Seekoei Estuary Mouth Management Plan
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Prepared for

KOUGA
local municipality
Good Governance through Service Excellence

By

Coastal and Marine Research

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Background

(extracted from CSIR. 2017. Artificial Breaching Protocol for the Western Cape Estuaries. CSIR, Stellenbosch).

Artificial breaching of an estuary mouth is a pervasive activity that severely threatens the ecological structure and functioning of the system. To prevent poorly-informed, ill-planned, and detrimental opening of an estuary, Mouth Management Plans may be developed to allow for artificial breaching. A Mouth Management Plan should be based on sound scientific knowledge and understanding of estuary functioning, coupled with a knowledge of the methods and mechanisms of breaching suitable to a specific estuary. A detailed, well researched Mouth Management Plan ensures rapid approval processes; quick response times, reduces confusion in emergencies and increases cooperation between key role players. They are thus seen as essential at estuaries that require regular breaching (i.e. breaching required every 2 years or less), but is also recommended for systems where ad hoc emergencies may occur that require quick response times.

Ideally, Mouth Management Plans should be nested in specific EMPs, which in turn are nested in Coastal Management Plans / Programmes (Figure 1). According to the National Environmental Management Act (No. 107 of 1998) ("NEMA"), viz, the Environmental Impact Assessment (EIA) Regulations 2014 (Government Notice No. R. 326, R 327, R. 325 and R. 324 in Government Gazette No. 40772 of 7 April 2017), artificial breaching may not commence without an environmental authorisation from the competent authority. The need for artificial breaching consequently triggers various listed activities, which thus require a basic assessment impact study to be conducted, unless it is carried out in accordance with an approved Maintenance Management Plan as identified by a Mouth Management Plan (Refer to Figure 1 below and Section 6.3).

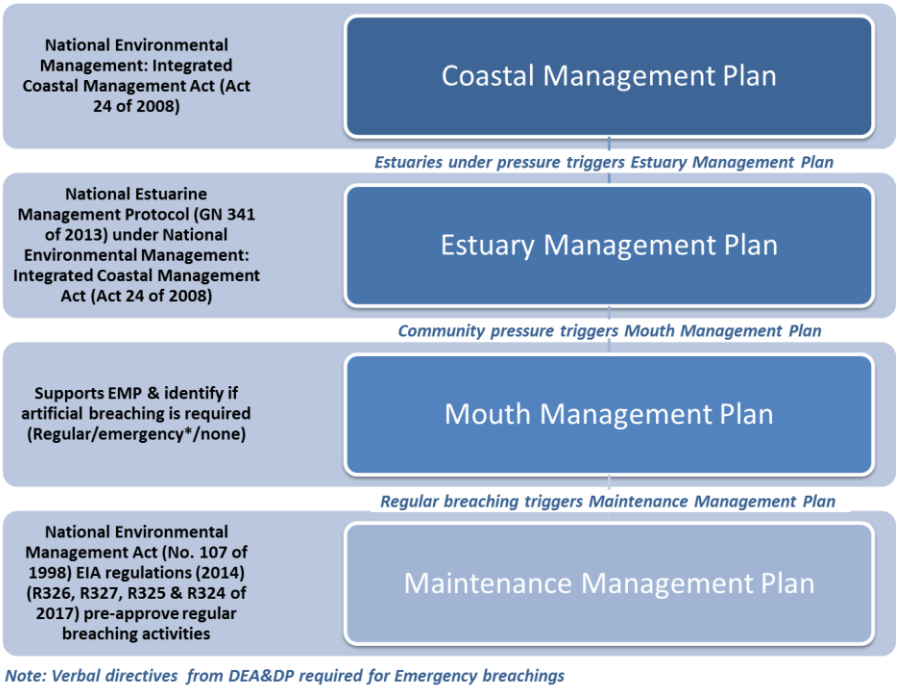

Figure 1 Mouth Management Plans and Maintenance Management Plans are nested in Estuary Management Plans

1. Objective of the Mouth Management Plan

1.1 Problem Statement

Mouth breaching no longer occurs at naturally high water levels or at the frequency that is necessary for the protection of infrastructure and ecosystem functioning at the Seekoei Estuary. Poorly planned infrastructure that is inundated at relatively low water levels necessitate artificial breaching of this stem at lower levels than natural. In addition, the decline in freshwater input due to dams within the catchment, drought conditions, and sediment trapping by the causeway has decreased the natural ability of the estuary to breach at intervals necessary to maintain estuary health. Current estimates suggest that abstraction and storage of freshwater in the catchment equals or even surpasses the annual river inflow from the catchment (refer to Section 6.1 of the Situation Assessment Report). At least 6 – 10 artificial breaching events were undertaken between 2009 and 2017.

Although the profile of the berm is in a state of constant change, there has been a progressive decline in recent years of average berm (sand bar) height across the estuary mouth (refer to Figure 10 in the Situation Assessment Report). This results in frequent trapping of sea water into the estuary during spring high tides and storm surges. The frequency of storm surges, particularly in winter, is increasing as the influence of climate change intensifies. Coupled with little freshwater input from the Seekoei and Swart tributaries, trapping of seawater into the estuary has resulted in periods of very high water levels and hypersaline conditions. The rise in the water level has threatened the infrastructure of the area, especially the causeway that links Paradise Beach and Jeffreys Bay. Properties adjacent to the estuary and those that lie within the Estuary Functional Zone (EFZ) are also threatened when water levels increase.

The result of the input of seawater, with no freshwater inflow to counter this, along with normal evaporation processes, has made the estuary hypersaline, which disrupts the normal ecological functioning of the estuary. Fish and invertebrate kills, vegetation diebacks and changes in types have been observed as well as a decline in water birds.

1.2 Objectives of the Seekoei Mouth Management Plan

The Mouth Management Plan for the Seekoei Estuary has three main objectives:

- Manage the estuary mouth as an integral part of the Seekoei Estuary Management Plan.
- Enhance the health of the estuary, i.e. no fish or invertebrate kills, normal estuarine vegetation structure, habitat and food for heathy bird life. This objective is combined with improving freshwater supply to the estuary and is addressed in the Estuary Management Plan.
- Manage risk to road infrastructure especially the causeway and flood risk to low-lying properties, especially in the Paradise Beach area.

