INKOMATI NWRCS

CONSEQUENCES OF SCENARIOS & RECOMMEND MANAGEMENT CLASSES: CROCODILE (X2) RIVER

- **Ecology**
- **Water quality**
- **Ecosystem Services**
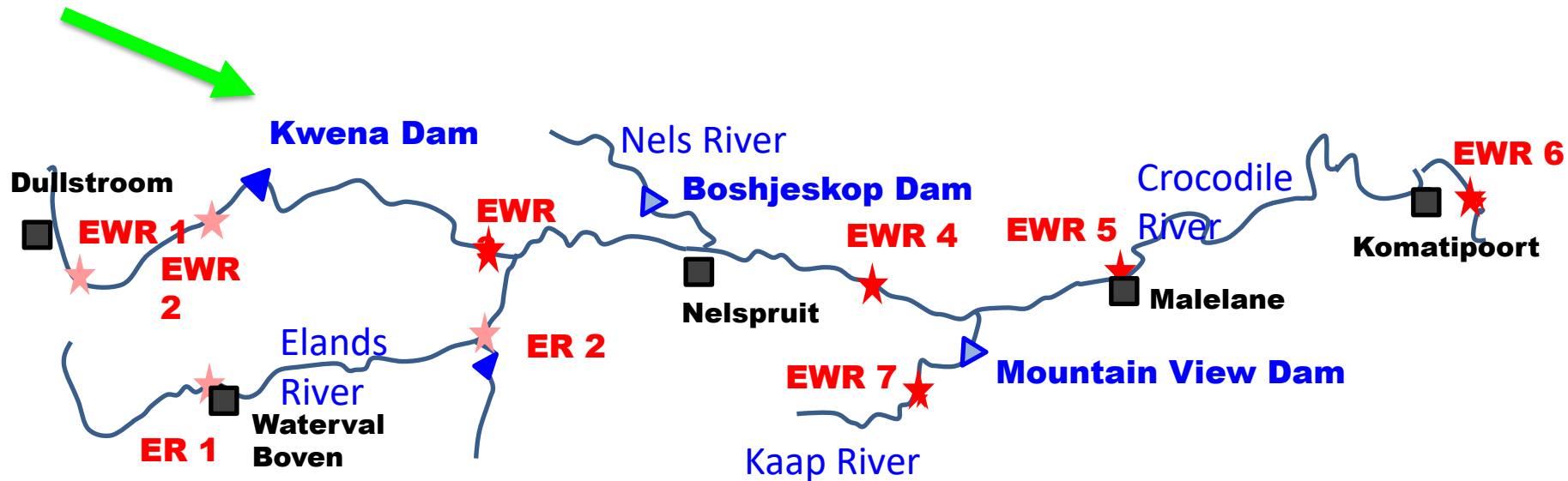- **Economics**
- **Management classes**

24 November 2014

SCENARIOS ONLY IMPACT ON SITES DOWNSTREAM OF KWENA DAM, I.E.:

➢ EWR C3 (DS of Kwena dam and US of Elands confluence)

➢ EWR C4 (Kanyamazane DS of Nelspruit)

➢ EWR C5 (Malelane)

➢ EWR C6 (Most DS point of river US of Komati confluence)

