catchment, was selected as a pilot catchment to apply compulsory licencing. One of the reasons for selecting the Kaap River as a pilot catchment is that the Water Allocation Plan (WAP) for the Crocodile River catchment (IUCMA, 2022) shows that water allocated in the Kaap River catchment exceeds available water resources by a significant margin after taking the Ecological Water Requirements (EWR) in account.

The WAP (IUCMA, 2022) lists several scenarios which could improve the water balance in the Kaap River catchment. These are:

1. Water Conservation and Demand Management
2. Changing to crops with lower water requirements
3. Developing the water resource
4. Reallocated the water resource.

The first three options have been modelled, and it was concluded that the final option, namely, reallocation of the resource, will be required.

1.2 Purpose of this Report

The purpose of this report is to present the various scenarios considered towards achieving a water balance in the Kaap River catchment and recommend a way forward.

1.3 Structure of this Report

The report firstly explains why there is a problem in the Kaap River catchment by comparing the water that has been allocated verses the available water resource. This includes allowance for the EWR at quaternary scale.

The report presents a problem statement which explains the over-allocated situation within the Kaap River Catchment. Several scenarios aimed at improving the water balance in the catchment are then presented. The report concludes with a summary and recommendations.

1.4 Hydrology of the Kaap River catchment

The Kaap River is a major tributary of the Crocodile River which joins the Komati River at the border with Mozambique to form the Incomati River. The Kaap River catchment consist of the X23 quaternary catchments. While there are no major dams in the catchment, water is transferred into the Kaap River catchment from the Lomati and Shiyalongubo dams which are located in the upper reaches of the Lomati River. See Figure 1.

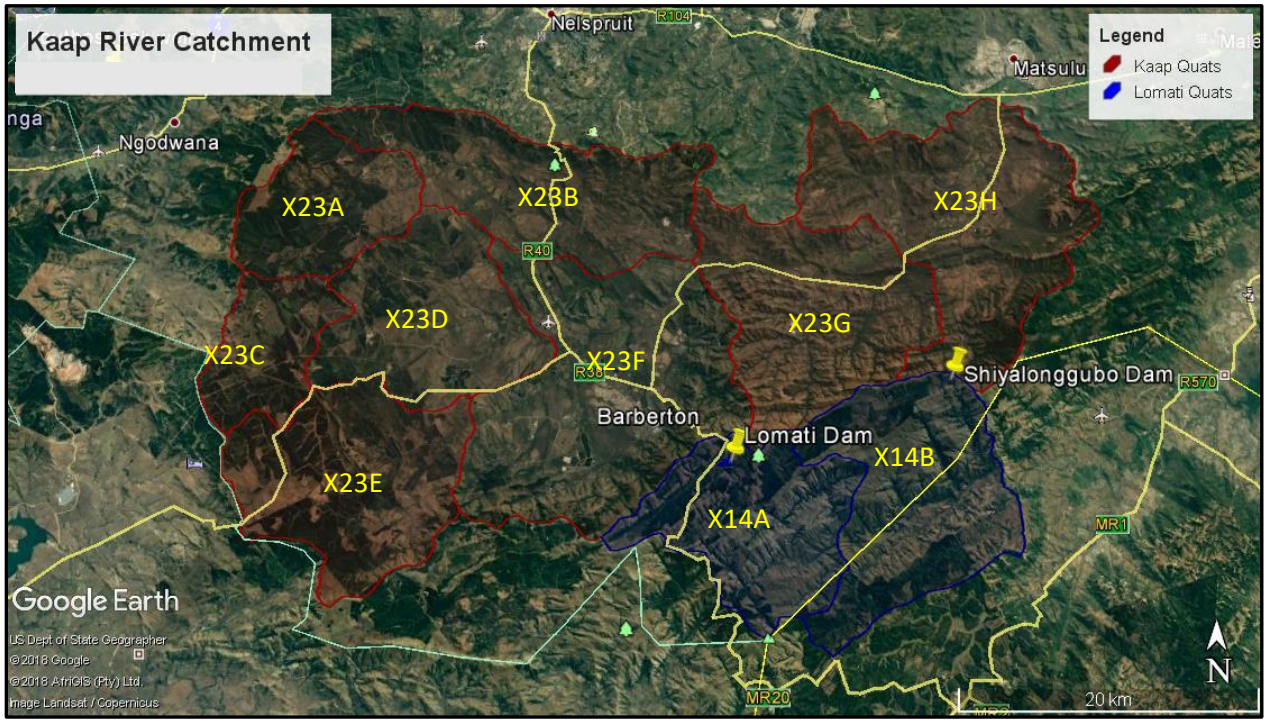

Figure 1: Location of the Kaap River catchment

The hydrology of the Kaap River catchment was recently updated as an ongoing process to update the hydrology of the Crocodile River catchment, of which the Kaap River forms a separate sub-catchment (IUCMA, 2018). The previous detailed hydrological analysis of the Kaap River was the so-called Inkomati Water Availability Assessment Study (IWAAS) (DWA, 2009).

Table 1 provides a summary of the updated hydrology of the Kaap River. Based on this latest assessment the natural flow is estimated to be slightly higher than previous estimates. This is due to improved information on groundwater use as well as improved modelling thereof.

Table 1: Summary of the Kaap River hydrology

Catchment	**Catchment area**	**Natural MAR**		
		million m^3/annum		**mm/annum**
	(km^2)	**This study (1920 – 2017)**	**IWAAS (1920 – 2004)**	**This study (1920 – 2017)**
X23A	208.1	38.3	36.0	184
X23B	229.1	16.2	14.9	71
X23C	81.3	26.8	25.9	330
X23D	181.8	34.2	35.6	188
X23E	180.4	31.6	30.0	175
X23F	309.6	21.1	18.1	68
X23G	225.1	22.7	18.6	101
X23H	306.0	30.3	25.1	99
Total	**1721.4**	**221.2**	**204.2**	
Average				**129**

1.5 Irrigation Boards

While the catchment has been divided into Quaternary catchments for the purpose of hydrological and water resources modelling, the dominant use on the catchment is irrigation and this is managed by several Irrigation Boards. Figure 2 shows the location of the irrigation boards while Table 2 shows the relationship between quaternary catchments and the irrigation boards.

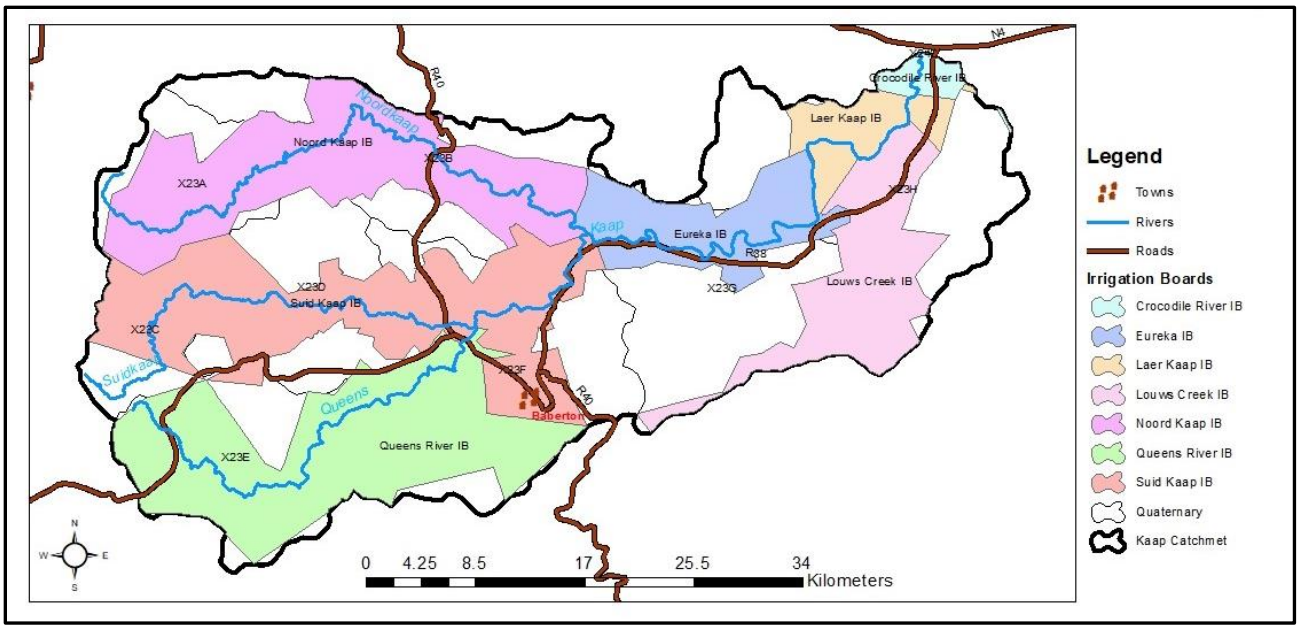

Figure 2: Kaap River Irrigation Boards

Table 2: Location of Irrigation Boards

Irrigation Board	Quaternary and/or quinary catchments
Noord Kaap	X23A, X23B
Suid Kaap	X23C, X23D, X23F2
Queens River	X23E, X23F1
Eureka	X23G, X23H1
Lows Creek	X23H2, X23H3
Lower Kaap	X23H4, X23H5

2. Problem Statement

This section presents a comparison of water allocation versus water availability to explain why there is water deficit in the catchment.