1.3 Conditions for Artificial Breaching

Any breaching of an estuary mouth should occur naturally, although circumstances sometimes prescribe that a mouth needs to be breached artificially (DWAF 2006, CSIR 2017). Advantages for a natural breaching are numerous and the following section is a broad summary of key issues relevant

to the Seekoei reiterated here from the Situation Report by Wooldridge et al. (2017) (from DWAF 2006):

- Natural breaching of a Temporary Open/Closed Estuary (TOCE) provides the natural variation and timing of the open phase that enables the estuary to function optimally. The seasonal utilization of the estuary as a nursery for juvenile fish is an example.
- Natural breaching of TOCE enables the water level in the estuary to reach the highest level possible before the mouth opens. The higher the water level, the greater the amount of accumulated sediment flushed from the system. The potential flushing of sediments increases exponentially with the increase in water velocity. Along the South African coastline, breaching of an estuary mouth usually occurs when water level in the estuary reaches +2.5 to 3.5 m MSL. When breaching persistently occurs at lower levels, less sediment is removed on each occasion and this results in increased sedimentation over time.
- Salinity levels in a TOCE will respond to variable inputs of river and marine water. If the estuary mouth is opened artificially and outside its natural cycle, the salinity shift in the estuary will have a negative effect on the biota.
- From a fish perspective, breaching events should occur between October and April (warmer months). This enables the estuary to fulfil a major ecological role as a nursery area for numerous marine fish species that require an obligatory estuarine phase of development during their respective life cycles in summer. Migration of juvenile fish into the estuary is only possible if an estuary mouth is open, although occasional berm overwash by seawater can transport some juveniles into the estuary. In the latter instance, chemical cues utilized by fish and provided by tidal pumping through the mouth are absent.
- Along the South African coastline high waves generally occur in winter. Under high wave conditions, mouth closure occurs more rapidly. These high waves also lead to an excessive influx of sediment into the estuary if the mouth is open at the time.
- Salt marsh vegetation in TOCEs should not be inundated by water for too long, especially during the warmer months. Germination of seeds for example, will be compromised by high water levels.
- Water quality problems are more likely to occur under closed mouth conditions. If the mouth is closed in summer when water temperatures are relatively high, pollution becomes an issue especially if the estuary is used for recreational purposes.

According to a draft protocol for breaching of estuaries in the Western Cape, CSIR (2017), there are 13 general principles that apply to any estuary in South Africa that may require artificial breaching. Issues that apply to the Seekoei Estuary are marked with an asterisk:

1. Natural breaching remains the preferred option (as noted above)*.
2. Water level in an estuary should be as high as possible prior to breaching*.
3. Breaching should be late in winter and/or spring (September – October)*.
4. Breach should happen a few days before springtide. In the case of the Seekoei, final opening of the mouth should happen on the day of peak spring tide level (refer to Tide Time Table).
5. Breaching should occur shortly after peak spring tide and as the tide begins to ebb*.
6. Consider public safety and animal mobility during breaching (e.g. day or night).

7. A deep and wide trench should be excavated before breaching to maximize outflow*. In the case of the Seekoei, a wide beach may be less important than depth because of the relatively low water volume in the estuary.
8. An appropriate location for the breaching trench should be selected*.
9. Important ecological functions and processes must be considered*.
10. To rebuild fish stocks, functional estuarine nurseries should be ensured to maximize recruitment.
11. Connectivity between the landscape, sea and estuary should be considered*.
12. Breaching should not be a panacea for water quality problems*.
13. Breaching may be used to ameliorate the impact of alien invasive species or pathogens.
14. Breaching may occur when the entire estuary is naturally hypersaline at salinity above 45 - 50 to prevent a fish and invertebrate kill*.

Given the status of the Seekoei Estuary, an artificial breaching plan is necessary. The following plan refers to the present state of the Causeway and any emergency breaching applies while the present causeway continues to be used. This situation may change due to a natural event (e.g. a flood, or if a future decision is taken on the possible removal or 'improvement' of the causeway). For an artificial breaching event to proceed efficiently, connectivity between the north and south sections of the estuary must be improved. This requires the removal of loose rubble on either side of the connecting ducts. Currently, there is a dam-wall effect and through-flow is inefficient. Through-flow from the northern part of the estuary will improve the rate at which water levels drop throughout the system.

2 Description of the Seekoei Estuary

The Seekoei Estuary (Figure 2) is located between the resort townships of Aston Bay on the eastern side and Paradise Beach on its western side. The estuary is accessible via a 5 km tar road from Jeffreys Bay and an 18 km route to the town of Humansdorp to the north. The two rivers originate northwest of the town of Humansdorp and are each approximately 35 km in length. At its widest point, the estuary is 580 m wide, with a variable depth profile. Tidal reach extended 4.2 km upstream and the original tidal prism was 0.82×10^6 m^3 of water per cycle (Esterhuysen 1982). The total area of the Seekoei Estuary is 276 ha, red line demarcates the EFZ at the 5 m contour as shown on Figure 1. The landscape between the estuary and Humansdorp is largely transformed, with extensive farming activity.

