

# CLASSIFICATION OF WATER RESOURCES AND DETERMINATION OF THE COMPREHENSIVE RESERVE AND RESOURCE QUALITY OBJECTIVES IN THE MVOTI TO UMZIMKULU WATER MANAGEMENT AREA

**DRAFT ESTUARY RESOURCE QUALITY OBJECTIVES** 

SUPPORTING DOCUMENT FOR PROJECT STEERING COMMITTEE MEETING 6

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## 1 uMkhomazi RQOs

PES:	С	REC:	B (Remove Weir)	TEC:	B/C (Leave weir)
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Components that require interventions to achieve the REC/TEC:

- TEC/REC: Improve water quality;
- TEC/REC: Restore estuarine intertidal and subtidal habitat through the removal sand mining in EFZ in middle and upper reaches
- REC: Restore estuarine habitat through the relocation/removal of Sappi Weir

	nrougn tne relocation/removal of Sappi vveir ry to ensure permanently open mouth state and salinity profile.
Ecological Specification	Threshold of Potential Concern
Hydrology	C/D
Maintain a flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality	<ul> <li>River inflow distribution patterns differ by more than 5% from that of Scenario B (i.e. approved flow scenario for the Mkomazi).</li> <li>Monthly river inflow &lt; 1.0 m3/s</li> <li>Monthly river inflow &lt; 2.0 m3/s persists for longer than 3 months in a row</li> <li>Monthly river inflow &lt; 5.0 m3/s for more than 30% of the time.</li> </ul>
Hydrodynamics	A
Maintain mouth conditions to create the required habitat for birds, fish, macrophytes, microalgae and water quality	Flows should not exceed natural and seasonal distribution should not be compromised. Current baseflows should be upheld into estuary to maintain present mouth state and salinity regime.  Mouth closure occurs more than 2 - 3 weeks in a year.  Mouth closure occurs for more than 2 years out of ten  Mouth closure occurs between September and April
Water Quality	C
Salinity distribution not to cause exceedence of TPCs for fish, invertebrates, macrophytes and microalgae (see above)	<ul> <li>0 in the upper reaches (End of Zone C and beginning of Zone D) of the estuary.</li> <li>Salinity values &gt; 20 ppt in middle reaches (above the N2 bridge) during the low flow season</li> <li>Freshwater dominated for 70% of the time</li> </ul>
System variables (pH, dissolved oxygen and turbidity) not to cause exceedence of TPCs for biota (see above)	River inflow:  T.5 < pH > 8.5 consistently over 2 months  DO <6 mg/l  Turbidity >15NTU (low flow)  Turbidity high flows naturally turbid  Estuary:  Average turbidity >10 NTU (low flow)  Turbidity high flow, naturally turbid  7.0 < pH > 8.5 in a sampling survey  Average DO <6 mg/l in a sampling survey
Inorganic nutrient concentrations (NO <sub>3</sub> -N, NH <sub>3</sub> -N and PO <sub>4</sub> -P) not to cause in exceedance of TPCs for macrophytes and microalgae (see above)	River inflow (flows < 5m³/s):  NOx-N > 150 μg/ℓ over 2 months  NH3-N> 20 μg/ℓ over 2 months  PO4-P > 10 μg/ℓ over 2 months  River inflow (flows > 5m³/s):  Average DIN > 200 μg/ℓ  Average DIP > 20 μg/ℓ  Estuary (river flows < 5m³/s):  Average NOx-N > 150 μg/ℓ in a sampling survey  Average NH3-N > 20 μg/ℓ in a sampling survey  Average PO4-P > 10 μg/ℓ in a sampling survey  Estuary (river flows > 5m³/s):  Average NOx-N > 300 μg/ℓ in a sampling survey  Average NOx-N > 300 μg/ℓ in a sampling survey  Average NH3-N > 20 μg/ℓ in a sampling survey  Average PO4-P > 20 μg/ℓ in a sampling survey  Average PO4-P > 20 μg/ℓ in a sampling survey
Presence of toxic substances not to cause exceedence of TPCs for biota (see above)	River inflow:  Trace metals (to be determined)  Pesticides/herbicides (to be determined)  Estuary:  Total metal concentrations in estuary waters exceed target values as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995  Total metal concentration in sediment exceeds target values as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)

Recreational use	Microbiology: Sufficient levels (DEA, 2012)
	Estimated risk per exposure: 8.5% GI illness risk
	<ul> <li>Enterococci (Count per 100 ml): &lt; 185 (90 percentile)</li> <li>E. coli (Count per 100 ml): &lt; 500 (90 percentile)</li> </ul>
Sediment dynamics	B
Flood regime to maintain the sediment distribution patterns and aquatic habitat (instream physical habitat) so as not to exceed TPCs for biota (see above)	<ul> <li>River inflow distribution patterns (flood components) differ by more than 20% (in terms of magnitude, timing and variability) from that of the Present State (2013)</li> <li>Suspended sediment concentration from river inflow deviates by more than 20% of the sediment load-discharge relationship to be determined as part of baseline studies (Present State 2013)</li> <li>Findings from the bathymetric surveys undertaken as part of a monitoring programme indicate changes in the sedimentation and erosion patterns in the estuary have occurred (± 0.5 m).</li> <li>Intertidal and subtidal habitat in Zone C and D are not available for estuarine species (increase by &gt; 20% from present).</li> </ul>
Changes in sediment grain size distribution patterns not to cause exceedance of TPCs in benthic invertebrates (see above).	<ul> <li>The median bed sediment diameter deviates by more than a factor of two from levels to be determined as part of baseline studies (Present State 2013).</li> <li>Sand/mud distribution in middle and upper reaches change by more than 20% from Present State (2013).</li> <li>Changes in tidal amplitude at the tidal gauge of more than 20% from Present State (2013)</li> </ul>
Microalgae	В
Maintain current microalgae assemblages, specifically >5 diatom species at a frequency >3% of the total population in saline reaches (i.e. Zone A in low flow)	<ul> <li>Medium phytoplankton: &gt; 5µg I-1 for more than 50% of the stations</li> <li>MPB: &gt; 30mg m2 for more than 50% of the stations in the saline portion of the estuary</li> <li>Observable bloom in the estuary</li> </ul>
Macrophytes	D
<ul> <li>Maintain the distribution of macrophyte habitats.</li> <li>Maintain the integrity of the riparian zone particulary where the sandmining no longer occurs</li> <li>No invasive floating aquatic species present in the estuary e.g. water hyacinth.</li> <li>No sugarcane in the estuarine functional zone.</li> </ul>	<ul> <li>Greater than 10 % change in the area covered by different macrophyte habitats.</li> <li>Canalisation of lower reaches</li> <li>Invasive plants (e.g. syringa berry, Spanish reed, black wattle, Brazilian pepper tree) largely absent from the riparian zone.</li> <li>Die-back of reeds &amp; sedges in the lower reaches.</li> <li>Unvegetated, cleared areas along the banks.</li> <li>Floating invasive aquatics observed in the upper estuary reaches.</li> <li>Sugarcane is present in the estuarine functional zone.</li> </ul>
Invertebrates	В
<ul> <li>Maintain current levels of zoobenthic abundance (including seasonal variation)</li> <li>Retain an invertebrate community assemblage in the estuary based on species diversity and abundance that includes a variety of indigenous</li> <li>Species diversity (between 15 species in summer - 40 species in winter).</li> <li>Polychaetes, amphipods and tanaeids should numerically dominate during all seasons. However, abundance of all taxon groups should be higher during summer high flow periods and lower during winter low flow period.</li> </ul>	<ul> <li>Salinities should be &lt;15 in</li> <li>DO's should not drop below 4 ppt in &gt;25% of the estuary</li> <li>Sediment distribution</li> <li>Greater than 20% change in the intertidal and subtidal habitats</li> <li>Occurrence of invertebrate alien species (e.g. Tarebia granifera)</li> <li>Decrease in abundance of zooplankton by &gt;20% in terms of numbers per m<sup>2</sup> over entire estuarine area (3 sample sites) over 3 years</li> <li>Decrease in abundance of benthic macroinvertebrates</li> <li>No occurrence of Paratylodiplax blephariskios in annual sample</li> </ul>
Fish  Zono C in its entirety acts as a	As sampled by saine and aill not in open waters:
<ul> <li>Zone C in its entirety acts as a nursery to a diversity of EDC2 species (EDC2a especially).</li> <li>A good trophic basis exists for predatory estuarine dependant marine species (e.g. Agyrosomus japonicus,</li> </ul>	<ul> <li>As sampled by seine and gill net in open waters:</li> <li>30 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.</li> <li>Estuarine resident species should comprise a minimum of 6 species.</li> <li>Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.</li> <li>Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should</li> </ul>

Carynx spp.).  Estuarine residents species represented by core group (Glossogobius spp., Oligolepis spp. Ambassis spp. and Gilchistella aestuaria).  Oreochromis mossambicus limited to the upper reaches of Zone C in the low flow period.  Species assemblage comprises indigenous species only.  Connectivity to a healthy transitional marine-estuary waters is maintained.	<ul> <li>occur with 100% frequency of occurrence (every sampling trip).</li> <li>Pomadasys commersonni and Argyrosomus japonicas should be sampled with 80% frequency of occurrence.</li> <li>Anguilid eels should use the system as a migratoty route between marine and riverine habitats (and catches of these eel should be reflected in river monitoring.</li> <li>Pelagic piscivores should occur (including Caranx spp and Sphyraena spp.).</li> <li>No alien fish species should occur.</li> <li>Fish should be free of lesions and other anomalies related to water quality.</li> <li>No fish kills should occur.</li> </ul>
Birds	С
The most characteristic component of the avifaunal waterbird community is the piscivores and it is this group that would be the most valuable for monitoring	<ul> <li>Resident pair of African Fish Eagle disappears or fails to breed successfully</li> <li>Pied Kingfishers, White-breasted Cormorants or Reed Cormorants fail to be recorded on more than three consecutive counts spanning a period of 18 months or more</li> <li>Numbers of waterbird species drop below 10 for 2 consecutive counts</li> </ul>

REC:

С

## 2 Mvoti RQOs

D

PES:

Components that require interventic  Protect baseflows to estuary to i  A significant improvement in war  Partial restoration of estuarine h  Prevent low oxegen events that	improve mouth state and salinity profile. ter quality needed; and abitat.
Ecological specification	Threshold of potential concern
Hydrology	C/D
Maintain a flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality	<ul> <li>Flows should not exceed natural and seasonal distribution should not be compromised.</li> <li>River inflow distribution patterns differ by more than 5% from that of Scenario A (i.e. the recommended flow scenario for the Mvoti Estuary).</li> <li>Monthly river inflow &lt; 1.0 m³/s</li> <li>Monthly river inflow &lt; 2.0 m³/s persists for longer than 3 months in a row</li> <li>Monthly river inflow &lt; 2.0 m³/s for more than 50% of the time.</li> </ul>
Hydrodynamics	А
Maintain a mouth conditions to create the required habitat for birds, fish, macrophytes, microalgae and water quality	<ul> <li>Mouth closure occurs more than 2 - 3 weeks in a year</li> <li>Mouth closure occurs for more than 2 years out of ten</li> <li>Mouth closure occurs between November and June</li> </ul>
Water Quality	C/D
	Salinity > 20 PSU 1 km from the mouth
Salinity	Salinity > 20 PS0 T kill from the mount     Salinity > 1 PSU for >50% of the time
System variables (pH, dissolved oxygen and turbidity) not to cause exceedence of TPCs for biota (see above)	

C/D

TEC:

	Average NH <sub>3</sub> -N > 30 μg/ℓ
	Average Nπ3-N > 30 μg/t Average PO4-P > 25 μg/t
Presence of toxic substances not to cause exceedence of TPCs for biota (see above)	River inflow:     Trace metals (to be determined)     Estuary     Total metal concentrations in estuary waters exceed target values as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995)
	Total metal concentration in sediment exceeds target values as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)
Recreational use	N/A Not identified as recreational area at stakeholder meeting
Sediment dynamics	B/C
Flood regime to maintain the sediment distribution patterns and aquatic habitat (instream physical habitat) so as not to exceed TPCs for biota (see above)	<ul> <li>River inflow distribution patterns (flood components) differ by more than 20% (in terms of magnitude, timing and variability) from that of the Present State (2013)</li> <li>Suspended sediment concentration from river inflow deviates by more than 20% of the sediment load-discharge relationship to be determined as part of baseline studies (Present State 2013)</li> <li>Findings from the bathymetric surveys undertaken as part of a monitoring programme indicate changes in the sedimentation and erosion patterns in the estuary have occurred (± 0.5 m)</li> <li>Changes in tidal amplitude at the tidal gauge of more than 20% from Present State (2013)</li> </ul>
Changes in sediment grain size distribution patterns not to cause exceedance of TPCs in benthic invertebrates (see above).	<ul> <li>The median bed sediment diameter deviates by more than a factor of two from levels to be determined as part of baseline studies (Present State 2013)</li> <li>Sand/mud distribution in middle and upper reaches change by more than 20% from Present State (2013)</li> </ul>
Microalgae	В
Maintain current microalgae assemblages, specifically >5 diatom species at a frequency >3% of the total population in saline reaches (i.e. Zone A in low flow)	<ul> <li>Medium phytoplankton: &gt; 3µg/l for more than 50% of the stations</li> <li>MPB: &gt; 20mg m2 for more than 50% of the stations in the saline portion of the estuary</li> <li>Observable bloom in the estuary</li> </ul>
Macrophytes	D
Maintain the distribution of macrophyte habitats, particularly the freshwater mangrove, Barringtonia racemosa stand at the mouth of the estuary. Control the spread of hygrophilous grasses into open water area.  Prevent the spread of invasive plants, trees and shrubs as well as aquatic invasive plants.  No sugarcane in the estuarine functional zone	<ul> <li>Greater than 10% change in macrophyte habitat</li> <li>Increase in reeds &amp; sedges and encroachment into main water channel due to nutrient enrichment, sedimentation and infilling of intertidal habitat</li> <li>Decrease in open water habitat to less than 16 ha</li> <li>Invasive plants (e.g. syringa berry, Brazilian pepper tree) and aquatic invasives (e.g. water hyacinth) cover &gt;5% of total macrophyte area</li> <li>Sugarcane is present in the estuarine functional zone</li> </ul>
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avifaunal waterbird community, occurring at high densities (relative to available shorelength) that includes representatives of all the major groups, i.e. aerial (e.g. kingfishers), swimming (e.g. cormorants) and large wading piscivores (e.g. herons), small invertebrate-feeding waders, including migratory Palaearctic sandpipers, herbivorous waterfowl (e.g. ducks and geese) and roosting terns and gulls