2.1 Water Uses

2.1.1 Section 21(a) water use

Section 21(a) of the NWA refers to abstraction of water from a water resource. This category has been subdivided into various sectors from domestic use (Water Services), Irrigation to Industry and Mining. The reason for categorizing water use into sectors is that the compulsory licencing process is likely to assign different values to water depending on how it is being used, and this will influence the reallocation process. Table 3 summarised the verified water use in the Kaap River catchment.

Table 3: Section 21(a): Verified water use (units are million m^3/annum)

Quaternary catchment	Verified water use (million m^3/annum)			
	Water Services	**Irrigation**	**Industry**	**Mining**
X23A	0.024	5.16	0.0	0.0
X23B	0.0	11.28	0.0	0.0
X23C	0.14	3.13	0.0	0.0
X23D	0.03	14.12	0.0	0.0
X23E	0.09	3.13	0.0	0.0
X23F	5.70	23.82	0.1	3.3
X23G	0.0	11.10	0.0	0.25
X23H	0.054	21.04*	0.0	0.26
Total	**6.038**	**92.78**	**0.1**	**3.81**

* Including Lows Creek

It is important to note that most of the irrigation water use falls within irrigation boards, listed in the WARMS database as indicted in Table 4 with only 4.33 million m^3/annum falling outside of the jurisdiction of the irrigation boards. The significance is that the water used by members of the Board is not specifically verified but rather the total allocated to the Board. However, the irrigation Boards keep a record of their members and their allocations, and this has been made available to the IUCMA.

Table 4: Water Use within Irrigation Boards

Irrigation Board	Verified water use (million m^3/annum)
Noordkaap Irrigation Board	15.23
Suidkaap Irrigation Board	29.05
Queens River Irrigation Board	13.78
Eureka Irrigation Board	11.1
Laer Kaap Irrigation Board	6.8
Lows Creek	12.49
Total	**88.45**

It is important to note that a portion of the Lows Creek Irrigation Board which is supplied from the Shiyalongubo Dam has been excluded from this compulsory licencing process because they are supplied from outside of the Kaap River catchment via a transfer from the Lomati River catchment. This amounts to 7.97 million m^3/annum. The remaining 4.52 million m^3/annum allocated to the Lows Creek Irrigation Board is supplied from the Kaap River. Appendix A shows how this could affects the Lows Creek Irrigation Board as a whole when applying a curtailment to to irrigators supplied from the Kaap River.

Hence, the total volume of water allocated to irrigators within the Kaap River catchment and subject to compulsory licencing is 84.81 million m^3/annum (92.78 – 7.97).

2.1.2 Sections 21(d) water use

Section 21(d) of the NWA refers to Streamflow Reduction Activity (SFRA). To date, only commercial forestry has been declared a streamflow reduction activity, see Table 5 below.

Table 5: Section 21(d): Verified Streamflow Reduction (units are million m^3/annum)

Quaternary catchment	Verified
X23A	6.10
X23B	1.53
X23C	3.44
X23D	3.80
X23E	5.14
X23F	0.62
X23G	0.00
X23H	0.00
Total	**20.63**

2.2 Ecological Water Requirements

While the EWR has been determined and Gazetted for the Kaap River as a whole (DWS, 2016; DWS, 2017; DWS, 2019), uncontrolled water use in the upper reaches of catchment results in the Gazetted EWR (referred to as EWR7) not being met if the full allocation is abstracted. Compulsory licensing will require assessing water abstractions from first principles and hence, as required for a water use licence, the EWR must be determined at each abstraction point.

Based on information provided in the Classification report (DWS, 2017) and the Government Gazette (DWS, 2016; DWS, 2019), the following EWRs were determined using the Reserve Model. The information on the EWRs determining during the Classification Process (DWS, 2017) is shown in Appendix B from which the extrapolated EWRs for each sub-catchment were determined. See Table 6.

Table 6: Summary of extrapolated EWRs

Quaternary catchment	MAR (Cumulative)	Class	EWR	
	million m^3/annum		% of MAR	million m^3/annum
X23A	38.3	C	23.5%	9.0
X23B	54.6	C	23.5%	12.8
X23C	26.8	B/C	39.5%	10.6
X23D	61.0	B/C	39.5%	24.1
X23E	31.6	B/C	27.0%	8.5
X23F-1	42.7	B/C	27.0%	11.5
X23F-2	113.6	C	31.0%	35.2
X23G (EWR7)	191.0	C	23.0%	43.9
X23H	221.0	C	23.0%	50.8

2.3 Water availability

Water availability or ***Yield*** of a dam or catchment is a complex concept in cases where users are supplied at different assurances. In the Kaap River catchment about 70% of the available water is allocated to irrigation at 80% and hence the low assurance yield of the catchment is a very important consideration. This problem was addressed in the WAP by first assuming that high assurance users (water services, miners and SFRA) are fully supplied and then calculating how much water is left at 80% assurance. Table 7 shows the catchment yield at high and low assurance. This has been determined with and without the EWR using the Water Resources Modelling Platform (WReMP) (Mallory et al, 2013).

A systems diagram for the Kaap River catchment is shown in Appendix C.

Table 7: Water availability in the Kaap River catchment based on verified water use

Quaternary catchment	Yield after SFRA (million m^3/annum)		
	Water services, Industry and Mining (98% assurance)	Irrigation (80% assurance)	
		No EWR	With EWR
X23A	0.024	8.8	5.3
X23B	0	5.6	4.8
X23C	0.14	2.9	2.0
X23D	0.03	16.0	4.6
X23E	0.09	5.3	3.6
X23F1	3.0	3.7	1.6
X23F2	5.5	4.6	3.9
X23G	0.25	6.4	12.0
X23H	0.314	11.2	13.3
Total	**9.35**	**64.50**	**51.1**

The analysis of the water resources of the Kaap River catchment shows that even without the EWR the catchment is over-allocated in that the verified lawful irrigation use excluding Low's Creek is approximately 84.81 million m^3/annum while the catchment can only support64.5 million m^3/annum at 80% assurance. Another useful way of analysing the available water resources of a catchment is to determine the assurance of supply for a given water use. This is referred to as the Status Quo in this report. See Table 8.

Table 8: Assurance of supply for the Kaap River catchment based on Verified Existing Lawful Use

Quaternary catchment	Irrigation Board	Assurance of Supply		
		Water services, Industry and Mining	Irrigation	
			Without EWR	*With EWR*
X23A	Noord Kaap	98%	95%	81%
X23B		98%	74%	66%
X23C	Suid Kaap	98%	77%	57%
X23D		98%	85%	59%
X23F-2		98%	69%	55%
X23E	Queens River	98%	98%	60%
X23F-1		98%	66%	59%
X23G	Eureka	98%	70%	73%

Quaternary catchment	Irrigation Board	Assurance of Supply		
		Water services, Industry and Mining	Irrigation	
			Without EWR	*With EWR*
X23H	Lower Kaap and a small portion of Lows Creek	98%	65%	68%

It can be concluded from this detailed water resources analysis that the verified water use is in excess of the available yield of the catchment. Water users will experience this deficit as low assurance of supply, especially within the Queens River and Suid Kaap Irrigation Boards.

2.4 Water Balance

While section 2.3 expressed the deficit in term of assurance of supply, this section presents a water balance which compares the available water resources with the water requirements. This water balance relates only to the irrigation sector with the water availability expressed at 80% assurance. High assurance use is approximately in balance. The water balance is presented with and without the EWR. See Table 9 and Table 10.