➢ EWR C7 (Lower Kaap River), but to a small degree

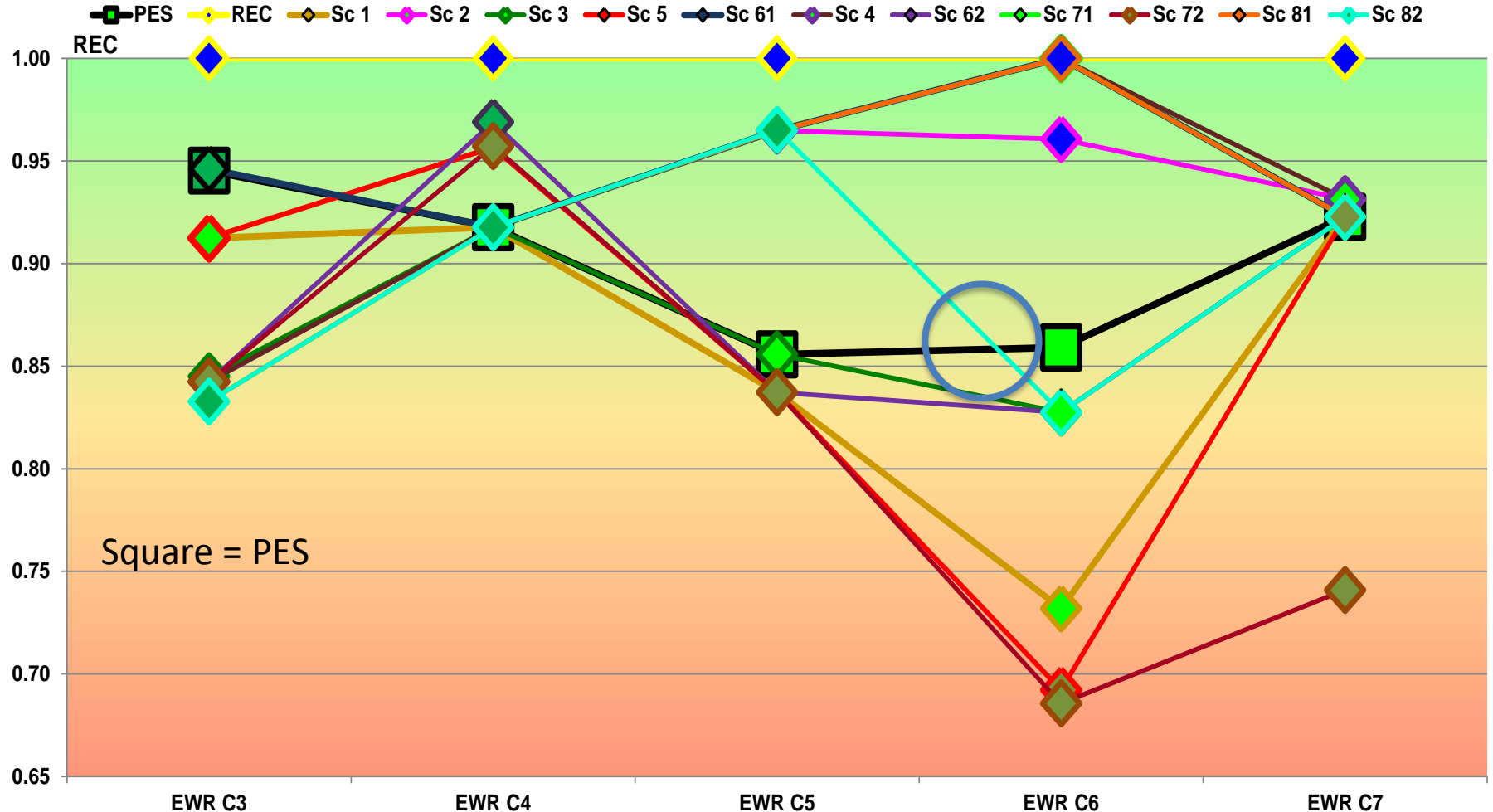# Crocodile River with key points for scenario evaluation

◀ Existing dam

▷ Proposed dam

★ EWR site impacted on by scenarios

★ EWR site not impacted on by scenarios

■ Town

Kwena Dam

Nels River

Boshjeskop Dam

Dullstroom

EWR 1

EWR 2

EWR

Elands River

ER 2

Nelspruit

EWR 4

EWR 5

Crocodile River

EWR 6

Komatipoort

Malelane

ER 1

Waterval Boven

EWR 7

Mountain View Dam

Kaap River

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ECOLOGIGAL CONSEQUENCES (RIVERS)

# CROCODILE RIVER: INTEGRATED CONSEQUENCES

Where lines cross, the ranking order is different between EWR sites.
Weights are therefore necessary as most important site ranking must play bigger role than ranking at other sites.

CROCODILE RIVER: SITE WEIGHTING

EWR site	PES	EIS	Conf	Locality in protected areas	Normalised Weight
EWR C1	A/B	Moderate	3.75	1	0.14
EWR C2	B	High	3.5		0.14
EWR C3	B/C	High	2.5	1	0.12
EWR C4	C	High	2.5	2	0.13
EWR C5	C	Very High	3.4	5	0.18
EWR C6	C	Very High	4	5	0.20
EWR C7	C	High	1	1	0.10