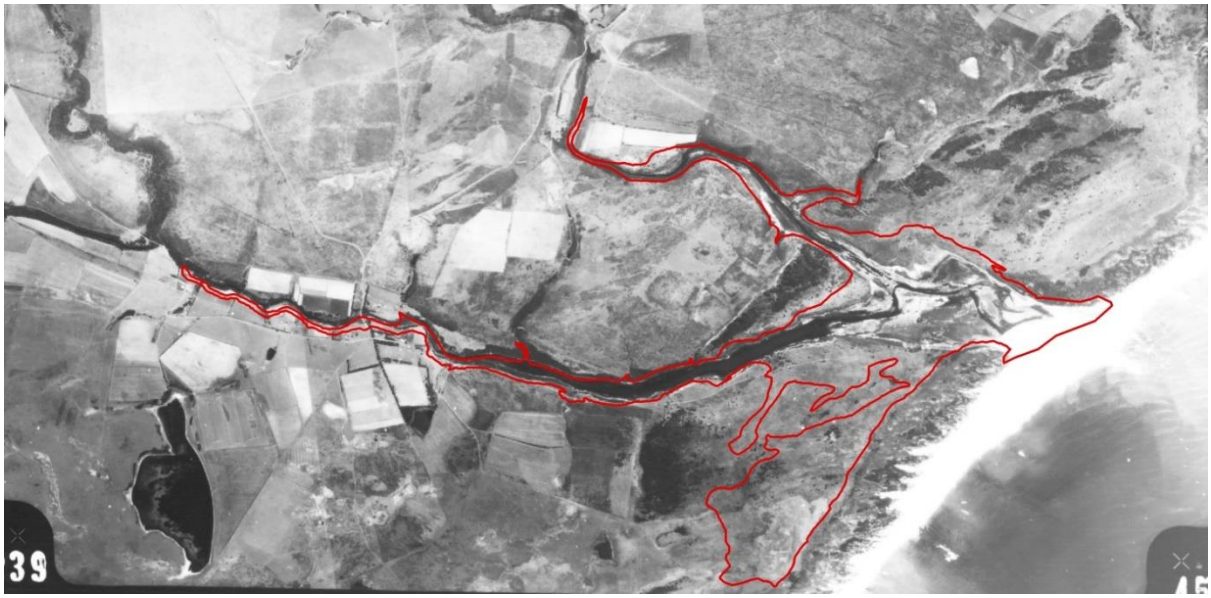

Figure 2 **Aerial survey image of the Seekoei catchment in 1975, the 5 m contour line around the estuary is outlined in red.**

3 Conditions for Artificial Breaching

A summary of motivations that would support an artificial breaching of the Seekoei Estuary Mouth is provided in Table 1.

Table 1 Summary of motivations for artificial breaching of the Seekoei Mouth based on human wellbeing, ecosystem requirements and in emergency circumstances.

Potential Threat		Relevance to the Seekoei	
Human wellbeing and safety	Threat to human life (high water levels)	Human life may be threatened if water overtops the causeway and obscures visionary cues as vehicles cross. This is particularly relevant if surface water is choppy because of wind action. Vehicles are known to have driven into the estuary.	
	Threats to immoveable property and infrastructure (high water levels)	Low lying properties on floodplains surrounding the estuary are threatened by high water levels.	
	Threat to pedestrians crossing the causeway	Pedestrians cross the causeway daily for work e.g. gardeners and household helpers. Learners also cross the causeway daily during the school week to link with the school transport vehicle in Aston Bay. Conversely, learners also return home to Paradise Beach. Note that pedestrians may encounter more threatening circumstances on return to their homes in the afternoon.	
	Human health impact (e.g. flooding of sewage pump station, septic tanks etc.)	An inflow of sewage is possible from the treatment works above the estuary.	
	Loss/impaired access (e.g. roads, footpaths, cattle crossings)	The causeway, the main road linking Paradise Beach and Jeffreys Bay becomes flooded under windy conditions when water levels begin to rise above +0.7 m MSL. At + 0.9 m MSL parts of the causeway are completely flooded. A water level of +0.70 MSL should trigger an artificial breach of the mouth.	
		Impact of artificial breaching	Recreational fishing: enhanced by open mouth conditions; Birdwatching: more estuarine associated species (e.g. waders) present in intertidal areas; Area of water surface reduced for small craft. Canoeing and wind-surfing are examples.
		Impact of NOT breaching	Flooding of the causeway prevents access between Paradise Beach and Aston Bay.
Ecosystem requirements	Impact on avifauna abundance, species richness and community composition	Impact of artificial breaching	Some water birds benefit from closed mouth conditions. Artificial breaching reduces open water surface area, but increases intertidal surface area favoured by waders.
		Impact of NOT breaching	Mouth closures and related high water levels have a negative effect on waders particularly. Higher water levels and the associated reduction in fish density per unit volume also indirectly impacts on cormorants and other piscivorous birds.

			If evaporation exceeds freshwater inflow, hypersaline conditions develop. Species richness declines and may also lead to mass mortality of biota if salinity levels become too high. Food availability for birds reduced and birds move elsewhere.
	Impact on estuarine fish abundance, species richness and community composition	Impact of artificial breaching	Restores estuarine connectivity to the sea and allows young and/or adult fish to return to the marine environment. Relatively few fish species breed in estuaries. Young fish that require an obligatory estuarine phase of development migrate into the estuary. The resultant plume of estuarine water that flows to the sea provides chemical cues that facilitates recruitment success for young fish. Marine fish that visit estuaries to feed or seek shelter increase species richness and general abundance of fish in the system, thereby enriching the food web for piscivorous birds.
Ecosystem requirements	Impact on estuarine invertebrate abundance, species richness and community composition	Impact of artificial beaching	Currently, the estuary supports a large population of the sandprawn, *Callichirus kraussi.* Artificial breaching reduces the habitat available to sandprawns. Density increases per unit area as the subtidal habitat shrinks and over time, mortality will increase and total biomass will decrease.
		Impact of NOT breaching	Closed mouth leads to decrease in species richness. Loss of recruitment of key species such as *Upogebia africana* and *Palaemon perengueyi*. These species require larval development in the marine nearshore. Mortality of some populations accelerated by bait collectors, reducing food availability to other estuarine organisms dependent on these organisms as a food source.
		Occurrence of invertebrate kills	As in the case of fish, invertebrate kills occur if the salinity exceeds threshold levels. Populations as well as species richness crash. Prior to population crashes, breeding patterns change or even cease before mortality occurs.
	Estuarine macrophytes	Impact of artificial breaching	Species of macrophytes that require permanent submergence desiccate and die, together with their associated epiphytes and invertebrates. These macrophytes also provide protective habitat for small fish reducing vulnerability to predators.
		Impact of NOT breaching	Community structures change, favouring species that require continual submergence rather than the balance associated with natural opening and closing events.