Table 9: Water Balance with the EWR (units are million m^3/annum)

Quaternary catchment	Irrigation Board	Verified Water Requirements	Available Water (Yield)	Water Balance (With EWR)
X23A	Noord Kaap	5.16	5.3	0.14
X23B		11.28	4.8	-6.48
X23C	Suid Kaap	3.13	2.0	-1.13
X23D		14.12	4.6	-9.52
X23F-2		13.25	3.96	-9.295
X23E	Queens River	3.13	3.6	0.473
X23F-1		10.57	1.67	-8.90
X23G	Eureka	11.10	12.0	0.9

Quaternary catchment	Irrigation Board	Verified Water Requirements	Available Water (Yield)	Water Balance (With EWR)
X23H	Lower Kaap and a portion of Lows Creek	13.07	13.3	0.23
Total		**84.81**	**51.23**	**-33.58**

Table 10: Water Balance without the EWR (units are million m^3/annum)

Quaternary catchment	Irrigation Board	Verified Water Requirements	Available Water (Yield)	Water Balance (Without EWR)
X23A	Noord Kaap	5.16	8.8	3.64
X23B		11.28	5.6	-5.68
X23C	Suid Kaap	3.13	2.9	-0.23
X23D		14.12	16.0	1.88
X23F-2		13.25	4.6	-8.65
X23E	Queens River	3.13	5.3	2.17
X23F-1		10.57	3.7	-6.87
X23G	Eureka	11.10	6.4	-4.70
X23H	Lower Kaap	13.07	11.2	-1.87
Total		**84.81**	**64.5**	**-20.31**

2.5 Current Actual Water Use

The current actual water use is currently considerably less than the verified water use. This is due to many emerging farmers and Community Property Associations (CPA) lacking funds to develop their properties and make beneficial use their water allocations. Table 11 presents a comparison of the current situation with the verified water use.

Table 11: Assurance of supply for the Kaap River catchment: Actual water use and Verified Existing Lawful Use

Quaternary catchment	Irrigation Board	Assurance of Supply			
		Water services, Industry and Mining	Irrigation		
			Current Actual water use without EWR	*Verified water use without EWR*	*Verified water use with EWR*
X23A	Noord Kaap	98%	100%	95%	81%
X23B		98%	82%	74%	66%
X23C	Suid Kaap	98%	100%	77%	57%
X23D		98%	97%	85%	59%
X23F-2		98%	76%	69%	55%
X23E	Queens River	98%	98%	98%	60%
X23F-1		98%	71%	66%	59%
X23G	Eureka	98%	78%	70%	73%
X23H	Lower Kaap	98%	68%%	65%	68%

This comparison of current water use and verified water use is presented in more detail in Appendix D.

3. Water Allocation Scenarios

3.1 Introduction to Scenarios

Several scenarios were modelled to assess how best to reduce and/or redistribute water requirements to match the water availability of the Kaap River. These scenarios are presented in Figure 3:

- Status Quo
- Cap streamflow reduction (SFR) due to commercial forestry to 15% of the natural runoff at quaternary catchments scale.
- Reduce irrigation requirements (as well as capping SFR) in the months of July through to the end of October.
    - 10% reduction
    - 20% reduction
    - 25% reduction
    - 35% reduction
    - 50% reduction
- Unutilised allocations reduced to 20% of their allocation

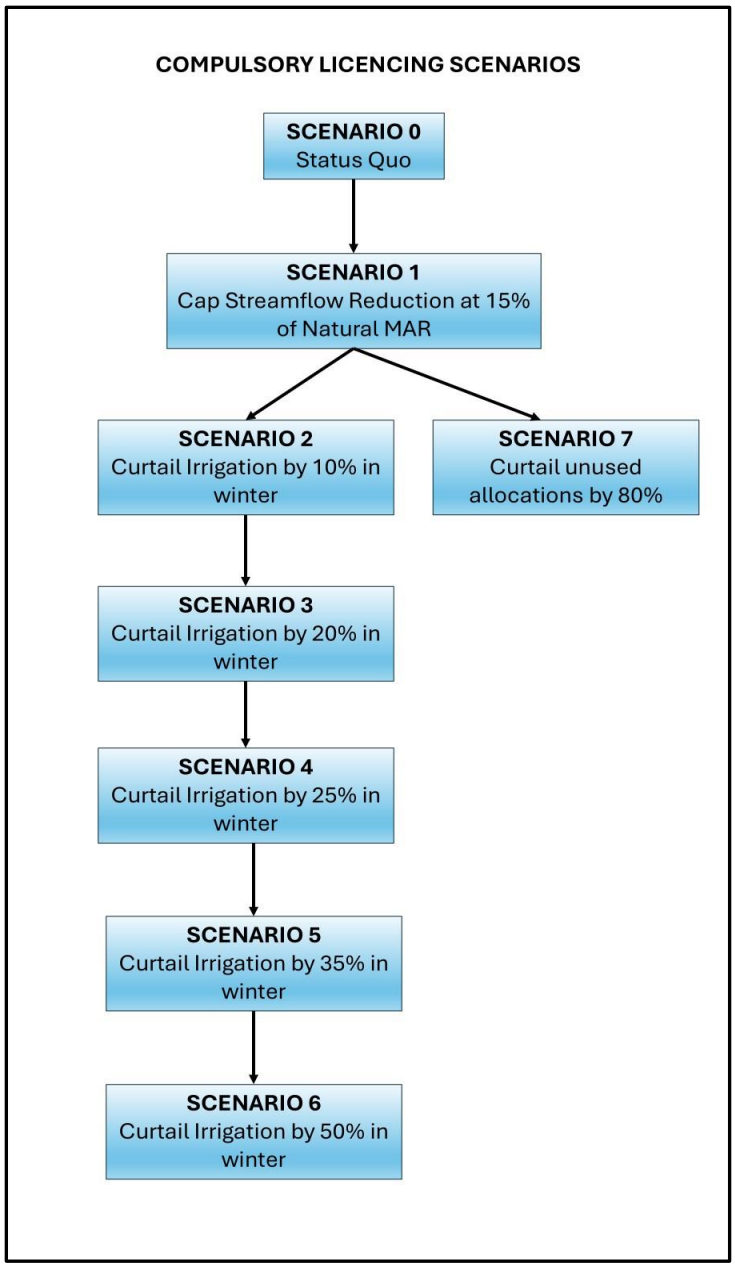

Figure 3: Compulsory Licensing Scenarios

These scenarios were the outcome of several stakeholder meetings. A scenario which was discarded early in the stakeholder process was to change the monthly distribution of the water requirements by changing from Macadamias to crops which do not require as much water in the low flow months of July through to the end of October. An alternative to this scenario, suggested by the irrigation boards, is to reduce the water requirements in winter.

The scenario presented in this report relate to surface water. Groundwater resources are less well understood but nevertheless are an important source of water, especially for rural communities.

It is important to note that all Scenarios, other than the Status Quo assume that the EWR is fully met.

3.2 Scenario 0: Status quo

This scenario is shown previously, in Table 2.9 and provides the motivation for compulsory licencing on the strength of the EWR not being, or, if the EWR is met then the assurance of supply to irrigators is too low to be commercially viable.

3.3 Scenario 1: Cap streamflow reduction to 15% of the natural runoff at quaternary scale

The verified areas of forestry are shown in Table 12. This shows that the headwater catchments of the Kaap River catchment have been extensively afforested. The question that must be asked as part of this compulsory licencing process is, would such large SFR (as a percentage of MAR) be allocated now under the National Water Act which requires that the EWR be met as a priority? This scenario was tested by removing all water use from the model and checking if the EWR is met in highly afforested headwater catchments. The outcome is that the EWR is not met even with only verified SFR in the X23A and E quaternaries catchments.

A pragmatic approach is to curtail forestry so as not to reduce the natural runoff by more than 15% of the catchment's natural runoff within each quaternary catchment. This approach needs to be seen in the context of the policy applied in KwaZulu-Natal to not allow more that 20% of a catchment's area to be forested. Applying the proposed 15% reduction in runoff rule would reduce the current SFR in X23A from 7.31 to 5.75 million m^3/annum (a 21% reduction) and 7.74 to 4.74 million m^3/annum in the X23E catchment (a 39% reduction) The equates to an estimate reduction of 1 523ha in X23A and 3 187 ha in X23E. See Table 13.