CROCODILE RIVER: INTEGRATED RANKING

INTEGRATED ECOLOGICAL RANKING

1.00 — REC
0.96 — Sc 61, Sc 4, Sc 81, 71, Sc 2
0.92 — PES, Sc 82
Sc 62, Sc 3, Sc 1, Sc 5
0.88
0.84 — Sc 72
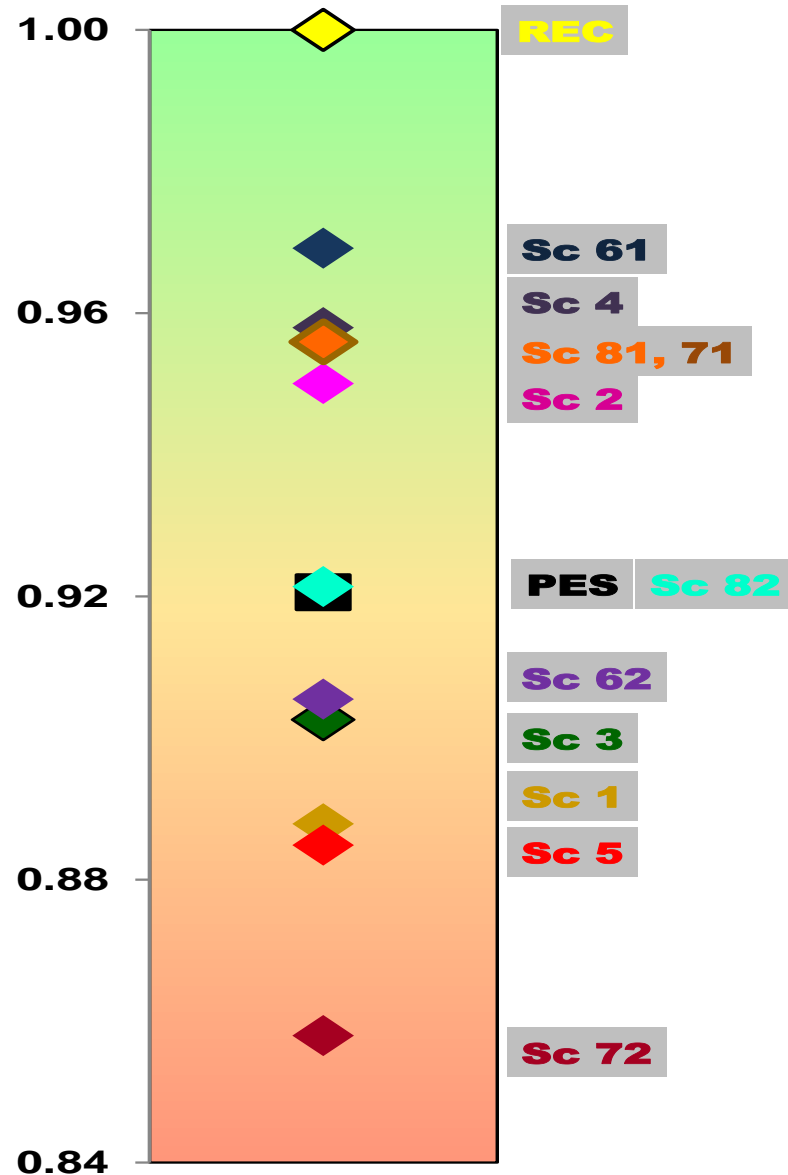
➢ Sc 72 & C 5 are the worst.
➢ Current operation rule (C1), also degrades river – but maintain PES at EWR 6.
➢ Best options are those that include the REC – potential serious economic consequences.
➢ Sc 3 and 82 possible best compromise options.

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USER WATER QUALITY CONSEQUENCES (RIVERS)

All Sc

CS

Site location
MRU Croc B, incl
EWR C3 on the
Crocodile River

Primary role players
Irrigation, esp. citrus

Primary wq drivers
Nutrients, salts, toxics

Site location
MRU Croc C, incl
EWR C4 on
the Crocodile River

Primary role players
KaNyamanzane
urban + industrial
area

Primary wq drivers
Nutrients, salts, toxics,
E. coli / coliforms

All Sc

CS

Sc2, 82
CS; Sc1,5

Site location
MRU Croc E, incl EWR C5 on the Crocodile River

Primary role players
Urban, incl sugar mill, fruit processing, WWTW;
+ KNP (one bank)