	Water quality (relevant to breaching policy only)	Salinity (high or low) that would compromise ecosystem or ecosystem services	Currently there are no limits set related to the breaching policy. Salinity levels above 45 – 50 become lethal to the aquatic biota, although reproductive activity may cease before these levels.
		Dissolved Oxygen levels	< 4 mg L^{-1}
Ecosystem requirements	Water quality	Pollution sources includes agricultural return flow and storm water, sewage outfalls from treatment works.	
	Eutrophication	Excessive reed growth	Currently not relevant
		Macrophyte blooms	Currently not relevant
		Harmful algal blooms	Currently not relevant
	Sedimentation	On-going sedimentation	Breaching at too low water levels reduces the removal of sediments by low current velocities. Should breaching at these low levels persist indefinitely, and too frequently, the longer-term effect is a net accumulation of sediment. This issue is closely linked to the frequency and magnitude of flood events, baseflows and causeway effects. Refer to the Estuary Management Plan.

Type		**Yes/No**	**Motivation**
Emergencies	Major flood events associated with severe flood damage OR Major storm surges from the sea and subsequent over-topping the closed berm that traps large volumes of sea water in the estuary. These events then threaten human safety and property damage as previously described.	Yes	An emergency if estuary water level is already high and a flood is eminent (i.e. cut-off low/1:10 year flood)

	Poor and/or unfavourable water quality	Yes	Low oxygen levels throughout the estuary may be considered an emergency. Levels consistently below 4 mg L^{-1} (approximately 50% saturation level) and/or stress in fish (gulping air at the water/air interface is an example). Must be verified before breaching approved. Note that invertebrates living in the sediments may be the first sign of low oxygen levels. In such cases, prawns and other species may emerge from the sediments and swim/crawl in relatively high numbers. Hypersalinity may lead to high/complete mortality of fish and invertebrates. Hypersalinity will normally occur under drought conditions when evaporation from the estuary exceeds freshwater supply to the closed water body. Note that breeding will cease in populations that breed in estuaries before mortality sets in. A salinity level of 50 must trigger a breaching event.
Emergencies	Repair work to causeway	Yes	Artificial breaching will be considered should repair work be required to the causeway. Any repair work requires full motivation submitted to the Municipal Manager. To be submitted if supported by the Estuary and Wetland Management Committee (also refer to Estuary Management Plan).
	Fish kills	Yes	Refer to hypersalinity events described above.
	Hazardous spill	Yes	Breaching will only be considered if hazardous substance holds no risk to nearshore environment and registered as a disaster.

4 Relevant Authorities

There are several key authorities involved in the artificial breaching of an estuary, whether it is under routine maintenance (repair work to causeway for example) or in an emergency scenario (Table 2).

Table 2 Key lead authority involved in artificial breaching.

Management Authority	Kouga Municipality	
Advisory Committee	Estuary and Wetland Management Committee (proposed)	
Authorisation (breaching / emergency)	DEDEAT	
Lead Authority	**Breaching sub-committee**	**Minimum Consultation in Case of Emergency**
Kouga Municipality (including Disaster Management)	✓	✓
Sarah Baartman District Municipality	✓	×
DEDEAT	✓	✓
DWS	✓	×
DEA	✓	×
DAFF	✓	×
NGOs	✓	×

The final decision to artificially breach will be made by the Municipal Manager after receiving the recommendation to breach from the Estuary and Wetland Advisory Committee. Supportive evidence on water level, berm height, salinity, as well as water quality parameters where feasible, will also be forwarded to the Municipal Manager to guide the final decision. Breaching specifications are summarized in Table 3.

Disaster Management	**Authority/Organisation**	**Status**
Early warning system	South African Weather Services (weather)	Yes
	DWS warning system (flow/water levels)	No
Disaster Management Plan	Municipality	Yes
Approved Maintenance Management Plan	Municipality	Yes

5 Breaching Specifications

The following breaching specifications need to be met before artificial breaching of the Seekoei Estuary can be considered (Table 3). ***Note:*** *There is currently a query regarding the MSL value of +1.4 m MSL (0.836 m + 1.4 m) used to trigger an artificial breach (water level in the estuary used by DEAT when a permit is granted to artificially breach the mouth). It is probable that this MSL level is about 400 – 500 mm too high when significant flooding of the causeway occurs. Until resolved, the current report refers to a water level of +0.70 m MSL (0.836 m + 0.70 m. MSL from the Tide Time Table, post 2003). This is about 400 mm below the roof of the main culvert under the causeway and about 450 mm - 500 mm below the road surface* ***at*** *the causeway. If a value of +1.4 m MSL is used to trigger a breach, then the water level in the lagoon will already overtop the tarred road by about 200 mm* ***at*** *the causeway and approximately 300 -400 mm at lower road surface levels on the causeway crossing.*

The surface of the causeway is not flat and currently, parts of the causeway are lower than the level of the road across the causeway. At such high water levels, the situation can become life-threatening. Considerable damage to vehicles because of the salt water also occurs. Note that the causeway roof is about 100 mm above the top of the concrete buttress (See Figure 3).

Figure 3 Extended buttress linked to the main culvert under the Seekoei Estuary. The top of the buttress is 100 mm below the roof of the culvert. The temporary gauge in the inset to this photograph shows that the water level is 300 mm below the top of the buttress (Photo: Billy Ives).

Table 3 Seekoei Estuary Breaching Specifications

Breaching Considerations	Details
Water level in the estuary (ideally, water level should be as high as possible before breaching).	Water level in the estuary should not exceed +0.70 m MSL at the main culvert. This level represents a value of 300 mm below the top of the buttress and about 500 mm below the level of the road above the culvert. This level of +0.70 m MSL should trigger an artificial mouth breach as it represents the level when water begins to splash across the lowest parts of the road along the causeway under windy conditions (Refer to Plate 11 of the Situation Assessment).
Salinity of the estuary water.	A salinity of 50 or higher on both sides of the causeway must trigger an artificial breach. Note: Salinity may vary between the water body above the causeway compared to the area below the causeway. If either of these sectors has a salinity of <45, no breach will be necessary.
Optimum breaching period (if applicable).	Warmer months between October and April.