Table 12: Proposed forestry curtailment

Quaternary Catchment	Catchment Area (ha)	Current Forestry area		MAR	SFR		Proposed SFR	
		ha	% of Quat area	million m3/annum)	million m3/annum	% of MAR	% of MAR	million m3/annum)
A	12730	7112.2	55.9	38.30	7.3	19.1	15.0	5.7
B	23010	2528.1	11.0	16.30	1.6	9.5	9.5	1.6
C	8160	3038.9	37.2	26.80	3.7	13.7	13.7	3.7
D	18260	7092.3	38.8	34.20	5.1	15.0	15.0	5.1
E	18110	8223.6	45.4	31.60	7.7	24.5	15.0	4.7
F	31090	887.6	2.9	21.00	0.7	3.3	3.3	0.7
G	2200	0.0	0.0	22.80	0.0	0.0	0.0	0.0
H	30730	1153.0	3.8	30.40	0.8	2.6	2.6	0.8
	144290.0	**30035.7**	**20.8**	**221.4**	**26.9**	**12.1**	**10.1**	**22.3**

Table 13: Assurance of supply for the Kaap River catchment: Scenario 1: SFR capped to 15% of the natural MAR

Assurance of Supply	Irrigation Board	Assurance of supply	
		Water services, Industry and Mining	Irrigation
X23A	Noord Kaap	98%	83%
X23B		98%	67%
X23C	Suid Kaap	98%	57%
X23D		98%	60%
X23F-2		98%	60%
X23E	Queens River	98%	75%
X23F-1		98%	63%
X23G	Eureka	98%	75%
X23H	Lower Kaap	98%	68%

3.4 Scenario 2: Reduce winter allocation by 10%

The dominant crop in the Kaap River catchment is Macadamia nuts. The water requirement, as estimated using the SAPWAT model, as indicated in Figure 4. The reduced allocation in the months of July to the end of October is also shown. The result of reducing the allocation during these months, expressed as a change in assurance of supply is shown in Table 14. Note that this scenario includes the 15% cap on SFR (Scenario 1).

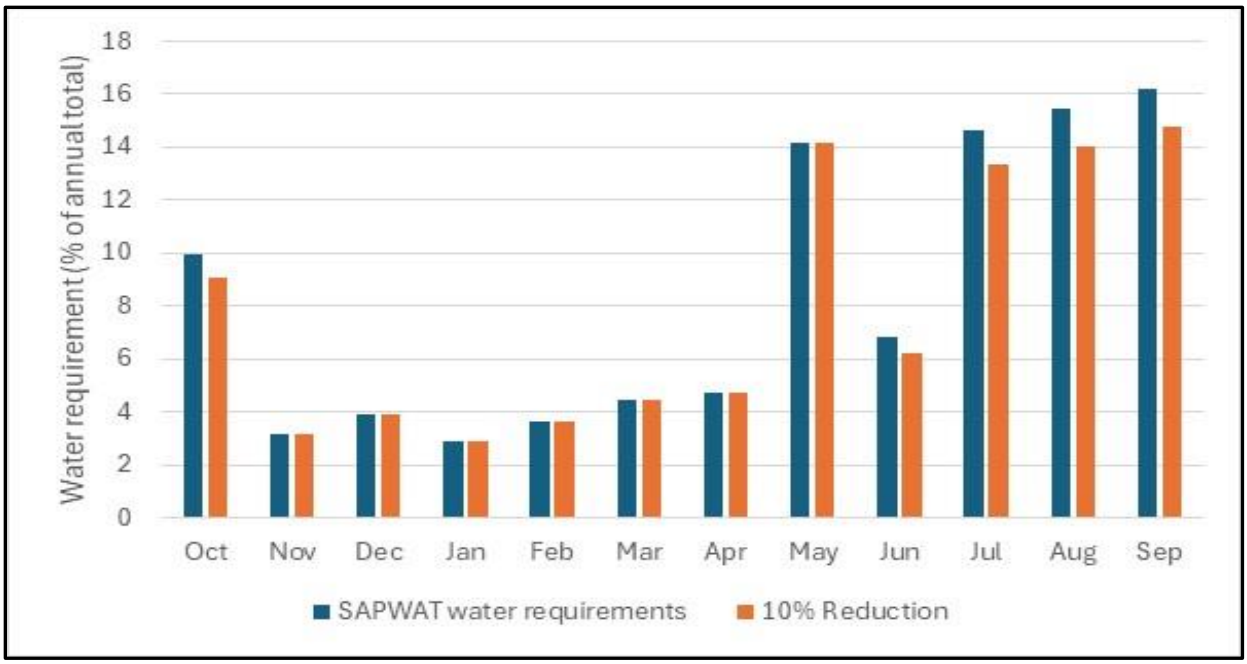

Figure 4: Monthly Distribution of crop water requirements Scenario 2 (10% reduction in winter allocations)

Table 14: Assurance of supply for the Kaap River catchment: Scenario 2: Winter use reduced by 10%

Assurance of Supply	Irrigation Board	Assurance of supply	
		Water services, Industry and Mining	Irrigation
X23A	Noord Kaap	98%	85%
X23B		98%	68%
X23C	Suid Kaap	98%	58%
X23D		98%	62%
X23F-2		98%	57%
X23E	Queens River	98%	77%
X23F-1		98%	63%
X23G	Eureka	98%	76%
X23H	Lower Kaap	98%	72%

3.5 Scenario 3: Reduce winter allocation by 20%

This scenario models a 20% reduction in the allocation in the months of July to the end of October. See Figure 5 and Table 15. This scenario includes the 15% cap on SFR (Scenario 1).

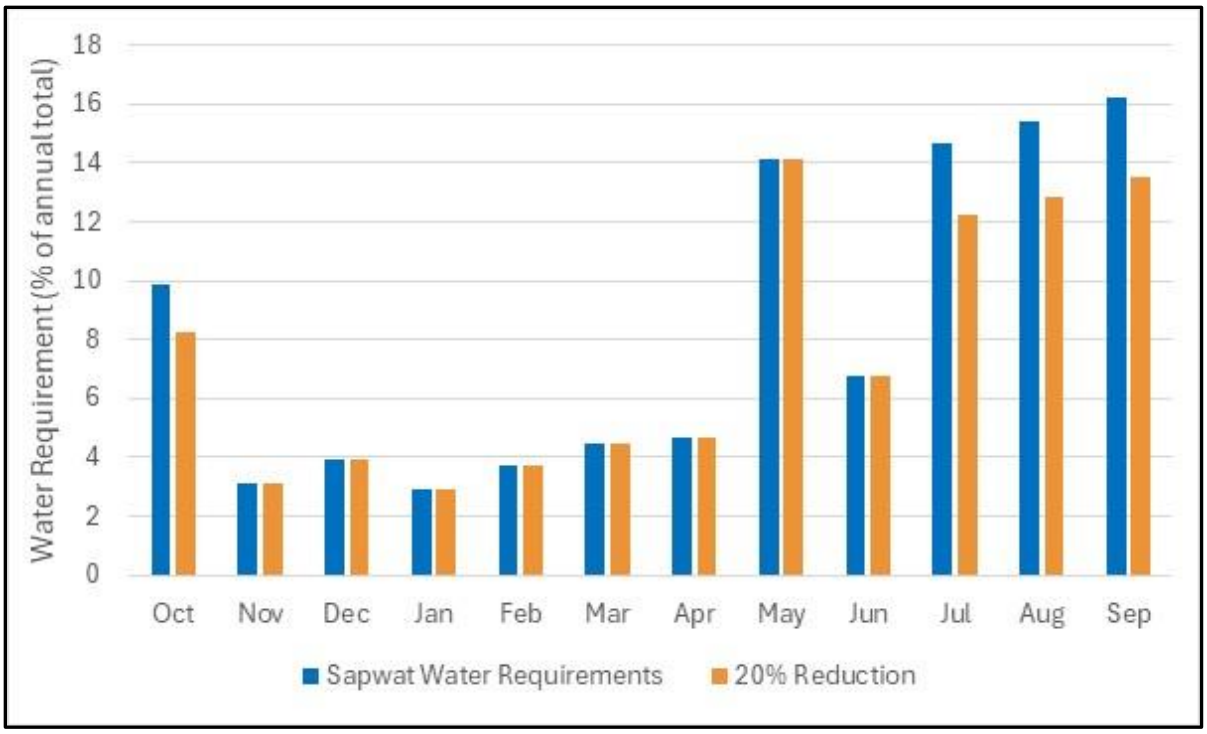

Figure 5: Monthly Distribution of crop water requirements: Scenario 3 (20% reduction in winter allocations)

Table 15: Assurance of supply for the Kaap River catchment: Scenario 3: Winter use reduced by 20%

Assurance of Supply	Irrigation Board	Assurance of supply	
		Water services, Industry and Mining	Irrigation
X23A	Noord Kaap	98%	86%
X23B		98%	69%
X23C	Suid Kaap	98%	59%
X23D		98%	62%
X23F-2		98%	57%
X23E	Queens River	98%	79%
X23F-1		98%	63%
X23G	Eureka	98%	79%
X23H	Lower Kaap	98%	77%

3.6 Scenario 4: Reduce winter allocation by 25%

This scenario models a 25% reduction in the allocation in the months of July to the end of October. See Figure 6 and Table 16. This scenario includes the 15% cap on SFR (Scenario 1).