- the resident pair of African
- Fish Eagles
- Numbers of bird species drops below 30 for 3 consecutive counts
- Number of roosting terns recorded in mid-summer fewer than 2000

## 3 Mhlali RQOs

Estuary:

Average 7.0 < pH > 8.5 in a sampling survey Average DO <6 mg/l in a sampling survey

Average turbidity >10 NTU (low flows), naturally turbid under high flows;

F	PES:	C/D	REC:		В/С	TEC:		D
Flow:								
		nMAR (MC	CM)			pMAR (M	CM)	
C/D	should be u the flood co Present (20	56.26 54.03  Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).  Present base flows poses a risk to the REC.						
Sedime	ent process		isk to the REG.					
C/D	<ul> <li>The hall the pair</li> <li>Ch</li> <li>Ch dia sair</li> <li>Ste</li> <li>Integral</li> </ul>	e flood regime maint bitat). The suspended present sediment lotterns in the estuary anges in tidal amplitianges in sediment gumeter deviates by lend/mud distributions ate over a five year a ertidal and subtidal h% from present).	d sediment concentral ad-discharge relation do not differ significate ude of less than 20% rain size distribution as than a factor of two in middle and upper verage.	ation f nship antly fi from patte vo froi reach	from river inflow (to be determination present (± a present (to be a present (to be a present levent levent on the characteristics)	v do not deviate ned). The sedim 0.5 m) (to be de determined). resent. The med Is levels ( to be nge by more tha	s by more than entation and etermined). dian bed sedin determined). n 20% from F	nn 20% of erosion ment The Present
В	Mouth ope	en conditions should	be maintained withir	the c	current range: 4	48% (± 5%). Bre	aching levels	are < 3.0
Water o	uality: Sali	nity						
В	reaches du confirmed). Salinity val	n needs variability in Iring the low flow sea Iues > 20 PSU in mid Is PSU zone detected	ason. Mid-waters in t Idle reaches during t	he lov he lov	ver reaches sh v flow season	ould be betweer	n 5 and 10 (to	
Water o	uality: Oth	er						
	Ecostyste	m health:				Recreationa	l use:	Yes
E	River: 7.5 < pH > DO <6 mg/ Turbidity >	lity poses risk to REC 8.5 consistently over 1 15 NTU (low flows), I over 2 months; NH3-	r 2 months naturally turbid unde	r high	flows; NOx-N		: Sufficient le	vels (DEA,
		over 2 months; NH3- er 2 months	n >20 µg/i Over 2 ff	ioritris	,, r∪4-r >	2012)		·

Average NOx-N >200 μg/l in a sampling survey; Average NH3-N >20 μg/l in a sampling surveyrvey; Average PO4-P >10 μg/l in a sampling survey

Toxic substances:

- Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);
- Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)

#### Microalgae

D

Maintain current microalgae assemblages, specifically >5 diatom species at a frequency >3% of the total population in saline reaches (i.e. Zone A in low flow)

- Medium phytoplankton: > 2μg/l for more than 50% of the stations
- MPB: > 10mg m2 for more than 50% of the stations in the saline portion of the estuary
- Observable bloom in the estuary

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). The swamp forest habitat is of particular importance.
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat. In particular no further sugarcane cultivation in the EFZ.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Maintain present salinity regime to maintain reed & sedge habitats (< 50 % loss of reed & sedge habitats in non-flood year).

#### Inverts

D/E

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

As sampled by seine and gill net in open waters:

- 13 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

#### Birds

D/E

The estuary should contain a relatively rich avifaunal waterbird community that includes representatives of all the major groups, i.e. aerial (e.g. kingfishers), swimming (e.g. cormorants) and large wading piscivores (e.g. herons), small invertebrate-feeding waders, including migratory Palaearctic sandpipers, herbivorous waterfowl (e.g. ducks and geese) and roosting terns and gull.

- Disappearance or lack of successful breeding by resident pair of African Fish Eagles.
- Numbers of bird species drops below 20 for 3 consecutive counts.
- Number of roosting terns recorded in mid-summer fewer than 500.

C/D

## 4 Mtamvuna RQOs

PES: B REC: A/B TEC: A/B

Components that require interventions to achieve the TEC:

- Restoration of estuarine riparian habitat;
- Reduce/contol fishing high pressure;
- Protect baseflows to estuary to maintain mouth state and salinity profile.

#### Flow:

PES	nMAR (MCM)	pMAR (MCM)
	275.19	239.49

Flows should not exceed natural and seasonal distribution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

#### Sediment processes:

- The flood regime maintains the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow does not deviate by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

В

A Mouth open conditions should be maintained within the current range: 78% ( $\pm$  10%)

#### Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid waters in the lower reaches should be between 10 and 15.

#### Water quality: Other

Ecosystem health	Recreational use	Yes
DIN: Freshwater inflow, 50%ile <0.2 mg/l DIP: Freshwater inflow, 50%ile <0.015 mg/l DO: Entire estuary, average ≥6 mg/l Turbidity: Estuary, clear (<10NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Microbiology: Sufficier (DEA, 2012)	nt levels

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different
  macrophyte habitats (accounts for natural changes due to the dynamic nature of estuaries). See Appendix
  A for detail on habitats distribution on this system.</li>
- Improve/maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along
  the banks. Prevent further disturbance (litter problematic) and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Lantana, Brazilian pepper tree) cover <5% of total macrophyte area.
- Maintain present salinity regime to maintain reed & sedge habitats (< 50 % loss of reed & sedge habitats in non-flood year).

#### Invertebrates

В

В

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by
  - Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.

- Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids and the crab Hymenosoma projectum. Insect taxa should occur in the far upper reaches only.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata, Varuna litterata, Macrophthalmus sp., Sesarmidae and Uca sp,
- Molluscan assemblage should include bivalves (including tellinids, Solen cylindraceus and Eumarcia paupercula) and gastropods (including Nassarius kraussianus, Natica spp. and Polinices sp.).
- Invasive alien species should not occur.

#### Fish

C

DEC.

As sampled by seine and gill net in open waters:

- 35 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 7 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni and Argyrsoomus japonicas should be sampled with 100% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp and Sphyraena spp.).

DEC.

- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

#### 5 Zolwane RQOs

PES:	S: B REC: B TEC:		В					
Flow:								
PES		nMAR (M	CM)		pMAR (MCM)			
		2.19			2.31			
Α	should be ເ the flood co	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).						
Sedime	ent processo	es:						
В	habitat) present the estu Change Change deviates	The suspended sed sediment load-disc. sediment load-disc. uary do not differ signs in tidal amplitude as in sediment grain so by less than a fact tions in middle and the sediment grain the sediment grain sediment gra	the sediment distribution the diment concentration that the harge relationship (to nificantly from present of less than 20% from size distribution patter or of two from present upper reaches do not	from river inflow do n be determined). The ht (± 0.5 m) (to be det n present (to be deter erns similar to presen t levels levels ( to be	ot deviates by mor sedimentation and ermined). mined). t. The median bed determined). The	re than 20% of d erosion patte sediment dian sand/mud	erns i metei	
Mouth	state:							
Α	Mouth ope	n conditions should	be maintained within	the current range: 81	1% (± 5%).			
Water o	quality: Sali	nity						
Α			salinity regime, with a ason. Mid-waters in th				ddle	
Water	quality: Othe	er						
	Ecosystem	health:			Recreatio	n use:	Yes	
		water inflow, 50%ile water inflow, 50%ile	<0.015 mg/l					

per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.
- Prevent reed encroachment that may become problematic due to nutrient enrichment from proposed future WWTW input.

#### Invertebrates

В

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids and the crab Hymenosoma projectum. Insect taxa should occur in the far upper reaches only.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata, Varuna litterata, Macrophthalmus sp., Sesarmidae and Uca sp.
- Molluscan assemblage should include bivalves (including Solen cylindraceus, Eumarcia paupercula) and gastropods (including Nassarius kraussianus, Natica spp., Polinices sp.).
- Invasive alien species should not occur in abundance.

#### Fish

C

В

As sampled by seine and gill net in open waters:

- 30 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 6 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni and Argyrosomus japonicas should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp and Sphyraena spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

## 6 Sandlundlu RQOs

PES:		С	REC:		С	TEC:	С		
Flow:									
PES	nMAR (MCM)				pMAR (MCM)				
		5.07				5.00			
A	should be ι	upheld into estuary to omponents differ by	al and seasonal distri o maintain present m no more than 10% (ii	outh sta	te and salin	ity regime. The distri	ibution patterns of		
Sedime	nt processo	es:							
С	habitat) present the estu Change Change deviates	The suspended sect sediment load-discluding the sediment load-discluding the sediment grain in sediment grain is by less than a factor.	he sediment distribut diment concentration harge relationship (to nificantly from preser of less than 20% fron size distribution patte or of two from preser	from rive be dete at (± 0.5 a present erns simi at levels	er inflow do rmined). Th m) (to be de t (to be dete lar to prese (to be deter	not deviates by mone se sedimentation and etermined). ermined). ent. The median bed mined). The sand/m	e than 20% of the derosion patterns in sediment diameter ud distributions in		

Mouth open conditions should be maintained within the current range: 60% (± 10%). Water quality: Salinity The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 15 (to be confirmed). Water quality: Other **Ecosystem health:** Recreation use: N/A DIN: Freshwater inflow, 50%ile <0.2 mg/l DIP: Freshwater inflow, 50%ile <0.015 mg/l DO: Entire estuary, average >6 mg/l Turbidity: Estuary, clear (<10NTU) accept during high inflow events Toxic substances: В Not identified as recreational Substance concentrations in estuarine waters not to exceed targets as area in stakeholder meeting per SA Water Quality Guidelines for coastal marine waters (DWAF, Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
   Submerged macrophytes have been recorded in the estuary historically.
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.

#### Inverts

D

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

## Fish

Ε

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni and Argyrosomus japonicas should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

## 7 Ku-Boboyi RQOs

P	PES:	В	REC:	В	TEC:	В
Flow:						
PES	nMAR (MCM)			pMAR (MCM)		
Α	1.00 0.99					

Flows should not exceed natural and seasonal distribution should not be compromised. Current baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

#### Sediment processes:

В

- The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present ( $\pm$  0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

В Mouth open conditions should be maintained within the current range: 53% ( $\pm$  5%).

#### Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 10 (to be confirmed).

#### Water quality: Other

 •		
Ecosystem health:	Recreation use:	N/A
DIN: Freshwater inflow, 50%ile <0.2 mg/l DIP: Freshwater inflow, 50%ile <0.015 mg/l DO: Entire estuary, average ≥6 mg/l Turbidity: Estuary, clear (<10NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Not identified as recreation stakeholder meeting	onal area in

#### Macrophytes (plants)

В

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different</li> macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aguatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Lantana, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.

#### Inverts

В

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

C

As sampled by seine and gill net in open waters:

- 13 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

## 8 Tongazi RQOs

F	PES:	B/C	REC:		B/C	TEC:	B/C
Flow:							
PES		nMAR (MC	CM)		pMAR (MCM)		
	7.00				7.32		
	Flows shou	ıld not exceed natura	al and seasonal distri	ibution	should not be	compromised, Curr	ent baseflows

Α

Flows should not exceed natural and seasonal distribution should not be compromised. Current baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

#### Sediment processes:

В

- The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

**B** Mouth open conditions should be maintained within the current range: 91% ( $\pm$  5%).

#### Water quality: Salinity

Α

C

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 10 (to be confirmed).

## Water quality: Other

Ecostystem health:	Recreational use:	Yes
Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk) DO: Entire estuary, average ≥6 mg/l (high risk) Turbidity: Estuary, clear (<10NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Microbiology: Sufficier (DEA, 2012)	nt levels

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.
- Prevent macroalgal blooms and reed encroachment which are likely to become problematic due to nutrient enrichment from proposed future WWTW input.

#### Inverts

C

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids and the crab Hymenosoma projectum. Insect taxa should occur in the far upper reaches only.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.

- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata, Varuna litterata, Macrophthalmus sp., Sesarmidae and Uca sp,
- Molluscan assemblage should include bivalves (including Solen cylindraceus, Eumarcia paupercula) and gastropods (including Nassarius kraussianus, Natica spp., Polinices sp.).
- Invasive alien species should not occur in abundance.

#### Fish

D

As sampled by seine and gill net in open waters:

- 30 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 6 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni and Argyrosomus japonicas should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp and Sphyraena spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

## 9 Kandandhlovu RQOs

I	PES:	В	REC:	В	TEC:	В		
Flow:								
PES	ES nMAR (MCM) pMAR (MCM)							
	1.53							
Α	Flows should not exceed natural and seasonal distribution should not be compromised. Current baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).							
Sedime	ent processe	s:						
С	habitat).  present s the estua Changes Changes deviates middle a	The suspended se sediment load-disc ary do not differ sig s in tidal amplitude s in sediment grain by less than a fa	ediment concentration charge relationship (to gnificantly from preser to fless than 20% from size distribution pattector of two from presertor of two from presertions.	from river inflow do be determined). Th ht (± 0.5 m) (to be de n present (to be dete terns similar to prese ent levels (to be dete		e than 20% of the rosion patterns ediment diamet ud distributions		
Mouth			al la conscipta in a al critto in	the comment was a F	(40/ / . 50/)			
A	mouth oper quality: Salin		d be maintained within	the current range: 5	4% (± 5%).			
B	The system	needs variability ii			se in salinity in the low ould exceed 5 (to be co			
Water o	quality: Othe	r			·	•		
	Ecostystem	health:			Recreational use:	N/A		
С	DIN: Freshy DIP: Freshy DO: Entire of Turbidity: Es Toxic substate Substate	water inflow, 50% vater inflow, 50% estuary, average stuary, clear (<10% ances: ace concentrations SA Water Quality (	EC/TEC, sufficiently recitle <0.2 mg/l (high risuile <0.015 mg/l (high side) ≥6 mg/l (high risk) struth accept during high sin estuarine waters no Guidelines for coastal	sk) a risk) the inflow events to to exceed targets	Not identified as rec stakeholder meeting			

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the swamp forest habitat is of importance.
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aguatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Improve the salinity regime to encourage the re-establishment of mangrove habitat and prevent reed encroachment.