Primary wq drivers
Nutrients, salts, toxics, temp.
E. coli **/ coliforms,**

Site location
MRU Croc E, incl EWR C6 on the Crocodile River

Primary role players
Urban impacts, WWTW;
International agreements + KNP

Primary wq drivers
Nutrients, salts, toxics,
E. coli **/ coliforms, international obligations**

Sc 2
CS; Sc1,82
Sc 5,72

Site location
MRU Kaap A, incl EWR C7 on
the Kaap River

Primary role players
Some irrigation;
Gold mines

Primary wq drivers
Nutrients, salts, toxics (As, Cn)

● CS; Sc2;4; 62

● All Sc

ECOSYSTEM SERVICES CONSEQUENCES
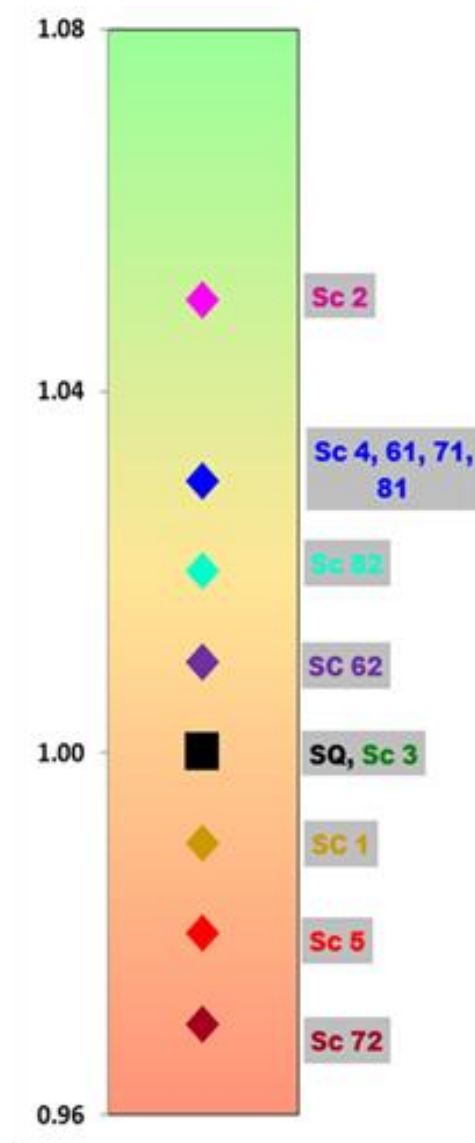
- Overall Sc C1, C5, and C72 were deemed to be marginally negative. The remaining scenarios were either neutral or marginally positive.
- Sc 72 was deemed overall to preform in most –ve manner.
- Water quality impacts were the primary driver for –ve aspect of Sc 72.
- Remaining aspects were mostly neutral.

ECONOMIC CONSEQUENCES

Scenario Evaluation – Crocodile River System

Crocodile River system - GDP (Percentage Change)

| Scenario	Value
Scenario 2	-22,3%
Scenario 3	-6,8%
Sceanrio 4	-23,7%
Scenario 5	2,2%
Scenario 6.1	-13,4%
Scenario 6.2	-3,1%
Scenario 7.1	-21,3%
Scenario 7.2	10,3%
Scenario 8.1	-11,2%
Scenario 8.2	-0,2%
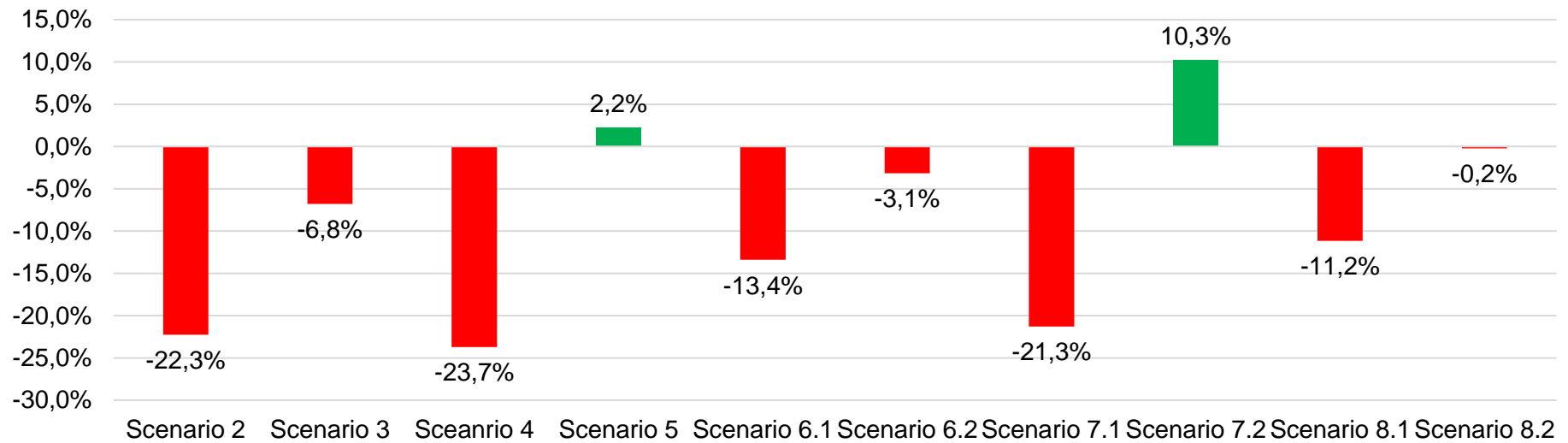
Crocodile River system - Employment (Percentage Change)