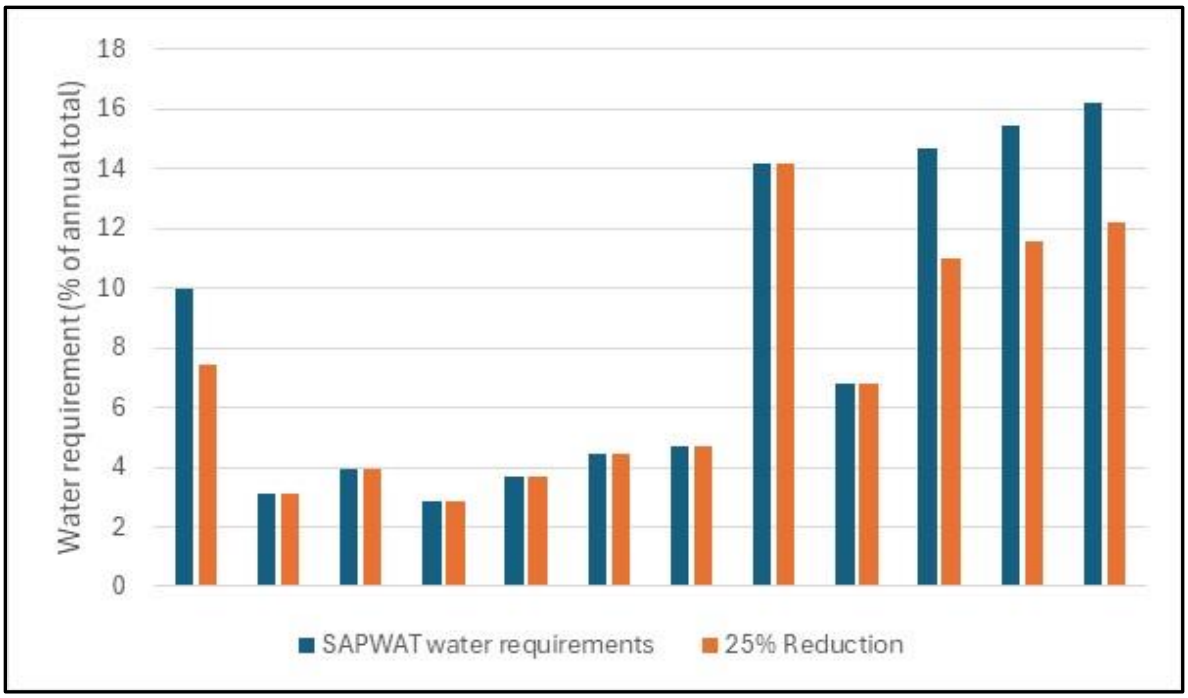

Figure 6: Monthly Distribution of crop water requirements: Scenario 4 (25% reduction in winter allocations)

Table 16: Assurance of supply for the Kaap River catchment: Scenario 4: Winter use reduced by 25%

Assurance of Supply	Irrigation Board	Assurance of supply	
		Water services, Industry and Mining	Irrigation
X23A	Noord Kaap	98%	87%
X23B		98%	70%
X23C	Suid Kaap	98%	59%
X23D		98%	63%
X23F-2		98%	57%
X23E	Queens River	98%	81%
X23F-1		98%	63%
X23G	Eureka	98%	83%
X23H	Lower Kaap	98%	79%

3.7 Scenario 5: Reduce winter allocation by 35%

This scenario models a 35% reduction in the allocation in the months of July to the end of October. See Figure 7 and Table 17. This scenario includes the 15% cap on SFR (Scenario 1).

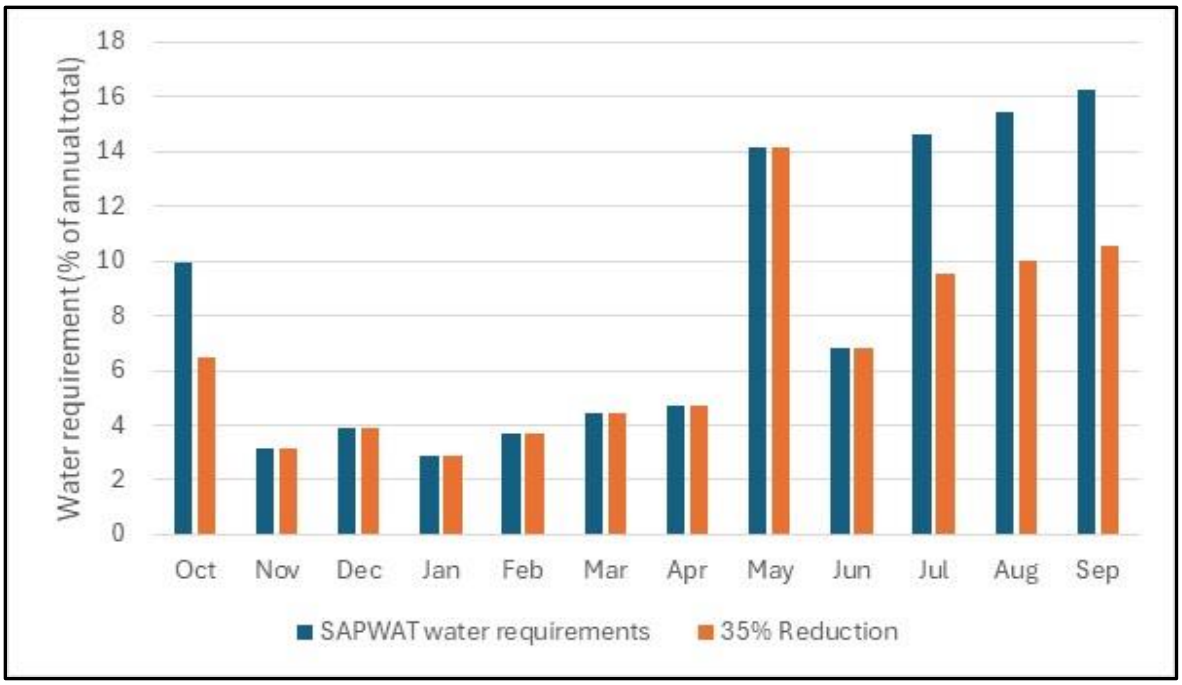

Figure 7: Monthly Distribution of crop water requirements: Scenario 5 (35% reduction in winter allocations)

Table 17: Assurance of supply for the Kaap River catchment: Scenario 5: Winter use reduced by 35%

Assurance of Supply	Irrigation Board	Assurance of supply	
		Water services, Industry and Mining	Irrigation
X23A	Noord Kaap	98%	88%
X23B		98%	73%
X23C	Suid Kaap	98%	60%
X23D		98%	64%
X23F-2		98%	58%
X23E	Queens River	98%	88%
X23F-1		98%	64%
X23G	Eureka	98%	85%
X23H	Lower Kaap	98%	83%

3.8 Scenario 6: Reduce winter allocation by 50%

This scenario models a 50% reduction in the allocation in the months of July to the end of October. See Figure 8 and Table 18. This scenario includes the 15% cap on SFR (Scenario 1).