#### Inverts

В

В

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species should not occur in abundance.

#### Fish

C

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 5 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

## 10 Mpenjati RQOs

PES: B/C REC: B TEC: B

Components that require interventions to achieve the TEC:

- Remove/reduce impact of sandmining;
- Improve water quality;
- Restore estuarine riparian habitat; and
- Protect baseflows to estuary to maintain mouth state and salinity profile.

#### Flow:

D

PES nMAR (MCM) pMAR (MCM)

23.61

23.77

Flows should not exceed natural and seasonal distribution should not be compromised. Current baseflows

Flows should not exceed natural and seasonal distribution should not be compromised. Current baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

#### Sediment processes:

• The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).

- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter

deviates by less than a factor of two from present levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

Mouth open conditions should be maintained within the current range: 70% ( $\pm$  5%). В

#### Water quality: Salinity

C

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid waters in the lower reaches should between 20 to 30, the middle reaches should be between 15 to 25, and the upper reaches between 10 to 15. Refer to DWS WQ data for

#### Water quality: Other

Ecostystem health:	Recreational use:	N/A
	Not identified as recreation stakeholder meeting	al area in

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). ). In particular the swamp forest habitat is of importance.
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.
- Prevent macroalgal blooms and reed encroachment which are likely to become problematic due to nutrient enrichment from proposed future WWTW input.

#### Inverts

D

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei. but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids and the crab Hymenosoma projectum. Insect taxa should occur in the far upper reaches only.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Molluscan assemblage should include bivalves (including Eumarcia paupercula) and gastropods (including Nassarius kraussianus, Natica spp.).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata, Varuna litterata, Macrophthalmus sp., Sesarmidae and Uca sp.
- Invasive alien species should not occur in abundance.

#### Fish

As sampled by seine and gill net in open waters:

- 25 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 5 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni and Argyrosomus japonicas should be sampled with 80% frequency of
- Pelagic piscivores should occur (including Caranx spp).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 11 Umhlangankulu RQOs

I	PES:	С	REC:	С	TEC:	С			
Flow:				<u> </u>	•				
PES		nMAR (M	CM)		pMAR (MCM)				
		2.87			2.87				
Α	baseflows distribution	should be upheld n patterns of the flo	into estuary to mai	distribution should intain present mou iffer by no more tha 2015).	th state and salinit	y regime. The			
Sedim	ent proces	ses:							
D	<ul> <li>The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).</li> <li>Changes in tidal amplitude of less than 20% from present (to be determined).</li> <li>Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.</li> </ul>								
Mouth	state:								
Α	Mouth op	en conditions shou	uld be maintained v	within the current ra	ange: 33% (± 10%	).			
Water	quality: Sa	alinity							
B		e reaches during ti firmed).		with a measurable . Mid-waters in the					
vvalei					Pocroational us	N/A			
E	Water qual DIN: Fresh DIP: Fresh DO: Entire Turbidity: events Toxic substangets marine Substangets excee	hwater inflow, 50% hwater inflow, 50% e estuary, average Estuary, clear (<15 stances: ance concentrations as per SA Water e waters (DWAF, 2 ance concentrations)	ns in estuarine sed /IO Region guidelir	risk) igh risk) ng high inflow ers not to exceed to for coastal	Not identified as recreational area in stakeholder meeting				
Macro	phytes (pla	ants)							
С	<ul> <li>Maintain the distribution of current macrophyte habitats (&lt; 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).</li> <li>Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.</li> <li>No invasive floating aquatic species present in the estuary e.g. water hyacinth.</li> <li>Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover &lt;5% of total macrophyte area.</li> <li>Improve the salinity regime to encourage the growth of mangroves.</li> </ul>								
Inverts	•	o aro saminy regin	10 to oncourage th	o growar or mangre	, v				
E	_	ed by plankton net	grah and din nets	/traps (as appropria	ate).				
_	, is sample	, piaimaon not,	g. a. and aip noto	apo (ao approprie	/-				

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

D

PES:

As sampled by seine and gill net in open waters:

- 13 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).

TEC:

- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

REC:

No fish kills should occur.

## 12 Kaba RQOs

			ta di						
Flow:									
PES		nMAR (MCM)			pMAR (MCM)				
Α	should be u	3.15  3.07  Flows should not exceed natural and seasonal distribution should not be compromised. Current baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).							
Sedim	ent process	,							
С	habitat) present the estu Change Change deviates	<ul> <li>The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).</li> <li>Changes in tidal amplitude of less than 20% from present (to be determined).</li> <li>Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.</li> </ul>							
			tor of two from present	levels (to be d	etermined). The sand/mud o	distributions in			
Mouth			tor of two from present	levels (to be d	etermined). The sand/mud o	distributions in			
Mouth A	state:	and upper reaches o	tor of two from present	t levels (to be d e than 20% fror	etermined). The sand/mud on Present State over a five y	distributions in			
Α	state:	and upper reaches of	tor of two from present do not change by more	t levels (to be d e than 20% fror	etermined). The sand/mud on Present State over a five y	distributions in			
Α	state:  Mouth ope quality: Sali The system	and upper reaches on conditions should nity	tor of two from present do not change by more be maintained within a salinity regime, with a	t levels (to be de than 20% from the current rang	etermined). The sand/mud on Present State over a five y	distributions in year average.			
A Water	state:  Mouth ope quality: Sali The system	and upper reaches on conditions should nity a needs variability in the low flow sea	tor of two from present do not change by more be maintained within a salinity regime, with a	t levels (to be de than 20% from the current rang	etermined). The sand/mud on Present State over a five yee: 27% (± 10%).	distributions in year average.			

Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.3 mg/l (high risk)

DIP: Freshwater inflow, 50%ile <0.025 mg/l (high risk)

DO: Entire estuary, average >4 mg/l (high risk)

Turbidity: Estuary, clear (<15 NTU) accept during high inflow events Toxic substances:

 Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);

 Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009) Not identified as recreational area in stakeholder meeting

#### Macrophytes (plants)

 Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).

- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.
- Maintain present salinity regime to prevent encroachment of reeds into the open water.

#### Inverts

D

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.

• Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.

- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

D

C

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

## 13 Mbizana RQOs

PES:		В	REC:	В	TEC:	В				
Flow:										
PES	nMAR (MCM)				pMAR (MCM)					
		36.30			35.52					
Α	Flows should not exceed natural and seasonal distribution should not be compromised. Current baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).									
Sedime	Present (2015).  Sediment processes:									

• The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical

habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in

21

the estuary do not differ significantly from present (± 0.5 m) (to be determined).

- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

A Mouth open conditions should be maintained within the current range: 54% (± 5%).

#### Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid waters in the lower reaches should be between 20 to 35, the middle reaches should be between 10 to 20, and the upper reaches between 5 to 10 (to be confirmed).

#### Water quality: Other

	Ecostystem health:	Recreational use:	N/A
С	Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk) DO: Entire estuary, average ≥6 mg/l (high risk) Turbidity: Estuary, clear (<10NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Not identified as recrea stakeholder meeting	tional area in

#### Macrophytes (plants)

 Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).

Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
 Prevent further disturbance and development of the floodplain habitat.

- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.
- Maintain present salinity regime to prevent encroachment of reeds into the open water.

#### Inverts

C

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species should not occur in abundance.

#### Fish

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 5 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

22

C

#### **Mvutshini RQOs** 14

PES:	B/C	REC:	B/C	TEC:	B/C		
Flow:	В/С	ILU.	ыс	ILO.	5/0		
	MAD /M	084)		MAD (MOM)			
PES	nMAR (MO	CM)	pMAR (MCM)				
А	1.66 1.63  Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).						
Sedime	ent processes:						
В	<ul> <li>The flood regime maintain thabitat). The suspended second present sediment load-disciple the estuary do not differ signed.</li> <li>Changes in tidal amplitude of the condition of the c</li></ul>	diment concentration from tharge relationship (to be nificantly from present ( of less than 20% from p size distribution pattern or of two from present I	om river inflow do r the determined). The fermal of the decoresent (to be detensional) the similar to present the devels (to be	not deviates by more the e sedimentation and entermined). rmined). at. The median bed sected e determined). The sar	han 20% of the rosion patterns in diment diameter ad/mud		
Mouth	state:						
В	Mouth open conditions should	be maintained within th	e current range: 4	2% (± 5%).			
Water o	quality: Salinity						
В	The system needs variability in reaches during the low flow sea						
Water o	quality: Other						
D	Ecostystem health:  Water quality poses risk to REC DIN: Freshwater inflow, 50%ile DIP: Freshwater inflow, 50%ile DO: Entire estuary, average ≥6 Turbidity: Estuary, clear (<10N' Toxic substances:  Substance concentrations as per SA Water Quality G (DWAF, 1995);  Substance concentrations targets as per WIO Region Secretariat and CSIR, 200	<0.2 mg/l (high risk) e <0.015 mg/l (high risk) mg/l (high risk) TU) accept during high in estuarine waters not uidelines for coastal ma in estuarine sediment r guidelines (UNEP/Nai	inflow events to exceed targets arine waters not to exceed	Recreational use:  Ramsgate (Blue Fla Microbiology: Excel. 2012)			
Macrop	ohytes (plants)						
С	<ul> <li>Maintain the distribution of current macrophyte habitats (&lt; 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).</li> <li>Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.</li> <li>No invasive floating aquatic species present in the estuary e.g. water hyacinth.</li> <li>Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover &lt;5% of total macrophyte area.</li> <li>Maintain present salinity regime to prevent encroachment of reeds into the open water.</li> <li>Prevent macroalgal blooms and reed encroachment which are likely to become problematic due to nutrient enrichment from proposed future WWTW input.</li> </ul>						
Inverts							
	As sampled by plankton net, gr • Population abundances of more than 30%.			elines to be set) shou	ıld not deviate by		

C

- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.

- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species should not occur in abundance.

#### Fish

С

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 5 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

## 15 Bilanhlolo RQOs

	PES:	С	REC:	С	TEC:	С	
Flow:							
PES		nMAR (M	CM)		pMAR (MCM)		
		5.02			4.98		
Α	should be ເ the flood co	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).					
Sedime	ent processo	es:					
D	<ul> <li>The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).</li> <li>Changes in tidal amplitude of less than 20% from present (to be determined).</li> <li>Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.</li> </ul>						
Mouth	state:						
Α	Mouth ope	n conditions should	l be maintained within	the current range:	47% (± 10%).		
Water o	quality: Sali	nity					
В			n salinity regime, with ason. Mid-waters in t				
Water o	quality: Othe	er					
	Ecostyster	n health:			Recreational use	e: Yes	
D	Water quality poses risk to REC/TEC, sufficiently reduced if:  DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk)  DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk)  DO: Entire estuary, average ≥6 mg/l (high risk)  Turbidity: Estuary, clear (<10NTU) accept during high inflow events  Ramsgate (Blue Flag)						

Е

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>

#### Inverts

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

D

As sampled by seine and gill net in open waters:

- 13 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

## 16 Uvuzana RQOs

F	PES:	С	REC:	С	TEC:	С		
Flow:								
PES	S nMAR (MCM) pMAR (MCM)							
		1.05			1.05			
Α	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).							
Sedime	ent processe	s:						
С	habitat).  present s the estua Changes Changes deviates	The suspended sec sediment load-discl ary do not differ sigi s in tidal amplitude o s in sediment grain by less than a facto ons in middle and u	liment concentration narge relationship (to nificantly from preser of less than 20% fron size distribution patte or of two from preser	from river inflow do be determined). The fit (± 0.5 m) (to be of the present (to be de firms similar to present the levels levels ( to levels ( to levels levels).		e than 20% of the l erosion patterns in sediment diameter and/mud		
Mouth	state:							
Α	Mouth oper	n conditions should	be maintained within	the current range:	32% (± 10%).			
Water o	quality: Salin	ity						

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 5 (to be confirmed).

Water quality: Other							
	Ecostystem health:	Recreational use:	N/A				
F	Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.3 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.025 mg/l (high risk) DO: Entire estuary, average ≥4 mg/l (high risk) Turbidity: Estuary, clear (<15 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Not identified as recreat stakeholder meeting	ional area in				

#### Macrophytes (plants)

 Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).

- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.
- Prevent further spread of reeds into water channel.

#### Inverts

D

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

D

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

## 17 Kongweni RQOs

PES:		E	REC:	D	TEC:		EF	
Water	Water quality: Salinity							
D	The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should be between 5 and 10 (to be confirmed).							
Water	quality: Othe	er						
	Ecostystem health: Recreational use: Yes							
F	Water quality poses risk to REC/TEC, sufficiently reduced if:  DIN: Freshwater inflow, 50%ile <0.5 mg/l (high risk)  Major holiday destination Microbiology: Sufficient levels (D							

DIP: Freshwater inflow, 50%ile <0.125 mg/l (high risk)</li>
DO: Lower estuary, average ≥4 mg/l (high risk)
Turbidity: Estuary, clear (<15 NTU) accept during high inflow events</li>
Toxic substances:
Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);
Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)

## 18 Vungu RQOs

В

**Iverts** 

PES:		В	REC:		В	TEC:		В
Flow:								
PES		nMAR (MC	CM)		pMAR (MCM)			
		27.79				28.88		
В	should be ι	uld not exceed natura upheld into estuary to omponents differ by 1 015).	naintain present m	outh st	ate and salini	ity regime. The distri	bution p	oatterns of
Sedime	ent process	es:						
В	<ul> <li>The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).</li> <li>Changes in tidal amplitude of less than 20% from present (to be determined).</li> <li>Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.</li> </ul>							
Mouth	state:							
В	Mouth ope	n conditions should b	e maintained within	the cui	rent range: 9	5% (± 5%).		
Water o	quality: Sali	nity						
В		n needs variability in uring the low flow sea					lower a	nd middle
Water o	quality: Oth	er						
	Ecostystei	m health:				Recreational use	e:	Yes
D	Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk) DO: Entire estuary, average ≥6 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)							
Macron	ohytes (plan	·	-,			1		
4	<b>7</b> 11	,						

Maintain the distribution of current macrophyte habitats (< 20 % change in the small reed area which

Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area. Prevent macroalgal blooms which are likely to become problematic due to nutrient enrichment from

accounts for natural changes due to the dynamic nature of estuaries).

proposed future WWTW input.