Scenario	Value
Scenario 2	-19,4%
Scenario 3	-6,1%
Scenario 4	-20,5%
Scenario 5	3,2%
Scenario 6.1	-10,4%
Scenario 6.2	-1,6%
Scenario 7.1	-14,4%
Scenario 7.2	7,8%
Scenario 8.1	-5,7%
Scenario 8.2	3,5%
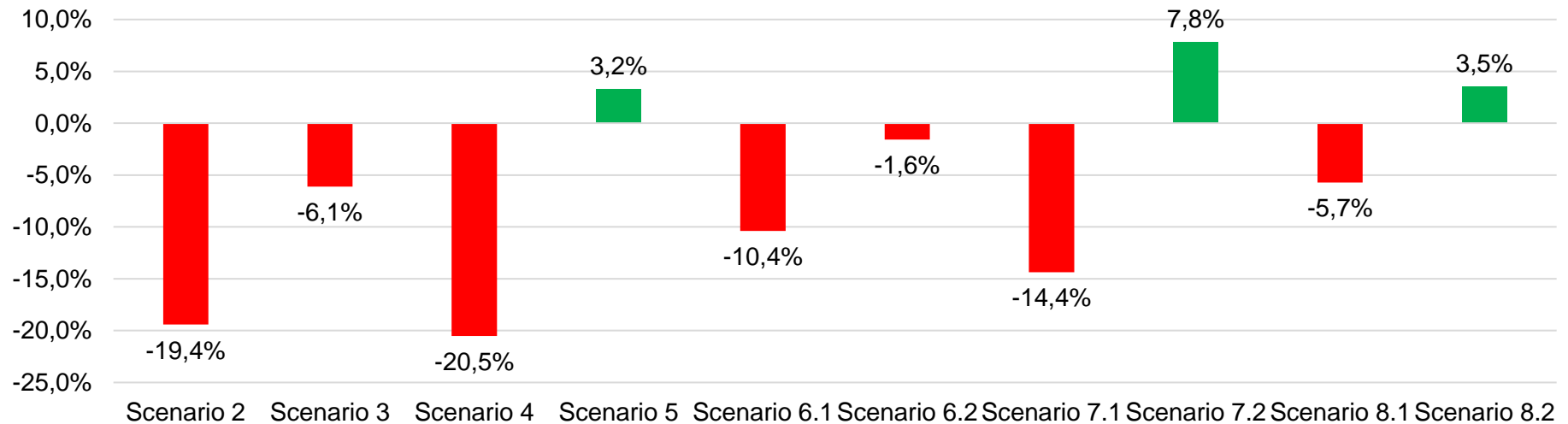
RECOMMENDED SCENARIO AND DRAFT MC

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Variable Scores & Weights

Variables	Scenarios										
	1	2	3	4	5	61	62	71	72	81	82
Ecological Status	0.89	0.95	0.91	0.96	0.89	0.97	0.91	0.96	0.86	0.96	0.92
Ecosystem Services	1.00	1.04	1.01	1.03	0.99	1.03	1.01	1.03	0.99	1.03	1.02
Economic Indicator (GDP) (R Millions)	4 522	3 699	4 235	3 656	4 626	3 988	4 384	3 729	5 041	4 069	4 513
Employment	35 197	29 473	33 167	29 206	36 377	318 88	34 653	30 772	38 167	33 294	36 475