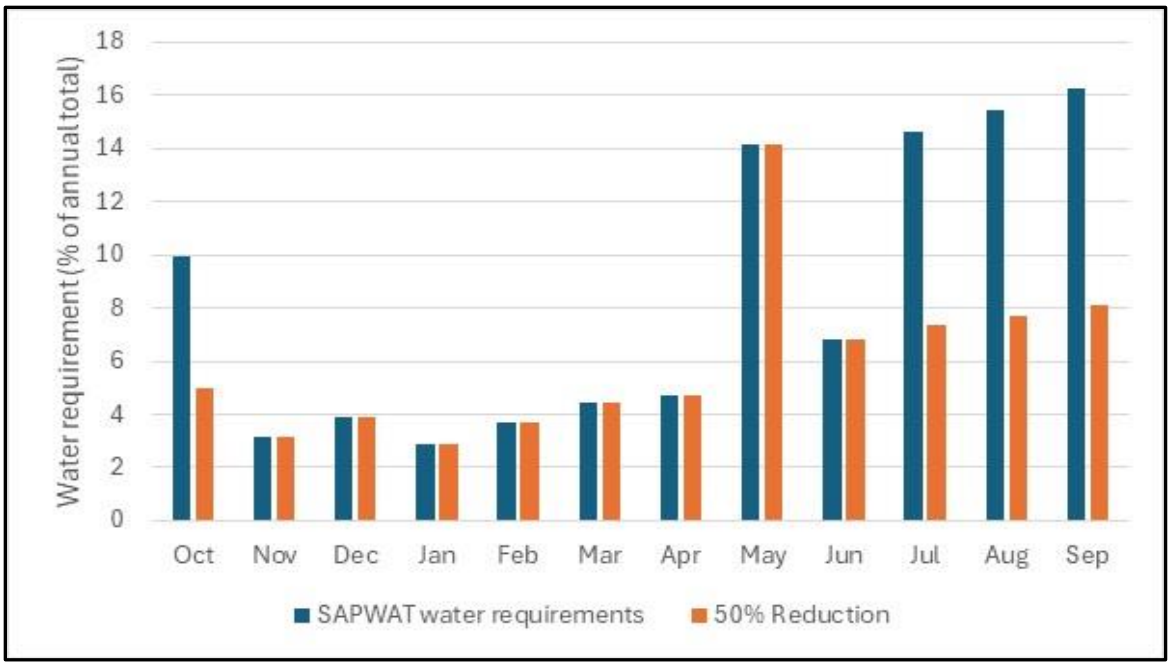

Figure 8: Monthly Distribution of crop water requirements: Scenario 6 (50% reduction in winter allocations)

Table 18: Assurance of supply for the Kaap River catchment: Scenario 6: Winter use reduced by 50%

Assurance of Supply	Irrigation Board	Assurance of supply	
		Water services, Industry and Mining	Irrigation
X23A	Noord Kaap	98%	96%
X23B		98%	84%
X23C	Suid Kaap	98%	68%
X23D		98%	67%
X23F-2		98%	62%
X23E	Queens River	98%	98%
X23F-1		98%	74%
X23G	Eureka	98%	92%
X23H	Lower Kaap	98%	94%

3.9 Scenario 7: Irrigation allocations not being used reduced by 80%

It was reported at one of the earlier stakeholder meetings that many irrigators with valid water allocations are not using their water. One of the options to improve the water balance

in the catchment is reduce these allocations. This scenario considers an 80% reduction in unused allocations. Table 19 and Figure 9 provides a breakdown of these unutilised allocations as provided by the Kaap River Main Irrigation Board. The assurance of supply for the 80% reduction in unused allocations is shown in Table 20.

Table 19: Scenario 7 proposed allocations (Units are million m^3/annum)

Quaternary catchment	Full Allocation including irrigators outside of the Irrigation Boards	Unused allocation	Proposed allocation
X23A	5.16	2.86	2.30
X23B	11.28	1.49	9.79
X23C	3.13	2.24	0.89
X23D	14.12	5.97	8.15
X23E	3.13	0.00	3.13
X23F1	13.25	1.09	12.16
X23F2	10.57	1.73	8.84
X23G	11.10	0.48	10.62
X23H	13.07	0.60	12.47
Total	**84.81**	**16.46**	**68.354**

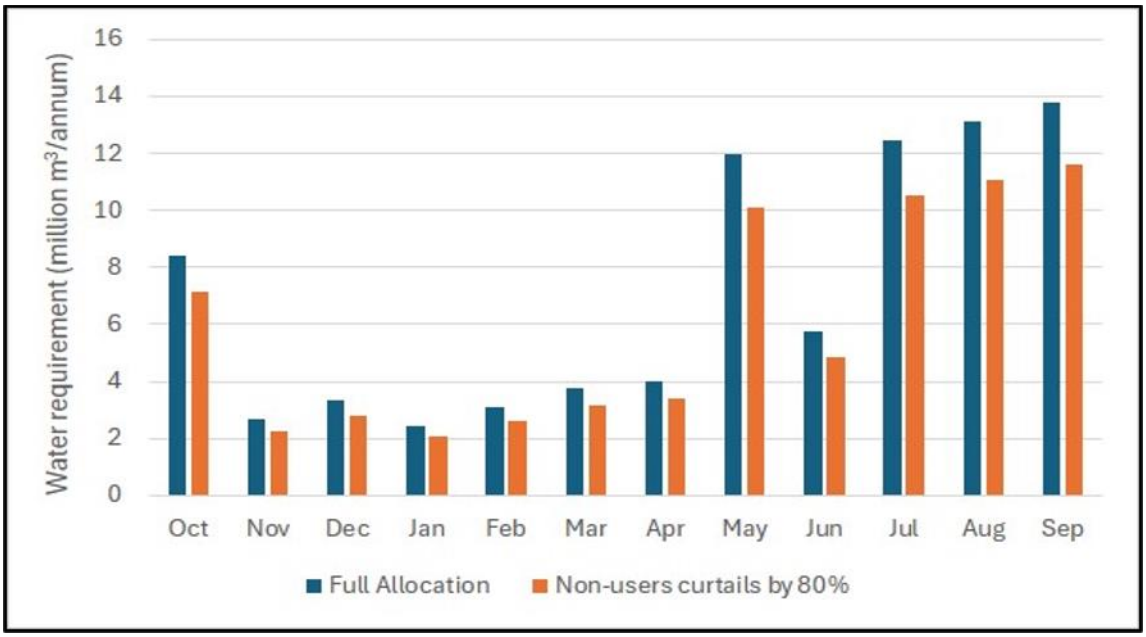

Figure 9: Scenario 7: Current allocation and non-users curtailed by 80%

Table 20: Assurance of supply for the Kaap River catchment: Scenario 7: Unused allocations curtailed by 80%

Assurance of Supply	Irrigation Board	Assurance of supply	
		Water services, Industry and Mining	Irrigation
X23A	Noord Kaap	98%	96%
X23B		98%	72%
X23C	Suid Kaap	98%	98%
X23D		98%	70%
X23F-2		98%	62%
X23E	Queens River	98%	75%
X23F-1		98%	63%
X23G	Eureka	98%	78%
X23H	Lower Kaap	98%	69%

3.10 Summary of results

Figure 10 shows the monthly distribution of water requirements for all scenarios while Table 3.9 compares the results of the analyses in terms of assurance of supply.

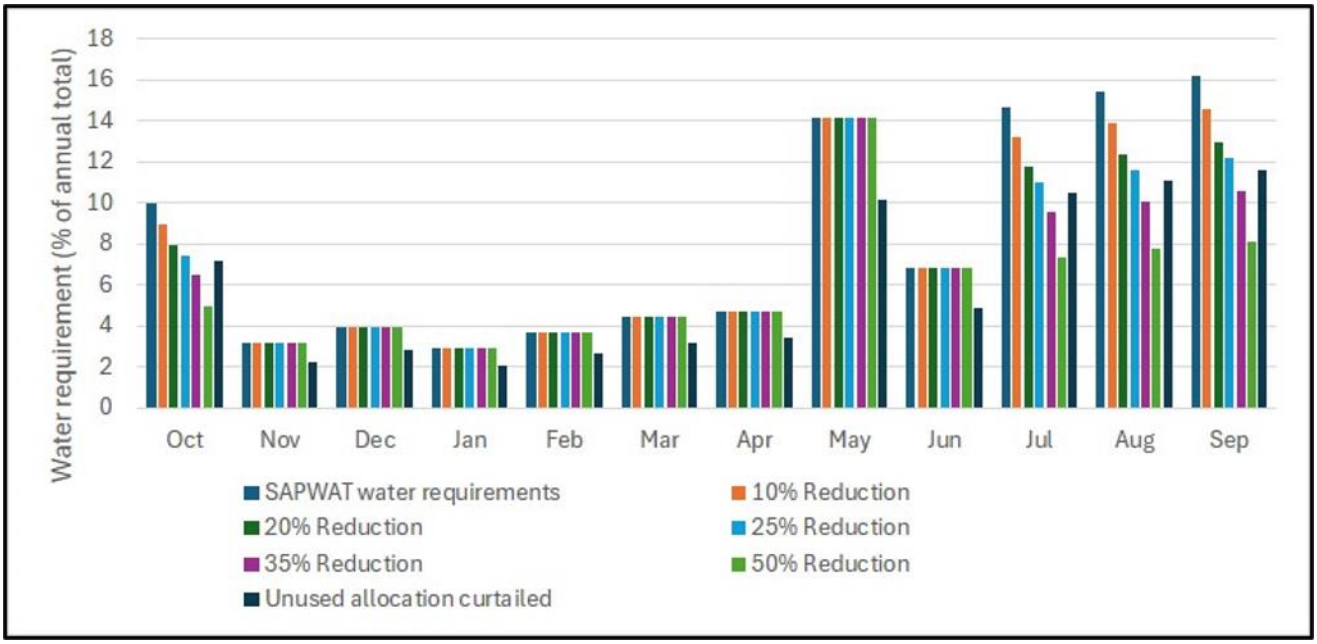

Figure 10: Monthly Distribution of crop water requirements and modelled reductions in winter allocations

Another way of reporting on the proposed curtailments is to compare the current allocations with curtailed allocations and the estimated volume of water supplied for each of the five scenarios, this is shown in Table 21. The volume of water supplied is less than the allocation because the assurance of supply is less than 100%, the implication being that there are times when irrigators do not receive their full allocation.