No invasive floating aquatic species present in the estuary e.g. water hyacinth.

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids, and polychaetes. Insect taxa should occur in the upper littoral reaches littoral only.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species should not occur in abundance.

#### Fish

C

С

As sampled by seine and gill net in open waters:

- 30 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 6 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni and Argyrosomus japonicas should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

## 19 Mhlangeni RQOs

l	PES:	С	REC:		C TEC: C				
Flow:									
PES		nMAR (MC	CM)			pMAR (MCM)			
		9.29				9.82			
В	should be u the flood co	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).							
Sedime	ent processe	es:							
D	<ul> <li>The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).</li> <li>Changes in tidal amplitude of less than 20% from present (to be determined).</li> <li>Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.</li> </ul>							20% of the on patterns in ent diameter nud	
Mouth	state:								
В	Mouth ope	n conditions should	be maintained withir	the	current range: {	55% (± 10%).			
Water	quality: Saliı	nity							
В						ase in salinity in the l ould be between 10			
Water o	quality: Othe	er							
	Ecostyster	n health:				Recreational use	<b>:</b>	N/A	
С	DIN: Fresh DIP: Fresh DO: Entire	quality poses risk to REC/TEC, sufficiently reduced if: eshwater inflow, 50%ile <0.3 mg/l (high risk) eshwater inflow, 50%ile <0.025 mg/l (high risk) tire estuary, average ≥4 mg/l (high risk) ty: Estuary, clear (<10 NTU) accept during high inflow events				ntional area in			

#### Toxic substances:

- Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);
- Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.
- Prevent macroalgal blooms and reed encroachment which are likely to become problematic due to nutrient enrichment from proposed future WWTW input.

#### **Iverts**

D

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei. but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachvuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

D

As sampled by seine and gill net in open waters:

- 13 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

#### 20 Zotsha RQOs

PES: B/C REC: TEC: В В Components that require interventions to achieve the TEC:

- Restoration of estuarine riparian habitat;
- Improve water quality.

#### Flow:

PES	nMAR (MCM)	pMAR (MCM)
	15.74	16.25

Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

#### Sediment processes:

 The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical) habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the

- present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present ( $\pm$  0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

C Mouth open conditions should be maintained within the current range: 76% ( $\pm$  5%).

#### Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should be between 5 and 10 (to be confirmed).

#### Water quality: Other

	Ecostystem health:	Recreational use:	N/A
D	Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk) DO: Entire estuary, average ≥6 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Not identified as recreations stakeholder meeting	onal area in

#### Macrophytes (plants)

• Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).

Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
 Prevent further disturbance and development of the floodplain habitat.

- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>

#### Inverts

С

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids and the crab Hymenosoma projectum. Insect taxa should occur in the far upper reaches only.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
  - Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
  - Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
  - Molluscan assemblage should include bivalves (including Eumarcia paupercula) and gastropods (including Natica spp.).
  - Large brachyuran crabs (macrocrustacea) should include Scylla serrata, Varuna litterata, Macrophthalmus sp., Sesarmidae and Uca sp,
  - Invasive alien species do not dominate macrobenthos.

#### Fish

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni and Argyrosomus japonicas should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

30

#### 1 1311

В

1	PES:	B/C	REC:	B/C	TEC:	B/C	
Flow:							
PES		nMAR (MC	CM)		pMAR (MCM)		
		8.25			8.07		
В	should be u	pheld into estuary to mponents differ by r	o maintain present m	nouth state and salinit	compromised. Currren y regime. The distributio timing and variability) f	on patterns of	
Sedime	ent processe	es:					
С	habitat). present the estu Change Change deviates	The suspended sed sediment load-disch ary do not differ sigr s in tidal amplitude c s in sediment grain s by less than a factorions in middle and u	liment concentration parge relationship (to prificantly from preser of less than 20% fror size distribution patte or of two from preser	from river inflow do not be determined). The nt (± 0.5 m) (to be determined) from present (to be determined in the present the levels levels ( to be		n 20% of the sion patterns ir ment diameter /mud	
Mouth		-					
Α	Mouth ope	n conditions should l	be maintained withir	n the current range: 95	5% (± 5%).		
Water o	quality: Salir	nity					
Α					se in salinity in the lowe uld exceed 5 (to be con		
Water o	quality: Othe	er					
	Ecostysten	n health:			Recreational use:	N/A	
С	DIN: Freshv DIP: Freshv DO: Entire e Turbidity: E. Toxic substa • Substa as per (DWAF • Substa targets	vater inflow, 50%ile vater inflow, 50%ile estuary, average ≥6 stuary, clear (<10 N ances: nce concentrations in SA Water Quality Gueron concentrations in the concentrations in the concentrations in the concentrations in	TU) accept during hi in estuarine waters r uidelines for coastal in estuarine sedimer guidelines (UNEP/N	igh inflow events not to exceed targets marine waters nt not to exceed	Not identified as recre stakeholder meeting	eational area in	
Macrop	ohytes (plant	ts)					
С	difi ess • Ma ba. cui • No • Co Ca • Pro	ferent macrophyte tuaries).  Initain the integrity on the integrity of the integrity of the integrity of the invasive floating and introl the spread of the invarina, Spanish resevent macroalgal bloomstaring of the integrity of	habitats which according the riparian zone of the riparian zone of the risturbance and FZ. In a species present invasive plants in ed, black wattle, Bra	ounts for natural change of the development of the nt in the estuary e.g. win the riparian zone azilian pepper tree) cocroachment which ar	20 % change in the a anges due to the dyr unvegetated, cleared floodplain habitat. Reswater hyacinth. Invasive plants (e.g. ver <5% of total macrope likely to become pro	namic nature of areas along the strict sugarcan syringa berryohyte area.	
Inverts			•				
В	<ul><li>Populati more that</li><li>Zooplan</li></ul>	on abundances of p an 40%.	inated by estuarine	assemblages (baselii copepods Acartia nata	nes to be set) should no		

Penaeid and carid (Caridina and Macrobrachium) prawns should occur.

- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata, Varuna litterata, Macrophthalmus sp., Sesarmidae and Uca sp,
- Molluscan assemblage should include bivalves (including Eumarcia paupercula) and gastropods (including Nassarius kraussianus, Natica spp.).
- Invasive alien species do not dominate macrobenthos.

#### Fish

C

As sampled by seine and gill net in open waters:

- 25 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 5 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni and Argyrosomus japonicas should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp and Sphyraena spp.).

•

- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

## 22 Mbango RQOs

F	PES:	E	REC:	D	TEC:	Ē	EF
Water q	ıuality: Sali	nity					
The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should be between 5 and 10 (to be confirmed).							
Water o	uality: Oth	er					
	Ecostyster	n health:			Recreational use	<b>)</b> :	N/A
E	DIN: Fresh DIP: Fresh DO: Lower Turbidity: E Toxic subst as per (DWAI Substa targets	water inflow, 50%ile water inflow, 50%ile estuary, average >4 stuary, clear (<15 N tances: ance concentrations SA Water Quality G. 1995); ance concentrations ance concentrations.	TU) accept during his in estuarine waters r uidelines for coastal in estuarine sedimer guidelines (UNEP/N	igh inflow events not to exceed targets marine waters nt not to exceed	Not identified as r stakeholder meet		al area in

## 23 uMzimkulu RQOs

PES:

<ul><li>Erac</li><li>Ren</li><li>Prol</li><li>Mar</li></ul>	Components that require interventions to counteract the downwards trajectory and meet the TEC:  • Eradicate invasive alien vegetation  • Remove derelict, redundant and old quays, jetties, wharfs and revetments; and rehabilitate banks;  • Prohibit dredge spoil dumping in inappropriate areas;  • Manage agricultural and industrial practices in the catchment, and  • Control/reduce and control fishing pressure							
Flow:	low:							
PES	ES nMAR (MCM) pMAR (MCM)							
	1452.49 1175.14							
	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of							

TEC:

REC:

the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

#### Sediment processes:

• The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).

• Changes in tidal amplitude of less than 20% from present (to be determined).

 Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

C

Mouth open conditions should be maintained within the current range: 97% (± 3%).

#### Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches between 20 to 30, the middle reaches should be between 15 to 25, and the upper reaches between 0 and 5.

#### Water quality: Other

	Ecostystem health:	Recreational use:	Yes
В	DIN: Freshwater inflow, 50%ile <0.2 mg/l DIP: Freshwater inflow, 50%ile <0.015 mg/l DO: Entire estuary, average ≥6 mg/l Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Paddling Microbiology: Sufficient 2012)	levels (DEA,

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). ). In particular the swamp forest habitat is of importance.
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.
- Maintain present salinity regime to maintain reed & sedge habitats (< 50 % loss of reed & sedge habitats in non-flood year).

#### Inverts

C

В

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids, polychaetes and the crab Hymenosoma projectum. Insect taxa should occur in the far upper reaches only.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata, Varuna litterata, Macrophthalmus sp., Sesarmidae and Uca sp,
- Molluscan assemblage should include bivalves (including Solen cylindraceus, Eumarcia paupercula) and gastropods (including Nassarius kraussianus, Natica spp., Polinices sp.).
   Invasive alien species should not occur in abundance.

#### • Invasive alien spec

As sampled by seine and gill net in open waters:

- 30 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 6 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of

Fish

В

gobius callidus, Myxus caperisis and Rhabdosargus nolubi snould occur with 100

- occurrence (every sampling trip).
- Pomadasys commersonni and Argyrosomus japonicas should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp and Sphyraena spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

## 24 uMthente (Mtentweni) RQOs

PES:		С	REC:	С		TEC:		С		
Flow:										
PES		nMAR (MC		pMAR (MCM)						
		12.07		11.14						
С	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).									
Sedime	nt process	es:								
D	habitat) present the esti Change Change deviate	od regime maintain to a control of regime maintain to be to see the second of the seco	diment concentration tharge relationship (to mificantly from preser of less than 20% fror size distribution patte or of two from preser	from river inflovence be determined, and (± 0.5 m) (to be a present (to be the property of the the property of	y do not de ). The sedii pe determin determine resent. The to be detei	viates by more mentation and ned). d). e median bed s rmined). The s	e than 209 erosion p sediment sand/mud	% of the patterns in diameter		
Mouth s	state:									
В	Mouth ope	en conditions should	be maintained withir	the current ran	ge: 40% (±	10%).				
Water o	μality: Sali	nity								
В	The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 5 (to be confirmed).									
Water o	quality: Oth	er								
	Ecostyste	m health:			Red	creational use	<b>e</b> :	Yes		
D	Toxic substance Substance as per (DWAI) Substance		rgets Mic	Microbiology: Sufficient levels (DEA, 2012)						
Macrop	hytes (plan		·		ı					
			current macronhyte	hahitate (< 20	% change	in the area	covered	hy difforant		

D

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.
- Prevent further reed encroachment into the main water channel.

#### Inverts

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

C

С

As sampled by seine and gill net in open waters:

- 13 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

## 25 Mhlangamkulu RQOs

PES:		С	REC:	С		TEC:	С			
Flow:										
PES	nMAR (MCM) pMAR (MCM)									
	2.06				1.73					
D	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).									
Sedime	ent processo	es:								
С	<ul> <li>The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).</li> <li>Changes in tidal amplitude of less than 20% from present (to be determined).</li> <li>Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.</li> </ul>									
Mouth	state:									
С	Mouth open conditions should be maintained within the current range: 19% ( $\pm$ 10%).									
Water o	quality: Sali	nity								
С	The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 5 (to be confirmed).									
Water	quality: Othe	er								
	Ecostystem health:					Recreational us	e:	Yes		
D	DIN: Fresh	water inflow, 50%il water inflow, 50%il	C/TEC, sufficiently re le <0.3 mg/l (high ride <0.025 mg/l (high	sk)		San Lameer Microbiology: Sufficient levels (L 2012)				

- Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);
- Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). Mangroves have been recorded in the estuary.
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Maintain present salinity regime to maintain reed & sedge habitats (< 50 % loss of reed & sedge habitats in non-flood year).

#### Inverts

C

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

C

D

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

## 26 Damba RQOs

PES: D REC: C TEC: D Flow: **PES** nMAR (MCM) pMAR (MCM) 4.56 3.85 Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows D should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015). Sediment processes:

• The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).

• Changes in tidal amplitude of less than 20% from present (to be determined).

 Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

# Mouth state:

Mouth open conditions should be maintained within the current range: 28% ( $\pm$  10%).

# Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 5 (to be confirmed).

## Water quality: Other

Ecostystem health:	Recreational use:	Yes
<ul> <li>Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile &lt;0.3 mg/l (high risk)</li> <li>DIP: Freshwater inflow, 50%ile &lt;0.025 mg/l (high risk)</li> <li>DO: Entire estuary, average ≥4 mg/l (high risk)</li> <li>Turbidity: Estuary, clear (&lt;10 NTU) accept during high inflow events Toxic substances:</li> <li>Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);</li> <li>Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)</li> </ul>	Microbiology: Sufficient level 2012)	's (DEA,

## Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Of particular concern would be >20 % change in the area covered by swamp forest and Barringtonia racemosa.
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. Ageratum conyzoides, Balloon vine (Cardiospermum grandiflorum), castor oil bush (Ricinis communis), Spanish Gold (Sesbania punicea) and Triffid weed (Chromolaena odorata) cover <5% of total macrophyte area.</li>
- Prevent further reed encroachment into the main water channel.