Variables	Weights	
Ecological Status	0.5	50% Ecology
Ecosystem Services	0.05	
Economic Indicator	0.2	50% Socio-Economic
Employment	0.25	

Visualisation of Variables Scores
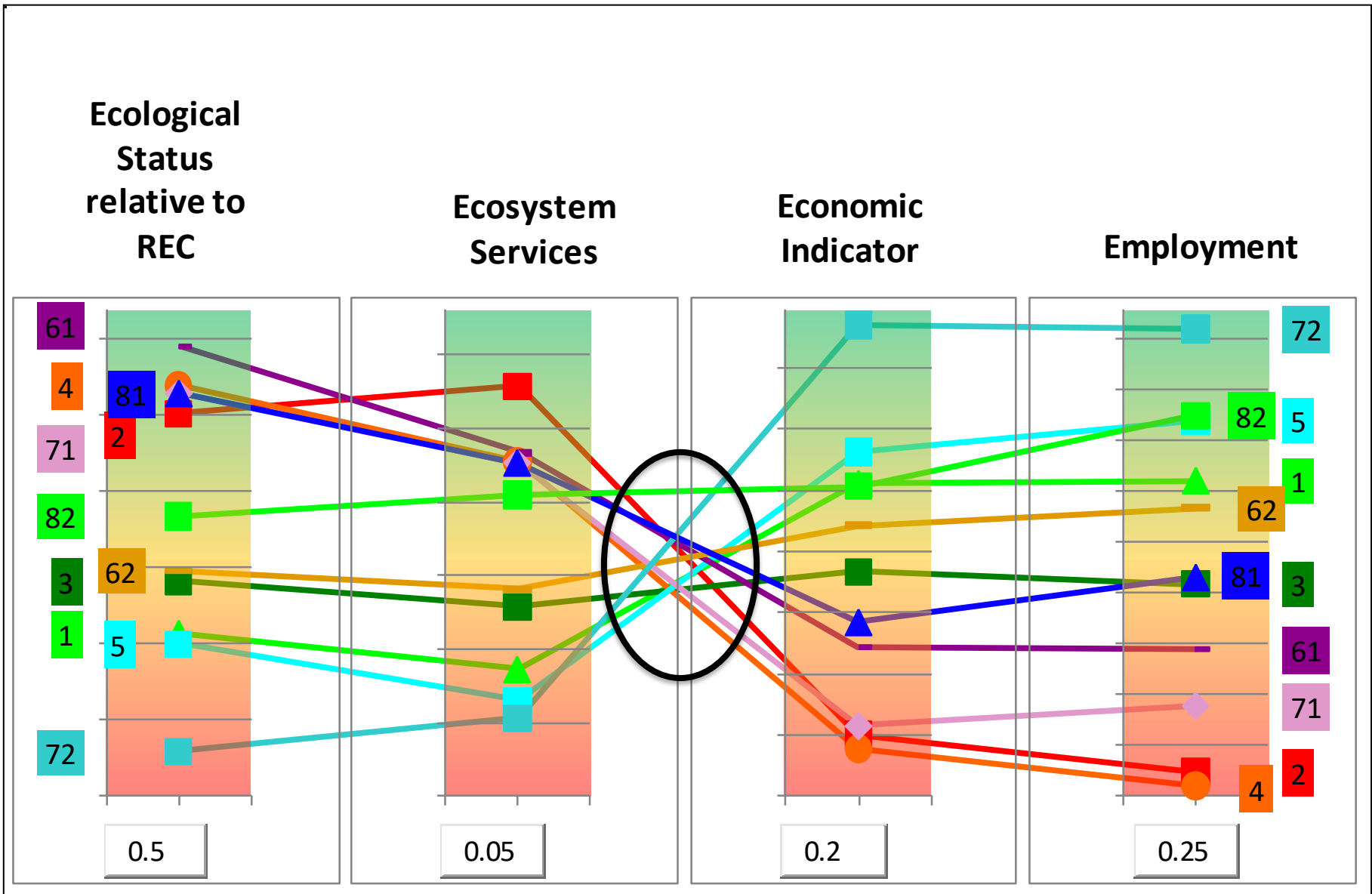
Overall Ranking (Two Rank Methods)