Breaching Considerations	Details
Neap-spring breaching considerations.	Mouth opening should happen as the cycle peaks around spring tides.
Timing of breaching.	Although excavation of the channel can begin well before final breach (refer to comment below), final opening of the mouth should happen as the spring tide begins to ebb. This will coincide with late afternoon and maximize outflow.
Consider safety of public during breaching.	A tape/rope cordon should exclude the public from coming too close to the front-end loaders as they excavate across the bar.
Breaching trench to maximise outflow.	Excavate a deep and wide trench 0.75 – 1 metre deep starting at edge of the water on the lagoon side. Time constraints are important and it may be necessary to begin the excavation about two days before final breach (depending on width and height of the berm at the time). The final outflow channel should be short and as close as possible to the high spring tide line. Consequently, extending the edge of the estuary water body closer to the sea before final breach will maximize scouring and water outflow when the final plug of sand is removed. Professional advice of an engineer or surveyor is highly recommended as their advice will optimize the outcome.
Location of the breaching position.	At the lowest level of the berm and in the direction towards the deepest part of the estuary. If there is little difference in berm height across the bar, the trench should be dug on the eastern side and close to the carpark.
Estimate amount of sediment to be moved during breaching.	Volume of sediment depends on the berm height and berm width. Not able to determine in advance.
Disposal of sediment removed during excavation.	Placed on the eastern side of the trench. Longshore drift as the tide rises should move sediment eastwards if wind direction is from the west.
Water quality considerations related to breaching.	Not currently an issue and therefore not a consideration for breaching of this estuary.
Ecological considerations	Outflow channels should be as deep as possible (not less than about 30 cm) to enable fish trapped in the estuary to return to the marine environment, particularly when salinity values in the estuary are close to lethal levels (45 – 50).

6 Operational Procedures

The Kouga Municipality is responsible for the operational aspects of the Seekoei Estuary MMP. They can delegate this function, but the establishment of a local Estuary and Wetland Management

Committee (EWC) to advise government (at all levels) on planning and management issues pertaining to the Seekoei Estuary, adjacent Wetlands and their respective catchments is considered essential. The forum should serve in an advisory capacity on issues threatening the health of the catchment, estuary and wetlands. This committee must be representative of all stakeholder groups including local, regional and national government Institutions. A qualified estuarine specialist should also be represented on the committee. The EWC will act in an advisory capacity, reporting directly to the Municipal Manager of the Kouga Municipality. Reporting will follow conventional procedures with formal minutes submitted to the Municipality. *Inter alia*, the following are suggested as key functions of the EWC

- To receive, review and interpret information gathered from the monitoring programme.
- To review and report on the health status of the estuary, mouth, wetlands and catchments on an ongoing basis.
- Monitor biotic responses to elevated water levels (e.g. fish aggregating at mouth, formation of algal blooms, die-back of macrophytes, bird nesting behaviour).
- Monitor traffic and pedestrian use of the causeway with the view of contributing to final discussion (at the end of 2023) on the future of the causeway. Monitoring programmes to be partnered with Neighbourhood Watch groups.
- Advise on use of causeway by heavy transport vehicles (Delivery trucks) with the view of closing the causeway to such vehicles due to safety issues and damage to the road crossing.
- Advise on safety issues and possible improvements to the causeway with the view of reducing potential accidents.
- Develop threshold points that signify a specific level of alert (e.g. increasing estuary water levels may threaten the well-being of residents using the causeway. At a specific level, the causeway may be closed to traffic. Increasing salinity in the estuary may threaten the health of the biota is another example).
- Provide early warning to residents of an approaching threat to human well-being - impending floods and heavy rains, storm seas etc.
- The highest level of alert must be immediately conveyed to the relevant authority for the implementation of appropriate action.
- Foster a working relationship with local schools and research groups to provide opportunities for education and research.
- Review grievance issues centered on the estuary and causeway. The grievance procedure is detailed in the Estuary Management Plan, Section 8.1 to 8.8.

6.1 Planned mouth breaching procedures

Two types of breaching are distinguished for the Seekoei Estuary, namely (a) Planned artificial breaching undertaken according to the Mouth Management Plan (MMP) and (b) Emergency breaching (e.g. to avoid danger of flooding). Each type is briefly discussed below.

Once the breaching criteria are met (refer to Table 3), the final decision to artificially breach will be made by the Municipal Manager after considering the recommendations of the Estuary and Wetland Management Committee. It should be recognized that an estuary mouth is highly dynamic and unforeseen events (increase in wave height in the nearshore, stronger winds generating stronger swash surges up the beach etc) may require special management actions. In such an event, additional

verbal (followed by written) authorisation may be required from the authorising authority (i.e. DEDEAT). A flow chart for a planned mouth breaching procedure is shown in Figure 4.

Once the EWC has established that the relevant criteria have been met (Table 3) and that an artificial breach must occur, advice together with appropriate documentation is forwarded to the Municipal Manager of the Kouga Municipality. The Kouga Municipality is responsible for the following:

- Ensuring the availability of earth moving equipment on day of breaching.
- Establishing the exact location of the breaching channel.
- Verifying that the sand berm at the mouth is high enough above the water line that there is no risk of "fluidization" of berm sediment (i.e. turns to quicksand) and associated risk to operator and equipment.
- Deployment of flags and signage to warm public of risk to safety.
- Breaching of the estuary mouth.

Finally, the Kouga Municipality is responsible for the compilation of a Breaching Incident Report to be provided to DEDEAT within 14 days of the actual breaching.