# Inverts

C

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

## Fish

D

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 27 Koshwana RQOs

TEC: PFS: C/D REC: R C Components that require interventions to achieve the TEC: Maintain water quality; and • Partial restoration of estuarine habitat. • Prevent low oxygen events that results in fish kills. Flow: **PES** nMAR (MCM) pMAR (MCM) 2.06 2.05 Present flows poses a risk to the REC. Flows should not exceed natural and seasonal distrubution should not В be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015). Sediment processes: • The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present ( $\pm$  0.5 m) (to be determined). D • Changes in tidal amplitude of less than 20% from present (to be determined). Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average. Mouth state: Mouth open conditions should be maintained within the current range: 26% ( $\pm 5\%$ ). Water quality: Salinity The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 10 (to be confirmed). Water quality: Other **Ecostystem health:** Recreational use: Yes Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk) DO: Entire estuary, average >6 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Ε Toxic substances: Microbiology: Sufficient levels (DEA. Substance concentrations in estuarine waters not to exceed targets 2012) as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995): Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009) Macrophytes (plants) Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat. Area covered by invasive waterweeds (e.g. water hyacinth, Azolla filiculoides) and nuisance D filamentous algae (e.g. Enteromorpha, Ulva, Cladophora) should cover <50% of water surface area. Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area. Prevent algal blooms and reed encroachment which are likely to become problematic due to nutrient enrichment from further WWTW input. Inverts As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

# Fish

D

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 28 Intshambili RQOs

PES: C REC: B TEC: C

Components that require interventions to achieve the TEC:

- Improve water quality; and
- Partial restoration of estuarine habitat.
- Prevent low oxegen events that results in fish kills.

#### Flow:

PES	nMAR (MCM)	pMAR (MCM)			
	6.48	4.86			

Present flows poses a risk to the REC. Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld, and if possible improved, to the estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

# Sediment processes:

- The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

# Mouth state:

C

Mouth open conditions should be maintained within the current range: 42% ( $\pm$  5%).

## Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 15 (to be confirmed).

# Water quality: Other

	Ecostystem health:	Recreational use:	Yes
С	Water quality poses risk to REC/TEC, sufficiently reduced if:  DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk)  DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk)  DO: Entire estuary, average ≥6 mg/l (high risk)	Microbiology: Sufficient 2012)	t levels (DEA,

Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:

- Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);
- Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Of particular concern would be >20 % change in the area covered by swamp forest and Barringtonia racemosa.
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>

#### Inverts

В

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

## Fish

C

As sampled by seine and gill net in open waters:

- 13 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

# 29 Mzumbe RQOs

PES: C/D REC: C TEC: C

Components that require interventions to achieve the REC/TEC:

Restore estuarine riparian habitat.

## Flow:

 PES
 nMAR (MCM)
 pMAR (MCM)

 58.53
 52.78

Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

# Sediment processes:

D

• The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).

- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

# Mouth state:

Mouth open conditions should be maintained within the current range: 74% (± 10%).

# Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 10 (to be confirmed).

## Water quality: Other

	Ecostystem health:	Recreational use:	Yes
С	DIN: Freshwater inflow, 50%ile <0.3 mg/l DIP: Freshwater inflow, 50%ile <0.025 mg/l DO: Entire estuary, average ≥4 mg/l Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Microbiology: Sufficient lev 2012)	rels (DEA,

#### Macrophytes (plants)

Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).

Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat. Sugarcane covers a large area of the EFZ and important swamp forest habitat has been removed.

No invasive floating aquatic species present in the estuary e.g. water hyacinth.

Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.

Prevent further reed encroachment into the main water channel.

# Inverts

D

Ε

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids, polychaetes and the crab Hymenosoma projectum. Insect taxa should occur in the far upper reaches only.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Molluscan assemblage should include bivalves (including Eumarcia paupercula) and gastropods (including Natica spp.).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata, Varuna litterata, Macrophthalmus sp., Sesarmidae and Uca sp.
- Invasive alien species do not dominate macrobenthos.

# Fish

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni and Argyrosomus japonicas should be sampled with 60% frequency of
- Pelagic piscivores should occur (including Caranx spp).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

- D

# 30 Mhlabatshane RQOs

A/B PES: B/C REC: TEC: В Components that require interventions to achieve the TEC: Improve water quality; and • Partial restoration of estuarine riparian habitat. Flow: **PES** nMAR (MCM) pMAR (MCM) 6.46 6.48 Present base flows poses a risk to the REC. Flows should not exceed natural and seasonal distrubution В should not be compromised. Currrent baseflows should be upheld, where possible improved, to the estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015). Sediment processes: The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present ( $\pm$  0.5 m) (to be determined). C • Changes in tidal amplitude of less than 20% from present (to be determined). • Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average. Mouth state: Mouth open conditions should be maintained within the current range: 50% ( $\pm$  5%). Water quality: Salinity The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 20 and that of the middle reaches exceed 10 (to be confirmed). Water quality: Other **Ecostystem health:** Recreational use: Yes Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk) DO: Entire estuary, average <a>6 mg/l (high risk)</a> Turbidity: Estuary, clear (<10 NTU) accept during high inflow events D Blue Flag Beach Toxic substances: Microbiology: Excellent levels Substance concentrations in estuarine waters not to exceed targets (DEA, 2012) as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995): Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009) Macrophytes (plants) Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the freshwater mangrove, Barringtonia racemosa, swamp forest would be of importance. Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat. C No invasive floating aquatic species present in the estuary e.g. water hyacinth. Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area. Maintain present salinity regime to maintain reed & sedge habitats (< 50 % loss of reed & sedge habitats in non-flood year). Inverts As sampled by plankton net, grab and dip nets/traps (as appropriate): C Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.

- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species should not occur in abundance.

# Fish

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 5 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

# 31 Mhlungwa RQOs

ı	PES: C	REC:	С	TEC:	С
Flow:					
PES	nMAR (M	CM)		pMAR (MCM)	
	5.78		5.67		
В	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).				
Sedime	ent processes:				
E	<ul> <li>The flood regime maintal habitat). The suspended set present sediment load-disc the estuary do not differ sig.</li> <li>Changes in tidal amplitude.</li> <li>Changes in sediment grain deviates by less than a distributions in middle and year average.</li> </ul>	ediment concentration for charge relationship (to be gnificantly from present of less than 20% from p a size distribution patter factor of two from pro-	from river inflow do be determined). Th (± 0.5 m) (to be de- present (to be dete rns similar to prese esent levels levels	o not deviates by mo e sedimentation and termined). rmined). ent. The median bed s ( to be determin	ore than 20% of the decision patterns of the decision patterns of the decision
Mouth	state:				
В	Mouth open conditions should	l be maintained within th	he current range: 2	9% (± 10%).	
Water o	quality: Salinity				
В	The system needs variability in reaches during the low flow se				
Water o	quality: Other				
	Ecostystem health:			Recreational use	: Yes
	<b>-</b>				

targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)

# Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the freshwater mangrove, Barringtonia racemosa, swamp forest.
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat particularly by sugarcane cultivation.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>

# Inverts

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

D

D

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 32 Mfazazana RQOs

PES: C REC:		В	TEC:	С						
Flow:	Flow:									
PES	PES nMAR (MCM) pMAR (MCM)									
		2.77			2.57					
В	Present base flows poses a risk to the REC. Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).									
Sedime	nt process	es:								
<ul> <li>The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).</li> <li>Changes in tidal amplitude of less than 20% from present (to be determined).</li> <li>Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.</li> </ul>										
Mouth s	state:									

Mouth open conditions should be maintained within the current range: 24% (± 5%).

# Water quality: Salinity The system near reaches during

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should be between 5 and 10 (to be confirmed).

## Water quality: Other

Ecostystem health:	Recreational use:	Yes
Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk) DO: Entire estuary, average ≥6 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:	Microbiology: Sufficient	levels
<ul> <li>Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);</li> <li>Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)</li> </ul>	(DEA, 2012)	

# Macrophytes (plants)

 Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the freshwater mangrove, Barringtonia racemosa, swamp forest.

- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat particularly by sugarcane.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.

#### Inverts

D

D

ח

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

D

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 33 Kwa-Makosi RQOs

PES: B/C REC: B TEC: B

Components that require interventions to achieve the REC/TEC:

Protect baseflows to estuary to maintain mouth state and salinity profile.

Improve water quality; and

• Partial restoration of estuarine habitat.

# Flow:

PES	nMAR (MCM)	pMAR (MCM)
	3.23	3.03
	Flows should not exceed natural and seasonal distrubute should be upheld into estuary to maintain present mouth the flood components differ by no more than 10% (in tent Present (2015).	n state and salinity regime. The distribution patterns of

#### Sediment processes:

• The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present ( $\pm$  0.5 m) (to be determined).

• Changes in tidal amplitude of less than 20% from present (to be determined).

 Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

C

Mouth open conditions should be maintained within the current range: 37% ( $\pm$  5%). В

#### Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should be between 5 and 10 (to be confirmed).

#### Water quality: Other

	Ecostystem health:	Recreational use:	N/A
С	Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk) DO: Entire estuary, average ≥6 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Not identified as recreation stakeholder meeting	al area in

# Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the freshwater mangrove, Barringtonia racemosa, swamp forest.
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.

#### Inverts

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species should not occur in abundance.

# Fish

As sampled by seine and gill net in open waters:

18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.

46

C

- Estuarine resident species should comprise a minimum of 5 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

# 34 Mnamfu RQO

C

	PES:	С	REC:	С	TEC:	С	
Flow:							
PES		nMAR (MC	CM)		pMAR (MCM)		
		3.08			2.88		
В	should be u	pheld into estuary to imponents differ by i	o maintain present n	rubution should not be nouth state and salini in terms of magnitude	ty regime. The distrik	oution patterns of	
Sedime	ent processe	es:					
С	habitat). present the estu Change Change deviates	The suspended sed sediment load-dischary do not differ sign is in tidal amplitude os in sediment grain is by less than a factoions in middle and u	liment concentration narge relationship (to nificantly from prese of less than 20% fro size distribution patt or of two from prese.	tion patterns and aqual from river inflow do not be determined). The ont $(\pm 0.5 \text{ m})$ (to be determined) are present (to be determs similar to present levels levels ( to be to change by more that	not deviates by more a sedimentation and termined). rmined). tt. The median bed set determined).	than 20% of the erosion patterns in ediment diameter and/mud	
Mouth:	state:						
В	Mouth oper	n conditions should	be maintained withii	n the current range: 4	2% (± 10%).		
Water o	quality: Salir	nity					
В				a measurable increa the lower reaches sho			
Water o	quality: Othe	er					
	Ecostysten	n health:			Recreational use	: N/A	
D	DIN: Fresh DIP: Fresh DO: Entire Turbidity: E. Toxic substa • Substa as per (DWAF • Substa targets		e <0.3 mg/l (high ri e <0.025 mg/l (high 4 mg/l (high risk) TU) accept during h in estuarine waters h uidelines for coastal in estuarine sedimen guidelines (UNEP/l	isk) In risk) In risk) In risk In inflow events In ot to exceed targets In marine waters In the not to exceed	Not identified as n stakeholder meeti	ecreational area in ng	
Macrop	ohytes (plant	ts)	•		<u>L</u>		
				hyte habitats (< 20 % natural changes due			

particular the freshwater mangrove, Barringtonia racemosa, swamp forest is important.

Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.

banks. Prevent further disturbance and development of the floodplain habitat. No invasive floating aquatic species present in the estuary e.g. water hyacinth.

Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the

Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina,

#### Inverts

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

D

As sampled by seine and gill net in open waters:

- 13 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

# 35 Mtwalume RQOs

PES:		С	REC:		C TEC: C			С
Flow:								
PES		nMAR (MC	CM)			pMAR (MCM)		
		57.60				41.79		
В	should be ι	uld not exceed natura upheld into estuary to omponents differ by 1 015).	o maintain present n	าouth เ	state and salini	ity regime. The distri	bution pa	tterns of
Sedim	ent processo	es:						
С	habitat) present the estu Change Change deviates	od regime maintain to a regime maintain to a regiment load-dische aary do not differ signes in tidal amplitude oes in sediment grain so by less than a factotions in middle and uerage.	liment concentration narge relationship (to nificantly from prese of less than 20% froi size distribution patt or of two from prese!	from to be deed to be	river inflow do etermined). The 0.5 m) (to be dete sent (to be dete imilar to presel els levels ( to be els levels ( to be els els els els els els els els els el	not deviates by more e sedimentation and etermined). ermined). nt. The median bed s e determined). The s	e than 209 erosion p sediment and/mud	% of the patterns in diameter
Mouth	state:							
С	Mouth ope	en conditions should	be maintained withir	n the c	current range: 7	71% (± 10%).		
Water	quality: Sali	nity						
В	The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should be between 15 and 20 (to be confirmed).							
Water	quality: Oth	er						
	Ecostyster	m health:				Recreational use	<b>)</b> :	Yes
С	DIN: Fresh	water inflow, 50%ile				Microbiology: Sufficient levels (DE 2012)		

Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:

- Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);
- Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)

## Macrophytes (plants)

C

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.

## Inverts

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids, polychaetes and the crab Hymenosoma projectum. Insect taxa should occur in the far upper reaches only.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Molluscan assemblage should include bivalves (including Eumarcia paupercula) and gastropods (including Natica spp.).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata, Varuna litterata, Macrophthalmus sp., Sesarmidae and Uca sp,
- Invasive alien species do not dominate macrobenthos.

# Fish

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).

C

- Pomadasys commersonni and Argyrosomus japonicas should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

#### 36 Mvuzi RQOs

F	PES:	С	REC:	REC: C TEC:		TEC:	С	
Flow:								
PES	nMAR (MCM)				pMAR (MCM)			
	1.65				1.55			
В	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).							
Sedime	nt processo	es:						

 The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the

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present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present ( $\pm$  0.5 m) (to be determined).

- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

Mouth open conditions should be maintained within the current range: 23% (± 5%).

#### Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 5 (to be confirmed).

# Water quality: Other

	Ecostystem health:	Recreational use:	N/A
С	DIN: Freshwater inflow, 50%ile <0.3 mg/l DIP: Freshwater inflow, 50%ile <0.025 mg/l DO: Entire estuary, average ≥4 mg/l Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Not identified as recreation stakeholder meeting	onal area in

# Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Prevent further reed encroachment into the main water channel.