Method	Scenarios										
	1	**2**	**3**	**4**	**5**	**61**	**62**	**71**	**72**	**81**	**82**
Overall Score (Rank Order method)	5.45	4.95	4.65	5.90	5.35	7.80	5.90	5.98	5.50	6.98	7.40
Rank (1 = best, 8 = worse)	**8**	**10**	**11**	**5.5**	**9**	**1**	**5.5**	**4**	**7**	**3**	**2**
Overall Score (Normalisation Method)	0.446	0.481	0.421	0.490	0.476	0.663	0.500	0.535	0.450	0.654	0.651
Rank (1 = best, 8 = worse)	**10**	**7**	**11**	**6**	**8**	**1**	**5**	**4**	**9**	**2**	**3**

Overall Ranking (Normalised Scores)
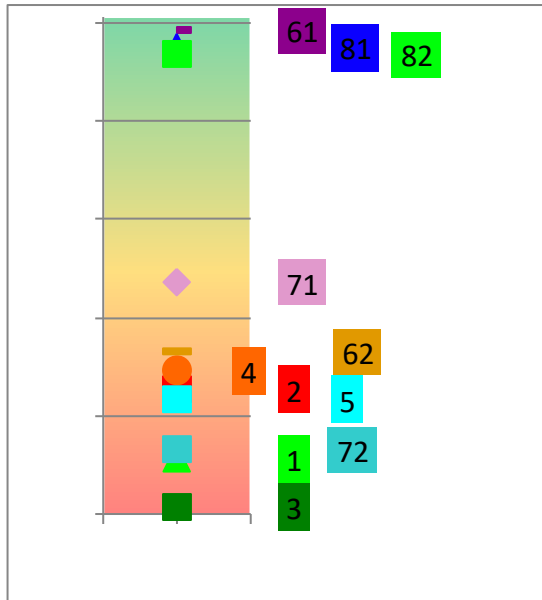
Overall Ranking (Rank Order)
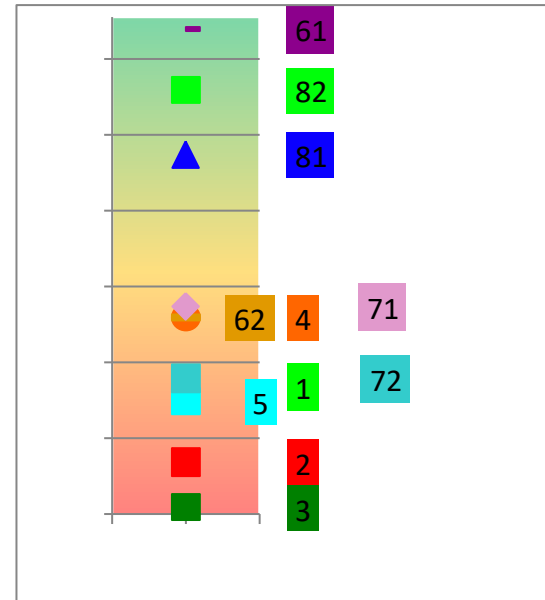
Sensitivity analysis and synthesis of

Nr	Alternative Weights:				Scenario and Ranking Order										
	Ecological	Ecosystem Services	Economy (GDP)	Employ ment	1	2	3	4	5	61	62	71	72	81	82
1	0.15	0.10	0.45	0.30	4	10	8	11	3	7	5	9	**1**	6	2
2	0.20	0.10	0.40	0.30	4	10	8	11	3	7	5	9	**1**	6	2
3	0.25	0.25	0.25	0.25	9	6	11	10	8	3	5	7	4	2	**1**
4	0.25	0.25	0.25	0.25	9	6	11	10	8	3	5	7	4	2	**1**
5	0.30	0.05	0.30	0.35	7	10	8	11	3	6	5	9	2	4	**1**
6	0.35	0.05	0.25	0.35	7	10	8	11	5	4	6	9	2	3	**1**
7	0.40	0.05	0.25	0.30	7	10	9	11	5	3	6	8	4	2	**1**
8	0.45	0.05	0.20	0.30	8	10	11	9	5	3	4	6	7	2	**1**
9	0.45	0.05	0.22	0.28	8	10	11	9	5	3	4	7	6	2	**1**
10	0.45	0.05	0.28	0.22	8	10	11	9	6	2	4	7	5	3	**1**
11	0.45	0.05	0.30	0.20	8	10	11	9	6	2	4	7	5	3	**1**
12	0.45	0.05	0.32	0.18	8	10	11	9	6	2	5	7	4	3	**1**
13	0.48	0.05	0.22	0.25	10	9	11	7	6	2	5	4	8	3	**1**
14	0.48	0.05	0.25	0.22	10	9	11	7	6	2	5	4	8	3	**1**
15	0.48	0.05	0.30	0.17	10	9	11	7	6	**1**	5	4	8	3	2
16	0.48	0.05	0.35	0.12	10	9	11	6	7	**1**	5	4	8	3	2
17	0.50	0.05	0.15	0.30	10	7	11	6	8	**1**	5	4	9	2	3
18	**0.50**	**0.05**	**0.20**	**0.25**	**10**	**7**	**11**	**6**	**8**	**1**	**5**	**4**	**9**	**2**	**3**
19	0.50	0.05	0.30	0.15	10	7	11	6	8	**1**	5	4	9	2	3
20	0.50	0.10	0.20	0.20	9	5	10	6	8	**1**	7	4	11	2	3
21	0.50	0.15	0.15	0.20	10	5	8	6	9	**1**	7	4	11	2	3