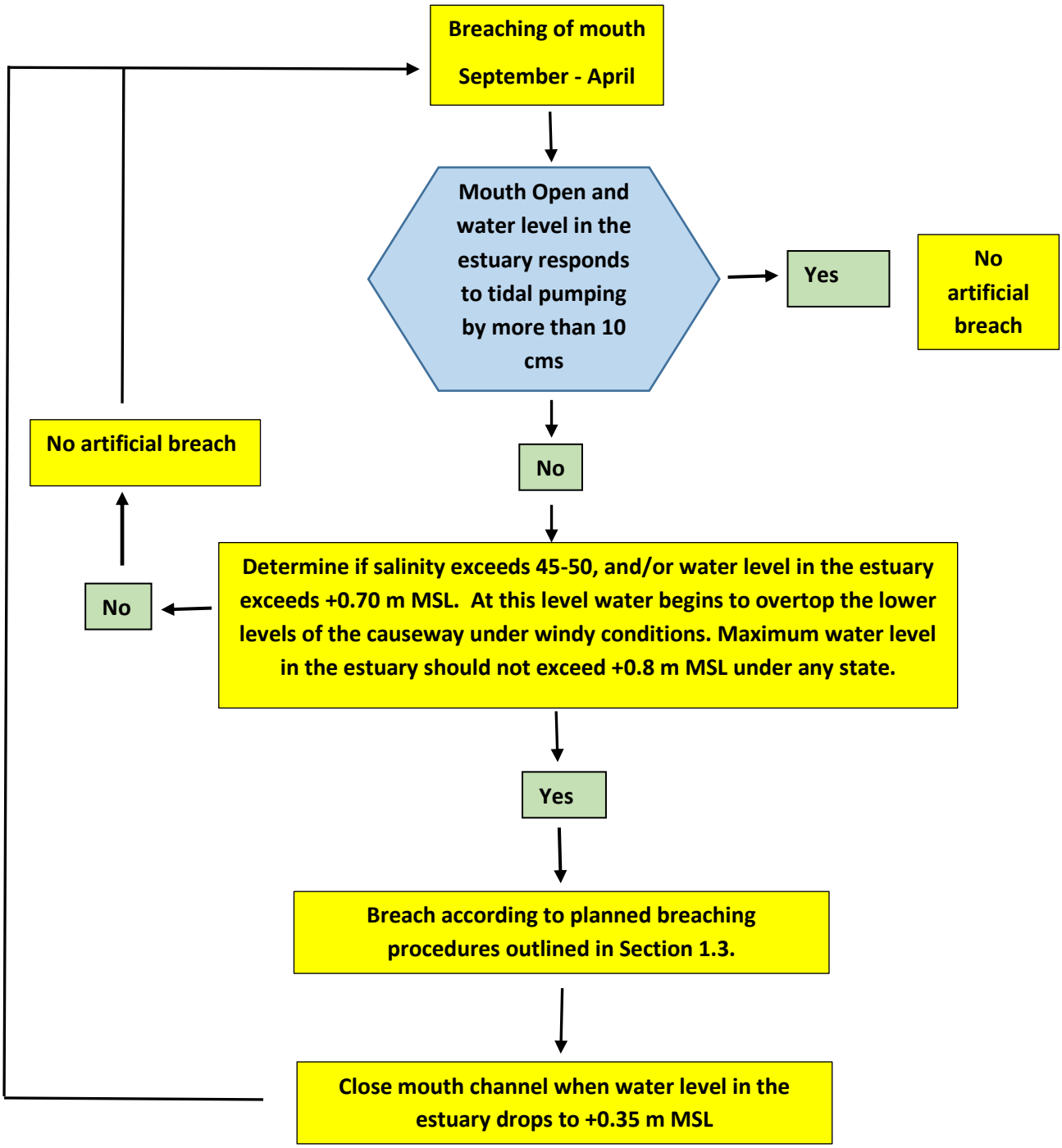

Figure 4: A flow chart illustrating the breaching plan for normal situations in the Seekoei Estuary.

6.2 Emergency Breachings

A flow chart for the undertaking of mouth breaching under emergency conditions is included in Figure 5. Breaching should be undertaken in the swiftest manner possible and in most cases the Disaster Risk Department of the local municipality is responsible. While breaching should be conducted according to an Estuary Mouth Management Plan Mouth and an approved Mouth Maintenance Plan

(Section 6.3 below and Figure 1), some of the general breaching principals may be waivered under emergency conditions to ensure an expedient breaching.

Emergency conditions could develop when an estuary mouth is closed/constricted and severe rainfall is predicted and this situation could lead to a serious flood that is potentially threatening to human well-being. The EWC will be responsible for monitoring any potential threats and these are outlined under Section 6. Tasks include the risk level as outlined (red for high alert). A well-designed display board on either side of the causeway should be one of the communication channels, in addition to the communication network channels available to Neighbourhood Watch Groups Constant monitoring of the conditions in the catchment is required when emergency conditions develop. Communication between the different role players, i.e. the local municipality and other key authorities) involved. Included in the monitoring are:

- The actual and expected rainfall in the catchment.
- The water level in the estuary and its rate of increase.
- The height and width (upshore) of the sand berm at the mouth.
- The actual and predicted wave conditions.
- The availability of equipment to breach the mouth on short notice.

6.3 Maintenance Management Plan

A Maintenance Management Plan is a legal requirement needed to regulate frequent artificial breaching if identified in the Mouth Management Plan. The proposed approval process for a Maintenance Management Plan is summarised as follows:

1. An applicant submits a request to apply for a Maintenance Management Plan for the specified listed activity to the DEDEAT.

2. The DEDEAT then responds via a letter to the applicant (within 10 days of receipt of request). This response letter indicates the required information and Public Participation Process to follow.

3. The Maintenance Management Plan is drafted and the Mouth Management Plan is conducted by the applicant.

4. The finalised Maintenance Management Plan and Public Participation Process information is then submitted to the Department.

5. The Department adopts the Maintenance Management Plan within 30 days (of receipt of the Mouth Management Plan) or requests further information.