# Inverts

C

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

# Fish

C

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 37 Fafa RQOs

D

more than 40%.

C/D REC: TEC: PFS. Components that require interventions to achieve the TEC: • Restore estuarine habitat. Flow: PES nMAR (MCM) pMAR (MCM) 46.45 37.64 Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows C should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015). Sediment processes: • The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined). D • Changes in tidal amplitude of less than 20% from present (to be determined). · Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average. Mouth state: C Mouth open conditions should be maintained within the current range: 45% (± 10%). Water quality: Salinity The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle В reaches during the low flow season. Mid-waters in the lower reaches should be between 10 and 15 (to be confirmed). Water quality: Other **Ecostystem health:** Recreational use: Yes DIN: Freshwater inflow, 50%ile <0.3 mg/l DIP: Freshwater inflow, 50%ile <0.025 mg/l DO: Entire estuary, average >4 mg/l Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances: C Microbiology: Sufficient levels (DEA, Substance concentrations in estuarine waters not to exceed targets 2012) as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995); Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009) Macrophytes (plants) Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular maintain the integrity of the swamp forest. Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat and sand mining in the upper D No invasive floating aquatic species present in the estuary e.g. water hyacinth. Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area. Prevent further reed encroachment into the main water channel. Inverts As sampled by plankton net, grab and dip nets/traps (as appropriate):

Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by

Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei,

- but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

# Fish

D

As sampled by seine and gill net in open waters:

- 13 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.

DEC.

- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

# 38 Mdesingane RQOs

DEC.

PES: D REC: D TEC: D					D		
low:			-	<u>.                                    </u>	•		
PES	nMAR (MCM)				pMAR (MCM)		
		2.02			2.02		
Α	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).						
edime	ent processe	es:					
E	habitat). present the estu Change Change deviates	The suspended see sediment load-disc ary do not differ sig s in tidal amplitude s in sediment grain s by less than a factions in middle and the sediment grain in middle and the sediment grain sediment	diment concentration tharge relationship (to inificantly from present of less than 20% from size distribution pattetor of two from present	from river inflow do n be determined). The t (± 0.5 m) (to be det n present (to be deter rns similar to presen t levels (to be		an 20% of the sion patterns ment diamete l/mud	
outh D	state:  Mouth ope	n conditions should	be maintained within	the current range: 58	3% (± 10%).		
/ater o	quality: Salir				,		
В					se in salinity in the lowe		
Vater o	quality: Othe	er					
· ato: \							
vator (	Ecostysten	n health:			Recreational use:	N/A	

targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)

# Macrophytes (plants)

Ε

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Prevent further reed encroachment into the main water channel.

#### Inverts

Ε

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 50%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton occur.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Carid prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.

#### Fish

Ε

As sampled by seine and gill net in open waters:

- 6 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 30% frequency of occurrence.
- Pelagic piscivores should occur).
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

# 39 Sezela RQOs

Water quality: Salinity

F	PES:	С	REC:	C TEC: C					
Flow:	Flow:								
PES		nMAR (M	CM)			pMAR (MCM)			
		3.92				3.89			
В	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).								
Sedime	ent process	es:							
D	<ul> <li>The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).</li> <li>Changes in tidal amplitude of less than 20% from present (to be determined).</li> <li>Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.</li> </ul>								
Mouth s	state:								
В	Mouth ope	en conditions should	be maintained within	the curre	nt range:	19% (± 5%).			

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 10 (to be confirmed). Water quality: Other **Ecostystem health:** N/A Recreational use: Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.3 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.25 mg/l (high risk) DO: Entire estuary, average >4 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Ε Toxic substances: Not identified as recreational area in Substance concentrations in estuarine waters not to exceed targets stakeholder meeting as per SA Water Quality Guidelines for coastal marine waters

# Macrophytes (plants)

(DWAF, 1995);

Secretariat and CSIR, 2009)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Prevent algal blooms and reed encroachment that may become problematic due to nutrient enrichment from further proposed WWTW input.

# Inverts

D

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
  - Invasive alien species do not dominate macrobenthos.

# Fish

D

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 40 Mkumbane RQOs

PES: C		REC:		С	TEC:	С				
Flow:										
PES	nMAR (MCM)				pMAR (MCM)					
	3.79				3.54					
В	should be ເ	upheld into estuary to	al and seasonal distro o maintain present m no more than 10% (ii	outh sta	ate and salini	ty regime. The distril	bution patterns of			

Present (2015).

## Sediment processes:

- The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- · Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

D

Mouth open conditions should be maintained within the current range: 8% ( $\pm$  5%).

# Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 5 (to be confirmed).

#### Water quality: Other

	Ecostystem health:	Recreational use:	N/A
D	Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.3 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.025 mg/l (high risk) DO: Entire estuary, average ≥4 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Not identified as recreational a stakeholder meeting	rea in

# Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aguatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.
- Prevent further reed encroachment into the main water channel.

# Inverts

D

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.

D

55

Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 41 uMuziwezinto (Mzinto) RQOs

F	PES:	C/D	REC:	C/D	TEC:	C/D			
Flow:	Flow:								
PES	nMAR (MCM)				pMAR (MCM)				
		23.17			20.09				
С	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows								

should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

# Sediment processes:

• The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).

- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of 2 from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a 5 year average.

#### Mouth state:

D

Mouth open conditions should be maintained within the current range: 15% ( $\pm$  5%).

# Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 5 (to be confirmed).

# Water quality: Other

	Ecostystem health:	Recreational use:	N/A
D	Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.3 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.025 mg/l (high risk) DO: Entire estuary, average ≥4 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Not identified as recreation stakeholder meeting	al area in

# Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the freshwater mangrove, Barringtonia racemosa, swamp forest is important.
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>

#### Inverts

D

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.

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- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

# Fish

D

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 42 Nkomba RQOs

F	PES:	B/C	REC:	B/C TEC: B/				
low:		-	-	-	-	-		
PES		nMAR (MC	CM)		pMAR (MCM)			
		0.69			0.69			
Α	should be ເ the flood co	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).						
Sedime	ent processo	es:						
С	habitat) present the estu Change Change deviates	The suspended sectors and the suspended sectors and the sectors are sectors are sectors and the sectors are sector	liment concentration narge relationship (to nificantly from present of less than 20% from size distribution patte or of two from present or of two from present size distribution present or of two from present or of two from present or of two from present present size or of two from present present size present size presen	tion patterns and aquifrom river inflow do a from river inflow do a be determined). The fit $(\pm 0.5 \text{ m})$ (to be determs similar to present levels (to be technique) to be the following by more that	not deviates by more e sedimentation and etermined). ermined). nt. The median bed s e determined). The s	e than 20% of the erosion patterns i sediment diameter and/mud		
Mouth :	state:							
Α	Mouth ope	en conditions should	be maintained withir	n the current range: 1	0% (± 5%).			
Nater c	quality: Sali	nity						
Α	reaches du	ring the low flow sea		a measurable increa he lower reaches sho				
Nater c	quality: Othe	er						
	Ecostyster	n health:			Recreational use	e: N/A		
D	Water quality poses risk to REC/TEC, sufficiently reduced if:  DIN: Freshwater inflow, 50%ile <0.3 mg/l (high risk)  DIP: Freshwater inflow, 50%ile <0.025 mg/l (high risk)  DO: Entire estuary, average ≥4 mg/l (high risk)  Turbidity: Estuary, clear (<10 NTU) accept during high inflow events  Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters  (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)							

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>

#### Inverts

D

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods (including Melanoides tuberculata).
- Invasive alien species should not occur in abundance.

#### Fish

C

As sampled by seine and gill net in open waters:

- 15 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 70% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 43 Mzimayi RQOs

confirmed).

F	PES:	C/D	REC:		C/D	TEC:	C/D
Flow:							
PES		nMAR (M	CM)			pMAR (MCM)	
		6.15				4.55	
D	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).						
Sedime	ent process	es:					
С	habitat) present the estu Change Change deviate	The suspended sectors. The suspended sectors is sediment load-disclusing do not differ signary do not differ signary in tidal amplitude as in sediment grain as by less than a factors in middle and to	he sediment distribut diment concentration narge relationship (to nificantly from preser of less than 20% fron size distribution patte or of two from preser upper reaches do not	from riv be det at (± 0.5 n prese erns sin at levels	ver inflow do termined). Th 5 m) (to be de ent (to be dete milar to prese s levels ( to b	not deviates by more e sedimentation and etermined). ermined). nt. The median bed s e determined). The s	e than 20% of the erosion patterns in sediment diameter and/mud
Mouth	state:						
D	Mouth ope	en conditions should	be maintained within	the cu	ırrent range: 2	20% (± 5%).	
Water o	Water quality: Salinity						

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should be between 0 and 5 (to be

Water quality: Other								
	Ecostystem health:	Recreational use:	Yes					
D	Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.3 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.025 mg/l (high risk) DO: Entire estuary, average ≥4 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Microbiology: Sufficient level 2012)	ls (DEA,					

# Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Prevent further reed encroachment into the main water channel.

#### Inverts

D

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

C

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 44 Mpambanyoni RQOs

PES:		С	REC:	С	TEC:	С					
Flow:	low:										
PES		nMAR (MC	CM)	pMAR (MCM)							
	60.06				55.53						
В	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).										
Sedime	nt processo	es:									

- The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present ( $\pm$  0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

D

В Mouth open conditions should be maintained within the current range: 78% (± 10%).

# Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle Α reaches during the low flow season. Mid-waters in the lower reaches should be between 10 and 15 (to be confirmed).

# Water quality: Other

	Ecostystem health:	Recreational use:	Yes
D	Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.3 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.025 mg/l (high risk) DO: Entire estuary, average ≥4 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Scottborough Microbiology: Sufficient level 2012)	's (DEA,

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat particularly by sugarcane
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.

#### Inverts

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids, polychaetes and the crab Hymenosoma projectum. Insect taxa should occur in the far upper reaches only.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Molluscan assemblage should include bivalves (including Eumarcia paupercula) and gastropods (including Natica spp.).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata, Varuna litterata, Macrophthalmus sp., Sesarmidae and Uca sp.
- Invasive alien species do not dominate macrobenthos.

#### Fish

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni and Argyrosomus japonicas should be sampled with 60% frequency o occurrence.

D

C

- Pelagic piscivores should occur (including Caranx spp).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 45 Mahlongwa RQOs

PES: C REC: B TEC: B

Components that require interventions to achieve the REC/TEC:

- Protect baseflows to estuary to maintain mouth state and salinity profile.
- Improve water quality; and
- · Partial restoration estuarine riparian habitat; and
- Control and reduce fishing pressure..

## Flow:

PES	nMAR (MCM)	pMAR (MCM)		
	13.76	13.18		
В	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflor should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patter the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that			

# Sediment processes:

Present (2015).

- The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

# Mouth state:

D

Mouth open conditions should be maintained within the current range: 22% ( $\pm$  5%).

#### Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 10 (to be confirmed).

## Water quality: Other

	Ecostystem health:	Recreational use:	Yes
D	Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk) DO: Entire estuary, average ≥6 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Microbiology: Sufficient lev 2012)	rels (DEA,

# Macrophytes (plants)

C

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aguatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Maintain present salinity regime to maintain reed & sedge habitats (< 50 % loss of reed & sedge habitats in non-flood year).
- Improve salinity regime to encourage the reestablishment of mangrove habitat.

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#### Inverts

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods (including Melanoides tuberculata).
- Invasive alien species should not occur in abundance.

#### Fish

C

As sampled by seine and gill net in open waters:

- 15 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 70% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 46 Mahlongwane RQOs

PES: C REC: B TEC: B

Components that require interventions to achieve the REC/TEC:

- Protect baseflows to estuary to maintain mouth state and salinity profile.
- Improve water quality; and
- Partial restoration of estuarine riparian habitat.

# Flow:

PES	nMAR (MCM)	pMAR (MCM)			
	2.69	2.93			
В	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of				

Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

# Sediment processes:

- The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

# Mouth state:

D

B Mouth open conditions should be maintained within the current range: 13% (± 5%).

# Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 10 (to be confirmed).

# Water quality: Other

Ecostystem health: Recreational use: Yes

Water quality poses risk to REC/TEC, sufficiently reduced if:

DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk)

DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk)

DO: Entire estuary, average >6 mg/l (high risk)

Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:

 Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);

 Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009) Microbiology: Sufficient levels (DEA, 2012)

# Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the Barringtonia racemosa and Hibiscus tiliaceus swamp forest is important.
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Prevent further reed encroachment into the main water channel.

#### Inverts

C

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods (including Melanoides tuberculata).
- Invasive alien species should not occur in abundance.

# Fish

C

As sampled by seine and gill net in open waters:

- 15 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 70% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 47 Ngane RQOs

F	PES:	С	REC:		С	TEC:	С	
Flow:								
PES	nMAR (MCM)					pMAR (MCM)  4.30  compromised. Currrent baseflows regime. The distribution patterns of		
	3.83				4.30			
В	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).							
Sedime	Sediment processes:							

The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical

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habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).

- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels (evols (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

Mouth open conditions should be maintained within the current range: 54% (± 5%).

# Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should be between 5 and 10 (to be confirmed).

# Water quality: Other

	Ecostystem health:	Recreational use:	Yes
С	DIN: Freshwater inflow, 50%ile <0.3 mg/l DIP: Freshwater inflow, 50%ile <0.025 mg/l DO: Entire estuary, average ≥4 mg/l Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Microbiology: Sufficient lev 2012)	els (DEA,

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.
- Maintain some saline input to encourage the growth of mangroves (e.g. Bruquiera gymnorrhiza).
- Prevent disturbance and further reed encroachment into the main water channel.