Rank: 1 = best, 11 = worse.

Considerations for scenario selection

- Scenarios 82, 61 and 81 is similar and the following should be considered.

- Large advantage in socio-economic scores for Scenario 82 compared to Scenario 61, while the ecology is maintained at a levels slightly above the Present Ecological State.

- This implies Scenario 82 is an improvement for both the ecology and socio-economics compared to current conditions (Scenario 1) while Scenario 61 only improves the ecology.

- A further aspect to consider is that the ecological score for Scenario 61 is the highest for all the scenarios and as such represents an "extreme" option and not a balanced outcome.

- **It is therefore proposed that Scenario 82 be selected as the preferred scenario for the long term future.**

- Scenario 82 incorporates both the future development options (Mountain View and Boschjeskop dams), which have the risk that it will be a long time before both dams are developed.

- **Scenario 62 (includes only Mountain View Dam) is therefore proposed as the scenario to be aimed at over the medium** term future since Mountain View Dam has a higher probability of being developed.

Considerations for scenario selection

- Over the short term the selection is between Scenario 1 and Scenario 3. Scenario 3 includes additional water for Mozambique, makes releases towards improving the current ecological conditions as well as allows for growth in domestic water supply and is therefore proposed for the preferred scenarios for the short term.

- All three the proposed scenarios (Scenarios 3, 62 and 82) are where the "PES" releases are the target EWR and allow improvements in both the ecological health as well as the socio-economic conditions in future.

Recommended Management Class Criteria Table

		% EC representation at units represented by biophysical nodes in an IUA					Prominent Ecological Categories
		≥ A/B	≥ B	≥C	≥ D	< D	
Class I		0	60	80	95	5	A & B
Class II			0	70	90	10	C
Class III	Either			0	80	20	D
	Or				100		

Unit Percentages:

Length of river in a given Ecological Category divided by the total river length in an IUA .

Resulting IUA Management Classes for all scenarios

IUA	PES	REC	Scenarios and Management Class										
			1	2	**3**	4	5	61	**62**	71	72	81	**82**
1	II	II	II	II	**II**	II	II	II	**II**	II	II	II	**II**
2	II	I	II	II	**II**	II	II	II	**II**	II	II	II	**II**
3	I	I	I	I	**I**	I	I	I	**I**	I	I	I	**I**
4	II	I	II	II	**II**	II	II	II	**II**	II	II	II	**II**
5	I	I	I	I	**I**	I	I	I	**I**	I	I	I	**I**
6	II	I	II	II	**II**	II	II	II	**II**	II	II	II	**II**
7	II	I	I	I	**I**	I	I	I	**I**	I	I	I	**I**
8	XXX	II	II	II	**II**	II	II	II	**II**	II	II	II	**II**
9	II	I	II	II	**II**	II	II	II	**II**	II	II	II	**II**
10	II	II	II	II	**II**	II	II	II	**II**	II	III	II	**II**
11	II	I	II	I	**II**	I	III	I	**II**	I	III	I	**II**
12	II	II	II	II	**II**	II	II	II	**II**	II	II	II	**II**
13	I	I	I	I	**I**	I	I	I	**I**	I	I	I	**I**

"XXX" – Scenario did not achieve Class III criteria