Table 21: Summary of Water requirements, water supply and assurance of supply

Scenario	Description	Irrigation Allocation (million m^3/annum)	Irrigation Supply (million m^3/annum)	Assurance of supply (%)
0	Status quo	84.8	58.9	55 to 81
1	Cap SFR to 15% of MAR	84.8	59.8	57 to 83
2	Reduce winter use by 10%	82.1	60.2	57 to 85
3	Reduce winter use by 20%	78.7	59.6	57 to 86
4	Reduce winter use by 25%	77.0	59.4	57 to 87
5	Reduce winter use by 35%	73.6	58.6	58 to 88
6	Reduce winter use by 50%	62.5	54.7	62 to 98
7	Non-users curtailed by 80%	71.6	55.2	62 to 98

It can be concluded that reducing the winter allocation has a limited effect on reducing the water requirements. This is because the winter allocations (July to October) only accounts for 56% of the allocation. A 25% reduction applied to 56% of the allocation amounts to a 14% reduction in the total allocation (73.3 to 63.3 million m^3/annum). Figure 11 shows an example of impact of curtailment for a user with allocation of 20 million m^3/annum which will translate to only 11.5% curtailment to the allocation of the user. A winter reduction of 25% in addition to a cap on SFR only brings the Lower Kaap and Eureka Irrigation Boards into an acceptable range of assurance of supply while the other irrigation boards will still experience unacceptably low assurance of supply. Augmentation of the resource in the Queens River and Noord Kaap River could alleviate the shortages in these upper reaches.

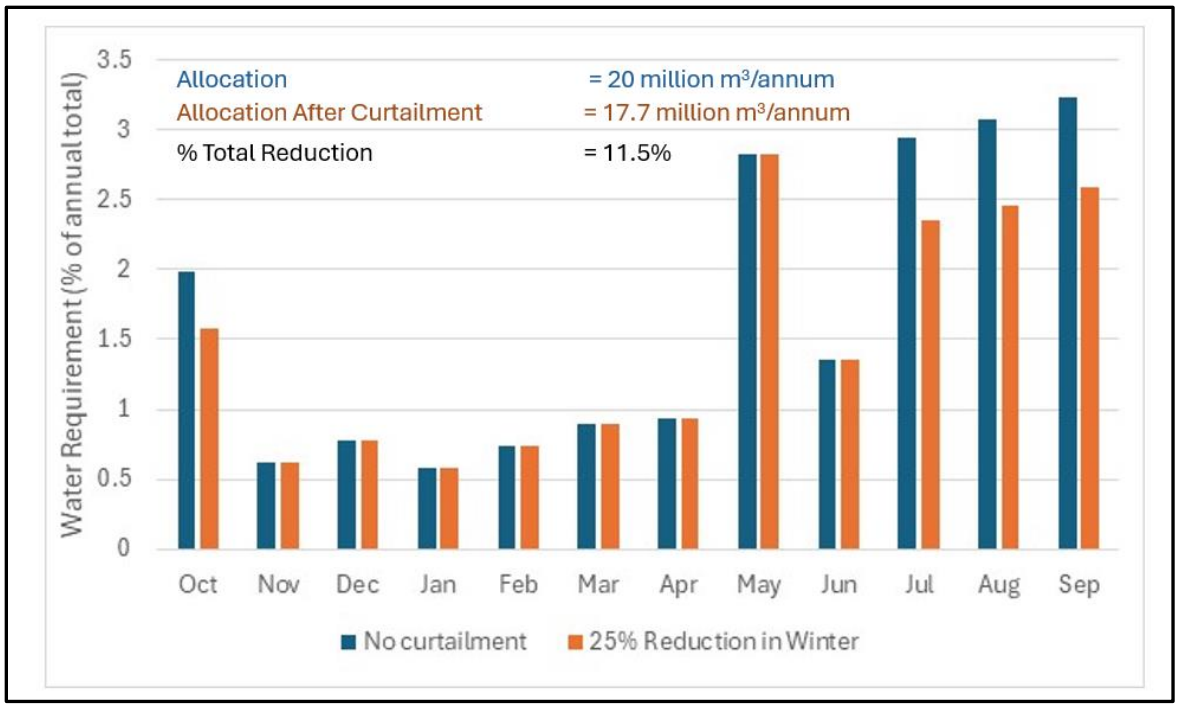

Figure 11: Example of impact of curtailment on overall water allocation of a user

4. Recommendations and Opportunities

It can be concluded that curtailing SFR or reducing winter allocations will have a limited impact on the water use in the Kaap River catchment, but when used together as a curtailment tool the reduction in water use is significant but not sufficient. The proposed measure will bring the Lower Kaap and Eureka Irrigation Boards into an acceptable range of assurance of supply, but the other irrigation boards will still experience unacceptably low assurance of supply.

The problem with the water supply to irrigators in the Kaap River catchment is not so much one of over-utilisation but over-allocation. Out of the 84.5 million m^3annum allocated to irrigators, an estimated 16.3 million m^3annum is not being used. One of the options being considered is to substantially curtail those users who are not utilising their allocation. This will bring the catchment approximately into balance with a few locations still experiencing lower than acceptable assurance.

However, there are augmentation opportunities available in the upper reaches which could alleviate water shortages for Queens River, Suid Kaap and Noord Kaap Irrigation Boards. These are the Hilversum Dam on the Queens River and a dam near Snymansbult on the Noord Kaap River. Preliminary estimates indicate these two dams could increase the assurance of supply to within acceptable norms if accompanied with Scenario 4 curtailments. Full feasibility studies into these two dams will however be required to check for fatal flaws. Also, if the Mountain View Dam is constructed then the Lower Kaap Irrigation Board could be supported with an allocation from this dam.

Individual farmers or consortiums could also construct off-channel dams filled from the river when water is available (November through to the end of May).

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APPENDIX A: LOUWS CREEK IRRIGAITON BOARD SHOWING HOW IRRIGATORS SUPPLIED FRIOM THE KAAP OR LOMATI RIVER COULD BE CURTAILED

Louws Creek Allocaiton		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
(% of Total)		10%	3%	5%	3%	4%	4%	4%	14%	7%	14%	15%	16%
Existing Allocation (million m3/month)													
	Annual	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Lomati	7.970	0.797	0.255	0.391	0.255	0.303	0.343	0.351	1.132	0.542	1.100	1.219	1.283
Kaap	4.520	0.452	0.145	0.221	0.145	0.172	0.194	0.199	0.642	0.307	0.624	0.692	0.728
Total Lows Creek	12.490	1.249	0.400	0.612	0.400	0.475	0.537	0.550	1.774	0.849	1.724	1.911	2.011
25% Winter Allocation APPLIED only on the Kaap River Users (million m3/month)													
	Annual	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Lomati	7.970	0.797	0.255	0.391	0.255	0.303	0.343	0.351	1.132	0.542	1.100	1.219	1.283
Kaap	3.896	0.339	0.145	0.221	0.145	0.172	0.194	0.199	0.642	0.307	0.468	0.519	0.546
Total Lows Creek	11.866	1.136	0.400	0.612	0.400	0.475	0.537	0.550	1.774	0.849	1.568	1.738	1.829
	Annual	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Curtailment Percentage	5%	9%	0%	0%	0%	0%	0%	0%	0%	0%	9%	9%	9%