# Inverts

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### **Fish**

As sampled by seine and gill net in open waters:

- 13 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

D

D

# 48 Umgababa RQOs

Inverts

PES: C **REC:** В TEC: B/C Components that require interventions to achieve the REC/TEC: Improve water quality; and · Partial restoration of estuarine habitat. Flow: **PES** nMAR (MCM) pMAR (MCM) 10.56 9.58 Present base flows poses a risk to the REC. Flows should not exceed natural and seasonal distrubution C should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015). Sediment processes: The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present ( $\pm$  0.5 m) (to be determined). C Changes in tidal amplitude of less than 20% from present (to be determined). Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/muo distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average. Mouth state: C Mouth open conditions should be maintained within the current range: 46% (± 5%). Water quality: Salinity The system needs variability in salinity regime, with a measurable increase in salinity in the system during the low flow season. Mid-waters in the lower reaches should exceed 15, while the middle and upper reaches should exceed 10 and 5 respectivly (to be confirmed). Water quality: Other **Ecostystem health:** Recreational use: Yes Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk) DO: Entire estuary, average >6 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events C Toxic substances: Microbiology: Sufficient levels (DEA, Substance concentrations in estuarine waters not to exceed targets 2012) as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995); Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009) Macrophytes (plants) Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). Submerged macrophytes (Ruppia and Zostera) used to occur in this estuary. The large Juncus kraussii stands are important. Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the important floodplain habitat. D No invasive floating aquatic species present in the estuary e.g. water hyacinth. Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area. Maintain present salinity regime to maintain reed & sedge habitats (< 50 % loss of reed & sedge habitats in non-flood year). Improve salinity regime to encourage the reestablishment of mangrove habitat.

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species should not occur in abundance.

# Fish

C

С

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 5 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

# 49 Msimbazi RQOs

PES:		B REC: A TEC:						
Flow:								
PES	S nMAR (MC		nMAR (MCM) pMAR (MCM)					
10.04  Flows should not exceed natural and seasonal distrubution should not be comprised.					10.34	10.34		
Α	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).							
Sedim	ent process	es:						
С	habitat) present the estu Change Change deviated distribut year av	<ul> <li>The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).</li> <li>Changes in tidal amplitude of less than 20% from present (to be determined).</li> <li>Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.</li> </ul>						
Mouth A		un conditions should	ho maintained within	the current renge.	260/ / . 50/)			
	•	en conditions should	be maintained within	Tine current range.	30% (± 5%).			
B	The system low flow se	The system needs variability in salinity regime, with a measurable increase in salinity in the system during the low flow season. Mid-waters in the lower reaches should exceed 15, while the middle and upper reaches should exceed 10 and 5 respectivly (to be confirmed).						
Water	er quality: Other							
	Ecostyster	n health:			Recreational use	e: Yes		
С	DIN: Fresh	ity poses risk to REC water inflow, 50%ile			Microbiology: Suf	ficient levels (DE)		

Toxic substances:

- Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);
- Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)

# Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Maintain present salinity regime to maintain reed & sedge habitats (< 50 % loss of reed & sedge habitats in non-flood year).
- Improve the salinity regime to encourage the re-establishment of mangrove habitat.

#### Inverts

В

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species should not occur in abundance.

# Fish

С

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 5 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

# 50 Lovu RQOs

PES: C/D REC: B TEC: B/C

Components that require interventions to achieve the TEC:

- Improve water quality; and
- Partial restoration of estuarine habitat.

# Flow:

 PES
 nMAR (MCM)
 pMAR (MCM)

 119.10
 82.47

Flows should not exceed natural and seasonal distribution should not be compromised. Current baseflows should be upheld into estuary to maintain present mouth state and salinity regime. Distribution patterns of the flood components differ by no more than 10% (magnitude, timing and variability) from that of the Present (2015). The Present baseflows/ low flows poses a risk to the REC and should be elevated.

# Sediment processes:

 The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the

- present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present ( $\pm$  0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

C

Mouth open conditions should be maintained within the current range: 77% ( $\pm$  5%).

# Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season.

PES: Mid-waters in the lower reaches should exceed 25, the middle reaches it should exceed 20, while the upper reaches should vary between 10 to 15

REC: Mid-waters in the lower reaches should vary between 20 to 35, the middle reaches it should exceed 15, while the upper reaches should vary between 5 to 10.

# Water quality: Other

	Ecostystem health:	Recreational use:	Yes
С	Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk) DO: Entire estuary, average ≥6 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995); Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Microbiology: Sufficier (DEA, 2012)	nt levels

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). Ir particular the swamp forest habitat is important.
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.
- Improve the salinity regime to encourage the re-establishment of mangrove habitat.

## Inverts

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton & benthic assemblages (baselines to be set) not deviate by > 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species should not occur in abundance.

# Fish

As sampled by seine and gill net in open waters:

- 25 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 5 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni and Argyrosomus japonicas should be sampled with 80% frequency of
- Pelagic piscivores should occur (including Caranx spp).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

68

C

C

# 51 Little aManzimtoti RQOs

PES: Ε REC: D TEC: FF Components that require interventions to achieve the REC: Reduce some of the baseflows to estuary to improve mouth state and salinity profile. • Significant improvement in water quality; and • Partial restoration of estuarine habitat. • Prevent low oxegen events that results in fish kills. Water quality: Other **Ecostystem health:** Recreational use: Yes Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.5 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.125 mg/l (high risk) DO: Lower estuary, average >4 mg/l (high risk) Turbidity: Estuary, clear (<15 NTU) accept during high inflow events Ε Microbiology: Sufficient levels (DEA, Substance concentrations in estuarine waters not to exceed targets 2012) as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995); Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention

# 52 aManzimtoti RQOs

Water quality: Salinity

should exceed 10, while the upper reaches exceed 5.

C

Secretariat and CSIR, 2009)

F	PES:	D/E	REC:	D	TEC:	D			
• Prot • Imp • Maii	Omponents that require interventions to achieve the REC:  Protect baseflows to estuary to maintain mouth state and salinity profile.  Improve catchment water quality; and  Maintain estuarine habitat.  Prevent low oxygen events that results in fish kills.								
Flow:									
PES		nMAR (MO	CM)		pMAR (MCM)				
		5.30			6.75				
С	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).								
Sedime	ent process	es:							
D	<ul> <li>The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).</li> <li>Changes in tidal amplitude of less than 20% from present (to be determined).</li> <li>Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.</li> </ul>								
Mouth	state:								
С	Mouth ope	en conditions should	be maintained within t	he current range:	44% (± 5%).				
					-				

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle

reaches during the low flow season. Mid-waters in the lower reaches should exceed 15, the middle reaches

Water quality: Other							
	Ecostystem health:	Recreational use:	Yes				
F	<ul> <li>Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile &lt;0.5 mg/l (high risk)</li> <li>DIP: Freshwater inflow, 50%ile &lt;0.125 mg/l (high risk)</li> <li>DO: Lower estuary, average ≥4 mg/l (high risk)</li> <li>Turbidity: Estuary, clear (&lt;15 NTU) accept during high inflow events</li> <li>Toxic substances:</li> <li>Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);</li> <li>Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)</li> </ul>	Microbiology: Sufficient l 2012)	evels (DEA,				

# Macrophytes (plants)

 Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). Maintain the integrity of the riparian zone.

Е

- No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Area covered by invasive waterweeds (e.g. water hyacinth, Azolla filiculoides) and nuisance filamentous algae (e.g. Enteromorpha, Ulva, Cladophora) should cover <50% of water surface area.</li>

#### Inverts

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 50%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton occur.

F

- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Carid prawns should occur.
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.

# Fish

As sampled by seine and gill net in open waters:

- 6 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 30% frequency of occurrence.
- Pelagic piscivores (e.g. Caranx spp.) should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

# 53 Mbokodweni RQOs

	PES:	E	REC:	D	TEC:	EF
Water	quality: Othe	er		•		
	Ecostyster	n health:			Recreational use	e: Yes
F	Ecostystem health:  Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.5 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.125 mg/l (high risk) DO: Lower estuary, average ≥4 mg/l (high risk) Turbidity: Estuary, clear (<15 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed target as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);		sk) risk) gh inflow events not to exceed targets	2012)	ficient levels (DEA,	

 Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)

# 54 Sipingo RQOs

i	PES:	F	REC:	E	TEC:	i	€F		
Water o	Vater quality: Salinity								
F	The system needs variability in salinity regime, with a measurable increase in salinity during the low flow season. Mid-waters in the lower reaches should exceed 30, the middle reaches should exceed 20, while the upper reaches is 5 (to be confirmed).								
Water o	quality: Othe	er							
	Ecostyster	n health:			Recreational use	e:	Yes		
Water quality poses risk to REC/TEC, sufficiently reduced if:  DIN: Freshwater inflow, 50%ile <0.5 mg/l (high risk)  DIP: Freshwater inflow, 50%ile <0.125 mg/l (high risk)  DO: Lower estuary, average ≥4 mg/l (high risk)  Turbidity: Estuary, clear (<15 NTU) accept during high inflow events  Toxic substances:  Substance concentrations in estuarine waters not to exceed target as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)					Microbiology: Suf 2012)	ificient lev	els (DEA,		

# 55 Durban Bay RQOs for shallow water and intertidal areas

PES: Ε REC: TEC: D\* D\* Components that require interventions to restore functionality (not back to refrence) to Durban Bay (achive the REC/TEC): • Protect baseflows to estuary to maintain mouth state and salinity profile. • Improve water quality; • Reduce fishing effort, and • Partial restoration of estuarine habitat in upper reaches. Prevent low oxegen events that results in fish kills. Flow: **PES** nMAR (MCM) pMAR (MCM) 36.33 63.44 Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015). Sediment processes: The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical

- The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

# Hydrodynamics:

F

E Mouth open conditions should be maintained within the current range: 100%

## Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should be between 30 and 35, while the

	upper reaches should vary between 25 to 30.		
Water	quality: Other		
	Ecostystem health:	Recreational use:	Yes
С	Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.3 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.025 mg/l (high risk) DO: Entire estuary, average ≥4 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  • Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  • Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Microbiology: Sufficient levels 2012)	(DEA,

# Macrophytes (plants)

F

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the remnant intertidal mangrove areas are important.
- Prevent further disturbance and development of the riparian and floodplain habitat.

#### Inverts

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 50%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton occur frequently.
- Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids, polychaetes.
- Chironomid larvae, oligochaetes and the polychaete Capitella capitata should not occur in abundance and should not dominate the benthos.
- Penaeid prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas throughout and should be abundant on the system's sandbanks in the lower reaches.
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata, Macrophthalmus sp., Portunus sanguinolentus, Sesarmidae and Uca sp.
- Molluscan assemblage should include bivalves (including tellinids, Solen cylindraceus, Eumarcia paupercula, Dosinia hepatica) and gastropods (including Nassarius kraussianus, Natica spp. and Polinices sp.).
- Invasive alien species do not occur in the soft sedminent macrobenthos.

# Fish

F

As sampled by seine and gill net in open waters:

- 30 species should occur to include estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Liza dumerilli, Acathopagurs vagus, Rhabdosargus holubi, Sillago sihama, Gerres filamentosus, Ambassis spp., Leiognathus equula and Pomadasys commersonni should be sampled with 100% frequency of occurrence (ie, every sampling trip).
- Pelagic piscivores should occur (including Caranx and Sphyraena spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 56 uMngeni (Mgeni) RQOs

PES: D/E REC: D TEC: D

Components that require interventions to achieve the REC/TEC:

- Restore baseflows to estuary to improve mouth state and salinity profile and Implement flow allocation in an estuary friendly manneri
- A significant improvement in water quality needed; and
- Restoration of macrophytes: removal of alien plant species, replanting/ reintroduction with indigenous species (some
  of which is already occurring)
- Wetland engineering (creation of new wetland habitats in close proximity to the uMngeni River banks,.
- Review the current breaching policy that only requires breaching after 2 to 3 weeks, this poses a risk to plant communities and birds.
- Develop an Estuary Management Plan

• Prevent low oxegen events that results in fish kills.

#### Flow:

D

PES	nMAR (MCM)	pMAR (MCM)
	671.30	208.46

Present flows poses a risk to the REC/TEC. Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

#### Sediment processes:

Е

- The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter
  deviates by less than a factor of two from present levels (to be determined). The sand/mud
  distributions in middle and upper reaches do not change by more than 20% from Present State over a five
  year average.

#### Mouth state:

F Mouth open conditions should be maintained within the current range: 95% (+5%).

#### Water quality: Salinity

F

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should be between 5 and 10 (to be confirmed).

#### Water quality: Other

	Ecostystem health:	Recreational use:	Yes
D	<ul> <li>DIN: Freshwater inflow, 50%ile &lt;0.5 mg/l</li> <li>DIP: Freshwater inflow, 50%ile &lt;0.125 mg/l</li> <li>DO: Lower estuary, average ≥4 mg/l</li> <li>Turbidity: Estuary, clear (&lt;15 NTU) accept during high inflow events</li> <li>Toxic substances:</li> <li>Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);</li> <li>Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)</li> </ul>	Microbiology: Sufficient le 2012)	evels (DEA,

#### Macrophytes (plants)

F

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the mangrove habitat is important.
- Maintain the integrity of the riparian zone. No additional bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Area covered by invasive waterweeds (e.g. water hyacinth, Azolla filiculoides) and nuisance filamentous algae (e.g. Enteromorpha, Ulva, Cladophora) should cover <50% of water surface area.</li>

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 50%
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton occur frequently.
- Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids, and the crab Hymenosoma projectum. Insect taxa should occur in the far upper reaches only.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid prawns should occur.
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata, Varuna litterata, Macrophthalmus sp., Sesarmidae and Uca sp,
- Molluscan assemblage should include bivalves and gastropods (including Nassarius kraussianus, Natica spp.).

Invasive alien species do not dominate macrobenthos in lower reaches.

#### Fish

As sampled by seine and gill net in open waters:

- 12 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni and Argyrosomus japonicas should be sampled with 30% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 57 Mhlanga RQOs

PES: D REC: B TEC: B

Components that require interventions to achieve the TEC:

Ensure that the existing pumping scheme comes into operation so that:

- Restore baseflows to estuary to improve mouth state and salinity profile.
- A significant improvement in water quality needed; and
- · Partial restoration of estuarine habitat.
- · Prevent low oxegen events that results in fish kills.

#### Flow:

D

D

PES	nMAR (MCM)	pMAR (MCM)
	13.34	22.33

Present flows poses a risk to the REC. Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

#### Sediment processes:

- The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

Ε

Mouth open conditions should be maintained within the current range: 48% ( $\pm$  10%).

#### Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should be between 5 and 10 (to be confirmed).