The Public Participation Process requires that the relevant Organs of State and Municipalities are provided with a 30-day commenting period. In terms of procedure, the Maintenance Management Plan should also be circulated to the relevant EIA Component in the Directorates for commenting during the 30-day period, as well as any other applicable Directorates within this Department, such as the Coastal Impact Management or Pollution and Chemicals Management Directorates. The EIA

Component will use this opportunity to highlight any issues, omitted information or requirements that may not have been met. Upon completion of the Public Participation Process and following any required amendments/revisions (if applicable), the Maintenance Management Plan can be submitted to the relevant EIA Component for approval. Should additional amendments or outstanding information be required, this will be requested. However, ordinarily, on the assumption that all information is presented and the document adequately addresses the proposed maintenance aspects, approval of the Mouth Management Plan occurs within 30 days. Within five years the Maintenance Management Plan should be subject to specialist review and re-submitted for approval by the competent authority prior to the Maintenance Management Plan lapsing.

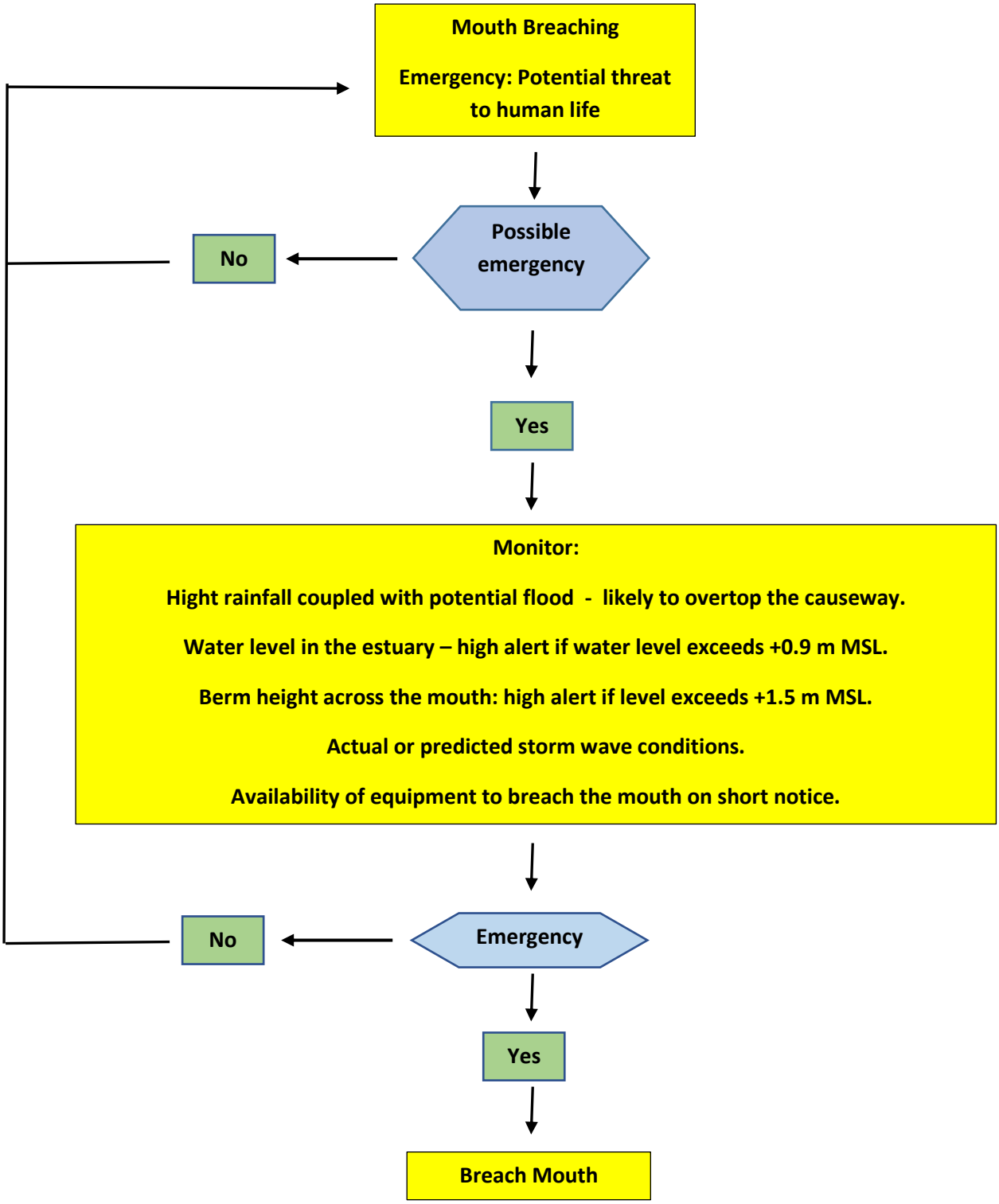

Figure 5: A flow chart illustrating the breaching plan for emergency conditions

7 Monitoring Programme

An estuarine monitoring programme is an essential tool in the Mouth Management Plan (summarized in Table 4). Monitoring is also essential in the Estuary Management Plan, but both Plans can be monitored together. In the case of the mouth:

- Berm height across the mouth sandbar should continue. Ten sites across the bar are monitored and submitted to the Technical Manager, Kouga Municipality. Information from these surveys provides useful information on the temporal behaviour of the berm, including the location of the lowest point. A water level recorder should be re-installed by DWA at the causeway. This recorder will provide the necessary information guiding the broad timing of an artificial event.

- Salinity readings must be taken monthly, immediately above and below the present causeway. The location along the causeway should approximate midway along the 450 m length.

- Freshwater inflow observations to the estuary must be done at least twice a month, noting approximate dimensions of the core of water flowing along the channel at the Seekoei causeway (Lombardini). A storage reservoir is present at the top end of the Seekoei arm (below the Lombardini causeway) and this reservoir must be checked for any freshwater overflow of the concrete spillway into the estuary. Water depth across the spillway must be measured, as this will provide a good estimate of freshwater supply to the estuary. A broad assessment of freshwater inflow through the Swart tributary must also be undertaken and recorded on the same day.