APPENDIX B: ECOLOGICAL WATER REQUIREMENTS

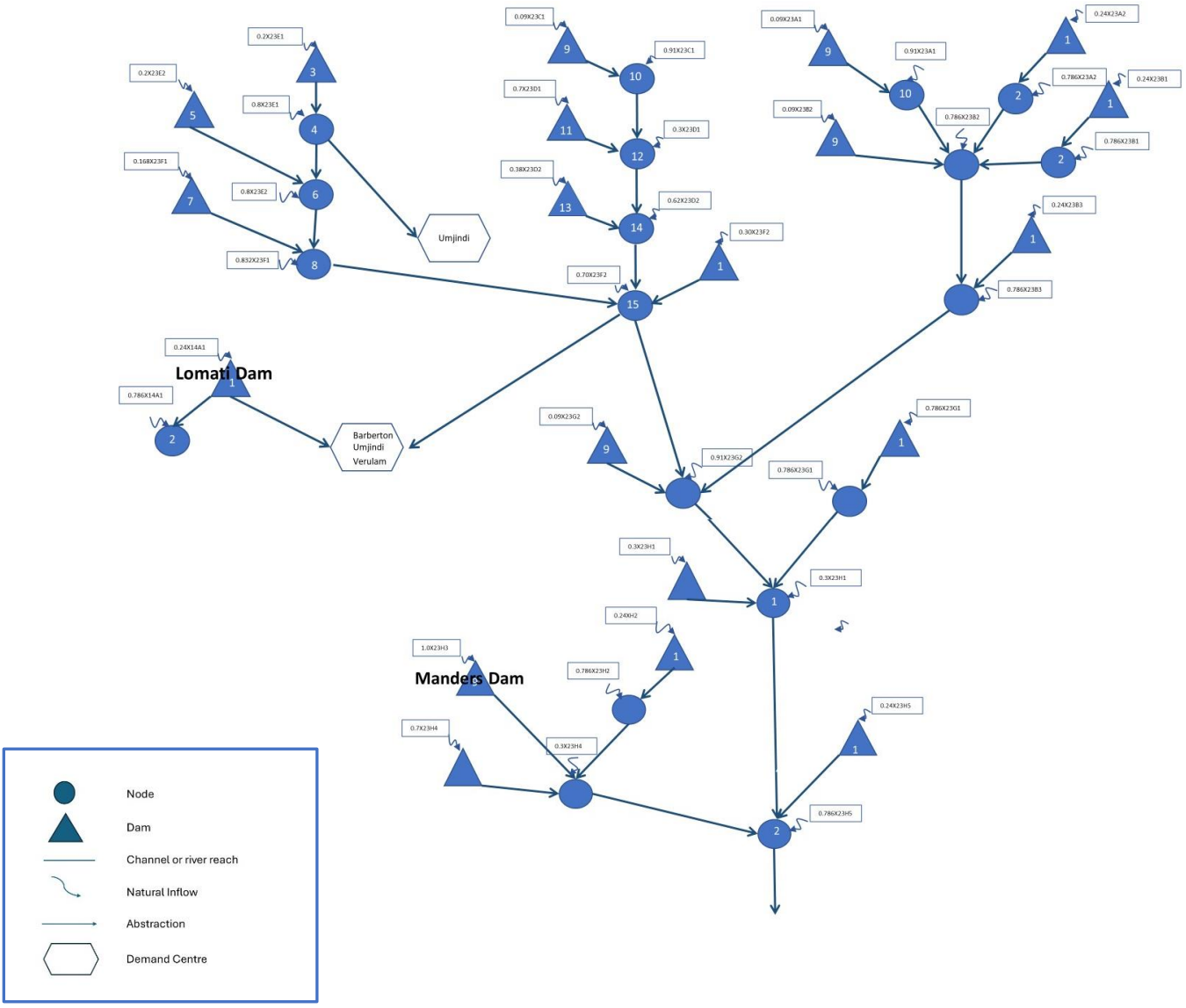
Source: DWS, 2019

	DESKTOP RESERVE RESULTS FOR THE INKOMATI RIVER SUB-QUAT. CATCHMENTS												
			Mean annual runoff (MAR) (10^6m^3)						Long-term mean flow requirement				
			Provided						Low flows		Total flows		
IUAs	Sub-quat code (Quat-NFEPA)	River name	Natural	PD inflow	Natural	PD outflow	Hydro. cat	REC	10^6m^3	MAR	10^6m^3	MAR	Desktop method
X2-10	X23B-01052	Noordkaap	50.9	35.7	50.9	33.5	C	D	8.66	17.0%	11.96	23.5%	RDRM
X2-10	X23C-01098	Suidkaap	61.8	39.2	61.8	37.8	D	C	20.12	32.6%	24.40	39.5%	RDRM
X2-10	X23E-01154	Queens	39.5	29.4	39.5	25.0	D	C	7.26	18.4%	10.71	27.1%	RDRM
X2-10	X23F-01120	Suidkaap	109.8	74.9	109.8	57.1	D	C	26.51	24.1%	34.04	31.0%	RDRM

X2-10: Kaap Catchment	II	X23B-01052	Noordkaap	C
		X23C-01098	Suidkaap	B/C
		EWRK7	Kaap	C
		X23E-01154	Queens	B/C
		X23F-01120	Suidkaap	C

IUA X2-10										
RU C16	*X23B-01052*	*Noordkaap*	C	*50.91*	*26.9*	*34.4*	*0.212*	*0.246*	*0.253*	*0.396*
RU C17	*X23C-01098*	*Suidkaap*	B/C	*61.75*	*32.6*	*39.5*	*0.025*	*0.027*	*0.025*	*0.037*
	X23E-01154	*Queens*	B/C	*39.54*	*23.4*	*32.7*	*0.121*	*0.146*	*0.169*	*0.22*
	X23F-01120	*Suidkaap*	C	*109.79*	*24.1*	*31*	*0.321*	*0.482*	*0.698*	*0.979*
MRU Kaap A	*X23G-01057 EWR C7*	*Kaap*	C	*179.5*	*6.18*	*19.23*	*0.069*	*0.144*	*0.349*	*0.559*

APPENDIX C: SYSTEMS DIAGRAM



APPENDIX D: ADDITIONAL SCENARIOS

Table C1: Comparison of Current water use and Verified Existing Lawful Use

Quaternary catchment	Irrigation Board	Current situation (70% of allocation used) No EWR			Full Allocation (100% of allocation used) with EWR		
		Water Requirements	Water Supply	Assurance of supply	Allocation	Water Supply	Assurance of supply
X23A	Noord Kaap	1.2	1.2	98%	2	1.4	70%
X23B		6.4	5.9	87%	9.1	6.2	63%
X23C	Suid Kaap	3	3	99%	3	2.3	74%
X23D		6.6	6.5	95%	11	6.2	60%
X23F-2		12.4	9.8	89%	21	8.4	48%
X23E	Queens River	3.1	2.50	85%0	3.1	2.5	85%
X23F-1		5.1	4.4	75%	9.9	6.1	55%
X23G	Eureka	6.9	6.9	80%	9.1	8.1	76%
X23H	Lower Kaap	4.7	4.7	99%	5	4	70%
Total		49.4	44.9		73.32	45.2	

APPENDIX E: PROPOSED REALLOCATION RULES

1. SFRA Rules	**Rule 1a**: All GA HDI (if any) should be given their full application of GA.
	Rule 1b: All lawful existing HDI SFRA applicants should be given their full ELU.
	Rule 1c: All ELU commercial forestry will be curtailed to limit SFRA to 15% of the natural MAR of each quaternary catchment in order to meet the Ecological Water Requirements. This equates to a reduction of 21% in X23A and 39% X23E. Excess forestry should be removed in a progressive manner over a number of years linked to the optimal harvest depending on the genus.
2. Irrigation Rules	**Rule 2a**: All GA HDI applicants should be given their full allocation applied for (possible to a maximum of GA).
	Rule 2b: All existing applicants who have an existing lawful use should be given at least 75% of their winter months ELU and 100% of their summer months ELU.
	Rule 2c: Unutilised allocations in the Kaap catchment should be given up to 20% of their ELU.
	Rule 2d: No new surface water non-HDI applicants will receive an allocation.
	Rule 2e: All ELU groundwater will be considered provided it is efficiently and sustainably utilised.
	Rule 2f: All new groundwater applicants will be considered provided it is efficiently and sustainably utilised.
3. Urban, Industrial and mining	**Rule 3a**: Urban and industrial users will be limited to an efficient water use guided by the non-revenue targets (15% for urban use, 10% for industrial use).
	Rule 3b: The municipality will be limited to water abstractions from the Suid Kaap based on the existing operating rules.
	Rule 3c: ELU groundwater use will not be restricted provided it can be shown that it is efficiently and sustainably utilised.
	Rule 3d: All new groundwater will be considered provided it is efficiently and sustainably utilised.
4. Expired and soon to expire	**Rule 4a:** All existing licenses that have expired or will expire by 31 December 2030 will be benchmarked to SAPWAT 4.
5. Review of existing licenses	**Rule 5a**: All existing licenses that have been in existence for five years or more will be reviewed as per Section 49 of the NWA.