# Water quality: Other

Ecostystem health:	Recreational use:	Yes
Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk) DO: Entire estuary, average ≥6 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed tal as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995); Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Conventi	rgets Microbiology: Sufficient levels	's (DEA,

Secretariat and CSIR, 2009)

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the swamp forest habitat is important.
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aguatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Improve salinity regime to encourage reestablishment of mangrove habitat.

#### Inverts

Ε

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species should not occur in abundance.

#### Fish

Ε

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 5 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp.).
- · No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

# 58 uMdloti (Mdloti) RQOs

PES: D REC: C TEC: D

Components that require interventions to achieve the TEC:

- Restore baseflows to estuary to improve mouth state and salinity profile.
- A significant improvement in water quality needed; and
- Partial restoration of estuarine habitat.
- Prevent low oxegen events that results in fish kills.

# Flow:

PES nMAR (MCM) pMAR (MCM)

100.19
85.03

Present flows poses a risk to the REC. Flows should not exceed natural and seasonal distrubution should not

Present flows poses a risk to the REC. Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

#### Sediment processes:

С

- The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter

deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

Mouth open conditions should be maintained within the current range: 40% ( $\pm$  5%).

#### Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should be between 5 and 10 (to be confirmed).

#### Water quality: Other

	Ecostystem health:	Recreational use:	Yes
F	Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.3 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.025 mg/l (high risk) DO: Entire estuary, average ≥4 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:  Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);  Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)	Windsurfing Microbiology: Sufficient 2012)	levels (DEA,

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the swamp forest habitat is important.
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aguatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Maintain present salinity regime to maintain reed & sedge habitats (< 50 % loss of reed & sedge habitats in non-flood year).

#### Inverts

D

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 50%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton occur.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Carid prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.

#### Fish

D

As sampled by seine and gill net in open waters:

- 6 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 30% frequency of occurrence.
  - Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

# 59 uThongathi (Tongati) RQOs

PES: REC: C TEC: D D Components that require interventions to achieve the REC/TEC: • Restore baseflows to estuary to improve mouth state and salinity profile. · A significant improvement in water quality needed; and • Partial restoration of estuarine habitat. • Prevent low oxegen events that results in fish kills. Flow: **PES** nMAR (MCM) pMAR (MCM) 70.79 79.21 Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of C the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015). Present flows poses a risk to the REC. Sediment processes: The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined). D Changes in tidal amplitude of less than 20% from present (to be determined). • Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average. Mouth state: Mouth open conditions should be maintained within the current range: 84% (± 10%). Water quality: Salinity The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle C reaches during the low flow season. Mid-waters in the lower reaches should be between 5 and 10 (to be confirmed). Water quality: Other **Ecostystem health:** Recreational use: N/A Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.5 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.125 mg/l (high risk) DO: Lower estuary, average >4 mg/l (high risk) Turbidity: Estuary, clear (<15 NTU) accept during high inflow events F Not identified as recreational area in Substance concentrations in estuarine waters not to exceed targets stakeholder meeting as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995); Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009) Macrophytes (plants) Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat. In particular by sugarcane cultivation in the EFZ. D No invasive floating aquatic species present in the estuary e.g. water hyacinth. Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area. Maintain present salinity regime to maintain reed & sedge habitats (< 50 % loss of reed & sedge habitats in non-flood year).

#### Inverts

Ε

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 50%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton occur frequently.
- Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids, polychaetes and the crab Hymenosoma projectum. Insect taxa should occur in the far upper reaches only.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Molluscan assemblage should include bivalves and gastropods.
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata, Varuna litterata, Macrophthalmus sp., Sesarmidae and Uca sp,
- Invasive alien species do not dominate macrobenthos in lower reaches.

#### Fish

Ε

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 30% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

# 60 Bob's Stream RQOs

	PES:	B/C	REC:		3/C	TEC:	B/C
Flow:							
PES	nMAR (MCM) pMAR (MCM)						
		0.53				0.53	
Α	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of Present (2015).				bution patterns of		
Sedime	ent processo	es:					
D	<ul> <li>The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).</li> <li>Changes in tidal amplitude of less than 20% from present (to be determined).</li> <li>Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.</li> </ul>						
Mouth	state:						
Α	Mouth ope	n conditions should	be maintained within	the curr	ent range: 2	0% (± 5%).	
Water (	quality: Sali	nity					
Α			salinity regime, with son. Mid-waters in th				
	quality: Othe						·
Water	quanty. Othic	er					·
Water	Ecostyster					Recreational use	e: N/A

Turbidity: Estuary, clear (<10 NTU) accept during high inflow events Toxic substances:

- Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);
- Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aguatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>

#### Inverts

В

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods (including Melanoides tuberculata).
- Invasive alien species should not occur in abundance.

#### Fish

В

As sampled by seine and gill net in open waters:

- 15 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 30% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

## 61 Seteni RQOs

PES: B/C REC: B/C TEC: B/C

Flow:

PES nMAR (MCM) pMAR (MCM)

1.42

Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

#### Sediment processes:

D

• The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).

- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter

deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

A Mouth open conditions should be maintained within the current range: 35% (± 5%).

#### Water quality: Salinity

The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should exceed 5 (to be confirmed).

#### Water quality: Other

Ecostystem health:	Recreational use:	N/A
<ul> <li>Water quality poses risk to REC/TEC, sufficiently reduced if:</li> <li>DIN: Freshwater inflow, 50%ile &lt;0.2 mg/l (high risk)</li> <li>DIP: Freshwater inflow, 50%ile &lt;0.015 mg/l (high risk)</li> <li>DO: Entire estuary, average ≥6 mg/l (high risk)</li> <li>Turbidity: Estuary, clear (&lt;10 NTU) accept during high inflow events</li> <li>Toxic substances:</li> <li>Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);</li> <li>Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)</li> </ul>	No identified as recreational stakeholder meeting	area at

#### Macrophytes (plants)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the swamp forest habitat would be of importance.
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat. In particular no further sugarcane cultivation should take place in the EFZ.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>

#### Inverts

В

D

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species should not occur in abundance.

#### Fish

В

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 5 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.

## 62 Mdlotane RQOs

ı	PES:	B REC: A/B		A/B	TEC:	A/B	
Flow:			•				
PES		nMAR (M	ICM)		pMAR (MCM)		
		6.04			5.85		
Α	should be ι	ipheld into estuary i Imponents differ by	ral and seasonal distri to maintain present m r no more than 10% (ii	outh state and salini	ity regime. The distr	ibution patte	erns of
Sedime	ent processo	es:					
В	habitat) present the estu Change Change deviates	The suspended se sediment load-discurry do not differ signs in tidal amplitude is in sediment grain is by less than a factions in middle and	the sediment distribut diment concentration charge relationship (to gnificantly from preser of less than 20% from a size distribution patte tor of two from preser upper reaches do not	from river inflow do not be determined). The not (± 0.5 m) (to be determined in present (to be determined in the levels (to be	not deviates by more sedimentation and stermined).  ermined).  nt. The median bed be determined).  determined). The second control of the second control o	e than 20% I erosion pa sediment di sand/mud	itterns in iameter
Mouth:	state:						
В	Mouth ope	n conditions should	d be maintained within	the current range: 1	14% (± 5%).		
Water o	quality: Sali	nity					
В			n salinity regime, with eason. Mid-waters in tl				
Water o	quality: Othe	er					
	Ecostyster	n health:			Recreational us	e:	Yes
D	DIN: Fresh DIP: Fresh DO: Entire Turbidity: E Toxic subst Substa as per (DWAI Substa	water inflow, 50%ile water inflow, 50%ile estuary, average stuary, clear (<10 fances: ance concentrations SA Water Quality (5=, 1995); ance concentrations	C/TEC, sufficiently re- e < 0.2 mg/l (high risk) e < 0.015 mg/l (high ris 6 mg/l (high risk) NTU) accept during hi s in estuarine waters re Guidelines for coastal s in estuarine sedimen n guidelines (UNEP/N	sk) gh inflow events not to exceed targets marine waters nt not to exceed	Microbiology: Su 2012)	fficient level	ls (DEA,

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the swamp forest habitat is of importance.
- Maintain the integrity of the riparian zone. No bare patches or unvegetated, cleared areas along the banks.
   Prevent further disturbance and development of the floodplain habitat.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Maintain present salinity regime to maintain reed & sedge habitats (< 50 % loss of reed & sedge habitats in non-flood year).

#### Inverts

В

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 25%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.

81

# С

- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves (including Hiatula lunulata) and gastropods (including Melanoides tuberculata).
- Invasive alien species should not occur.

#### Fish

C

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 4 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 70% frequency of occurrence.

REC:

- Pelagic piscivores should occur (including Caranx spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 63 Nonoti RQOs

PES.

F	PES:	С	REC:	С	TEC:	С		
low:								
PES	nMAR (MCM) pMAR (MCM)							
	34.74 34.74							
В	should be ເ the flood co	Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).						
edime	ent processo	es:						
С	habitat) present the estu Change Change deviates	The suspended sec sediment load-discl uary do not differ sign es in tidal amplitude es in sediment grain s by less than a fact tions in middle and u	diment concentration tharge relationship (to nificantly from preser of less than 20% fron size distribution patte or of two from presen	from river inflow do r be determined). The at (± 0.5 m) (to be dete in present (to be dete erns similar to presen at levels (eto be		nan 20% of the rosion patterns diment diamete nd/mud		
outh	state:							
В	Mouth ope	en conditions should	be maintained within	the current range: 1	8% (± 5%).			
Vater c	quality: Sali	nity						
В					se in salinity in the low ould exceed 10 (to be o			
Vater c	quality: Othe	er						
	Ecostyster	n health:			Recreational use:	Yes		
D	DIN: Fresh DIP: Fresh DO: Entire Turbidity: E Toxic substa as per (DWAI Substa	water inflow, 50%ile water inflow, 50%ile estuary, average >4 Estuary, clear (<10 N tances: ance concentrations SA Water Quality G F, 1995); ance concentrations	C/TEC, sufficiently red <0.3 mg/l (high risk) <0.025 mg/l (high risk) I mg/l (high risk) ITU) accept during high in estuarine waters in uidelines for coastal in estuarine sediment guidelines (UNEP/N	k) gh inflow events ot to exceed targets marine waters t not to exceed	Microbiology: Suffici 2012)	ient levels (DE		

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries).
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat. In particular no further sugarcane cultivation should take place within the EFZ.
- No invasive floating aguatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Prevent macroalgal blooms and reed encroachment which are likely to become problematic due to nutrient enrichment from proposed further WWTW input.

#### Inverts

C

D

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 40%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei.
- Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) are dominated by Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species do not dominate macrobenthos.

#### Fish

Ε

As sampled by seine and gill net in open waters:

- 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 3 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 60% frequency of occurrence.
- Pelagic piscivores should occur.
- No alien fish species should occur.
- Fish should be free of lesions and other anomalies related to water quality.

No fish kills should occur.

# 64 Zinkwasi RQOs

PES: B/C REC: A/B TEC: B

Components that require interventions to achieve the REC/TEC:

- Protect baseflows to estuary to ensure mouth state and salinity regime.
- · Improve water quality; and
- Partial restoration of estuarine habitat.

#### Flow:

PES nMAR (MCM) pMAR (MCM)

14.49

14.04

Flows should not exceed natural and seasonal distribution should not be compromised. Currrent baseflows should be unheld into estuary to maintain present mouth state and salinity regime. The distribution natterns of

Flows should not exceed natural and seasonal distrubution should not be compromised. Currrent baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

#### Sediment processes:

- The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).
- Changes in tidal amplitude of less than 20% from present (to be determined).
- Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels levels ( to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

#### Mouth state:

C

Mouth open conditions should be maintained within the current range: 28% (± 5%). Water quality: Salinity The system needs variability in salinity regime. Mid-waters in the lower reaches should be between 20 to 15, while the middle reaches should vary between 10 to 15 and the upper reaches between 5 to 10. Water quality: Other Recreational **Ecostystem health:** Yes use: Water quality poses risk to REC/TEC, sufficiently reduced if: DIN: Freshwater inflow, 50%ile <0.2 mg/l (high risk) DIP: Freshwater inflow, 50%ile <0.015 mg/l (high risk) DO: Entire estuary, average >6 mg/l (high risk) Turbidity: Estuary, clear (<10 NTU) accept during high inflow events C Microbiology: Sufficient levels (DEA, Substance concentrations in estuarine waters not to exceed targets 2012) as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995); Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention

#### Macrophytes (plants)

Secretariat and CSIR, 2009)

- Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the swamp forest habitat is of importance.
- Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat. No further sugarcane culitivation in the EFZ.
- No invasive floating aquatic species present in the estuary e.g. water hyacinth.
- Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area.</li>
- Maintain present salinity regime to maintain reed & sedge habitats (< 50 % loss of reed & sedge habitats in non-flood year).

#### Inverts

C

C

As sampled by plankton net, grab and dip nets/traps (as appropriate):

- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%.
- Zooplankton should be dominated by estuarine copepods Acartia natalensis and Pseudodiaptomus hessei, but include other groups such as mysids. Meroplankton are abundant.
- Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab Hymenosoma projectum and insect taxa.
- Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos.
- Penaeid and carid (Caridina and Macrobrachium) prawns should occur.
- Sandprawn Callichirus kraussi should occur in sandy areas in the systems lower reaches (to be confirmed).
- Large brachyuran crabs (macrocrustacea) should include Scylla serrata and Varuna litterata.
- Molluscan assemblage should include bivalves and gastropods.
- Invasive alien species should not occur in abundance.

#### Fish

C

As sampled by seine and gill net in open waters:

- 18 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes.
- Estuarine resident species should comprise a minimum of 5 species.
- Estuarine resident and estuarine dependant marine fishes should dominate cathes by abundance.
- Oligolepis keiensis, Oligolepis acutipennis, Gilchristella aestuaria, Glossogobius callidus, Myxus capensis and Rhabdosargus holubi should occur with 100% frequency of occurrence (every sampling trip).
- Pomadasys commersonni should be sampled with 80% frequency of occurrence.
- Pelagic piscivores should occur (including Caranx and Sphyraena spp.).
- No alien fish species should occur.
- Fish should be free of lesions and other anomlies related to water quality.

No fish kills should occur.