All readings in the monitoring programme should be submitted to the Chairman of the Estuary and Wetland Management Committee (EWC). The EWC will analyse and discuss the results and together with the appropriate documents, submit recommendations and/or comments to the Municipal Manager of the Kouga Municipality.

Table 4 Monitoring programme for Seekoei Estuary

MONITORING ACTIONS	FREQUENCY	LOCAL REQUIREMENT - YES/NO	AGENCY RESPONSIBLE
Weather forecast (rainfall, waves and wind)	Period leading up to breaching	Yes	SA Weather Services
Measured rainfall	Period leading up to breaching	Yes	DEDEAT
Estuary Water levels	Continuous	Yes	To be determined
River inflow data	Twice a month	Yes	DEDEAT
Photographs	To be arranged between authorities before, during and after breaching	Yes	Municipality/DEDEAT

Bathymetric surveys	Every 3 years	Yes	Kouga Municipality/DEDEAT
Salinity	Quarterly (and just before and after breaching breaching) .	Yes	Kouga Municipality
In situ water quality measurements (e.g. oxygen)	Quarterly	Yes	Kouga Municipality
Berm levels	Quarterly (and just before breaching)	Yes	Kouga Municipality
Observations on estuarine vegetation (e.g. inundation of salt marsh, reeds & sedges, occurrence of algal blooms)	Quarterly (and just before breaching)	Yes	Kouga Municipality
Observations on Invertebrate behavior for signs of stress (e.g. invertebrate kills)	Quarterly (and just before breaching)	Yes	Kouga Municipality/DEDEAT
Fish surveys Observations on fish behavior for signs of stress (e.g. spawning aggregations, fish kills)	Bi-annually	Yes	DAFF
Co-ordinated Water Bird Counts (CWAC)	Bi-annually	Yes	By arrangement with local birders through the Chairperson of the St Francis Bird Club.

8 Reporting

All breaching reports are to be submitted to the Estuary and Wetland Committee (EWC) in the first instance. After formal discussion, reports and comments/recommendations by the EWC to be submitted to the Municipal Manager at the Kouga Municipality.

Following an estuary mouth opening a Breaching Incidence Report needs to be compiled and provided to DEDEAT within 2 weeks of breaching. This report should contain as much information as possible on the breaching motivation and the process followed during the breaching.

In addition to the Breaching Incidence Report, the Municipal Authority needs to compile an Annual Mouth Breaching Report that summarises information on all mouth manipulation activities, ecological responses and consequences to human well-being and safety. The Annual Breaching Report needs to be presented to all Interested and Affected Parties (I&AP) (relevant authorities and civil society) to communicate progress with the implementation of the MMP. Such feedback sessions provide the opportunity for a critical review of current breaching practises and discussions on possible improvements to future MMPs. The Annual Mouth Breaching Report will also serve as a national reporting document.

8.1 Breaching Report

Table 5 below summarises the minimum content of a Seekoei Estuary Breaching Report. The initial report should be compiled within two weeks of breaching, with data gaps (e.g. duration open) addressed after mouth closure.

Table 5: Content of Seekoei Estuary breaching report

ACTIONS	LOCAL REQUIREMENT - YES/NO	AGENCY RESPONSIBLE
Met-ocean information • State of the tide (spring-neap/ high-low tide) • Sea conditions (waves calm/stormy).	Yes	Kouga Municipality
Estuary Information • Water level before breaching. • Maximum outflow rate during breaching calculated from water levels and surface area of system. • Outflow duration (from water level graph). • Lowest water level achieved after breaching (from water level graph). • Did flooding problems arise before or during the breaching? If so, quantify these problems. • Could measures be taken to prevent such problems in the future? For example, by protection of low lying properties. Distinguish between short-term and long-term measures. • Could further problems arise by approval of new developments at too low levels? • Were there problems with septic tanks before the breaching? If so quantify. • Date since last breaching. • Photographs.	Yes	Kouga Municipality
Location of channel • Align with historical position of channels. • Reduce channel length.	Yes	Kouga Municipality
Period the mouth stayed open.	Yes	Kouga Municipality
Do bathymetric surveys results show ongoing sedimentation?	No	
Salinity measurement before and after breaching.	Yes	Kouga Municipality
Macrophyte conditions.	No	
Fish recruitment survey Bi-Annually on five-year rotation	No	DAFF
Avifuana counts (CWAC)	Yes	DEDEAT (Seekoei)
Other		
<u>Assessment record compiled by:</u> Name: Organization:		

ACTIONS	LOCAL REQUIREMENT - YES/NO	AGENCY RESPONSIBLE
Date: Contact details:		

8.2 Feedback on breaching activities

Table 6 below summarises the minimum information required as evidence of breaching feedback reporting. Such report back sessions should be held at least once a year to ensure that the correct breaching procedures are being followed and that additional interventions are not required.

Table 6: Minimum information required on breaching feedback sessions

ACTIONS	LOCAL REQUIREMENT - YES/NO
Responsible agency /authority	Kouga Municipality
Place & Workshop venue	
Date	
Meeting/committee/workshop participants (attached attendance register)	
Workshop chaired by	
Key lessons learned that could assist with future breaching	
Material presented at meeting (including copies of presentations)	

9 References

CSIR. 2017. Artificial Breaching Protocol for the Western Cape Estuaries. CSIR, Stellenbosch.

DWAF. 2006. Kromme/Seekoei Catchments Reserve Determination Study - Technical Component. Report No. RDM/K90/04/CON/0705, Department of Water Affairs, Pretoria.

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Whitfield, A. K., and M. N. Bruton. 1989. Some biological implications of reduced fresh water inflow into eastern Cape estuaries: a preliminary assessment. *South African Journal of Science* **85**:691-695.

Wooldridge, T. H., J. B. Adams, D. M. Schael, and T. Ridden. 2017. Draft Situation Assessment Report: Seekoei Estuary. Institute for Coastal and Marine Research, Port Elizabeth.