



MAINTENANCE MANAGEMENT PLAN FOR THE ONRUS ESTUARY, HERMANUS



December 2024



Cover photo: Barry Clark

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Report prepared for:



Overstrand Local Municipality

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EXECUTIVE SUMMARY

Background

The Onrus Estuary is a small temporarily closed estuary located within the cool temperate biogeographic region of South Africa. The Onrus River catchment (G40H) covers an area of only 59 km² and lies within the Overstrand Local Municipality (part of the Overberg District Municipality) in the Western Cape Province. It forms part of the Breede-Gouritz Water Management Area. The Onrus River and Estuary is prone to flooding, with the “Heritage Day” flood event in September 2023 resulting in destructive erosion of an upstream peat wetland. This flooding led to the deposition of a considerable volume of sediment in the lower river and estuary, with the estuarine bed level being raised by over 3 meters in places. In its current state, the Onrus Estuary has no flood attenuation potential, and any subsequent flood/ heavy rainfall events are likely to put the lives of the residents of Onru villages, as well as their properties, at risk.

In addition to flooding risks, the revised Ecological Health Assessment for the Onrus Estuary, completed by Anchor Environmental Consultants in November 2024, found that there has been a substantial collapse in the ecological condition in the estuary due to the sedimentation. The healthy status of the system has been downgraded from a Present Ecological Status (PES) of “D” (Heavily Modified) in 2018, to “E” (Severely Modified) in 2024. Concerningly, this includes a collapse in the estuarine fish and invertebrate community, rating of which have both been lowered to an “F” (Critically Modified) category, with a near-complete absence of either in the estuary. The collapse in fish and invertebrate communities has likely driven the associated decline in the estuarine waterbird community, which dropped from a “C” (Moderately Modified) to D (Heavily Modified). However, the greatest decline between the 2018 and 2024 surveys is in estuarine hydrodynamics, which dropped from a rating of “B” (Near-Natural) to “F” (Critically Modified).

At present, the estuary is broadly characterised by wide, vegetation-less sand- and mudflats, with water predominantly flowing through small deltaic rivulets, without any established deepwater basin. These mudflats provide the ideal conditions for nuisance propagation of the common reed *Phragmites australis*. These reeds have been a recurring issue historically, as they outcompete other estuarine species and trap sediment, hence increasing sediment accumulation rates. Whilst performing some beneficial ecological functions, nuisance propagation of *Phragmites* will result in further deterioration of estuary health.

The Onrus Estuary, River, and surrounding terrestrial environment, are also heavily impacted by alien invasive plants. Recent satellite imagery suggests that the estuarine functional zone is almost completely covered with alien invasive plants, mostly trees—with these species outcompeting indigenous vegetation, and increasing rates of soil erosion.

All told, the current condition of the lower Onrus River, and Onrus Estuary is considered to be unacceptable for ecological functioning, flood risk, human health, etc. and require rapid remediation and restoration actions.

Purpose of this Maintenance Management Plan

To address these issues, a Maintenance Management Plan (MMP, this Report) has been drafted to facilitate the management of sedimentation accumulation in the lower Onrus River and Estuary. To address the former, a comprehensive dredging, dewatering, and sediment reuse plan has been drafted—which will enable sediment to be strategically removed from the estuary in a manner which

maximises ecological and anthropogenic benefits, whilst minimising unnecessary environmental impacts.

Legislative Context

The National Environmental Management Act (NEMA, Act 107 of 1998)

This MMP falls predominantly under the ambit of the National Environmental Management Act (NEMA, Act 107 of 1998), with its subordinate legislation, namely the EIA Regulations (GN R982 of 2014) and its associated Listing Notices handling the issue of MMPs. In particular, MMPs allow for the conducting of maintenance activities that would otherwise trigger listed activities under Listing Notice 1 (LNI, GN R983 of 2014), Listing Notice 2 (LN2, GN R984 of 2014) and Listing Notice 3 (LN3, GN R985 of 2014).

This MMP is specifically designed to allow for the conducting of maintenance which would otherwise trigger Activities 19 and 19A of LNI, Activity 24 of LN 2, and Activity 12 of LN3—which are described briefly as follows:

LNI Activity 19: “The infilling or depositing of any material of more than 10 cubic metres into, or **the dredging, excavation, removal or moving** of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a **watercourse**; **but excluding** where such infilling, depositing, dredging, excavation, removal or moving - **(b) is for maintenance purposes undertaken in accordance with a maintenance management plan**”

LNI Activity 19A: “The infilling or depositing of any material of more than 5 cubic metres into, or **the dredging, excavation, removal or moving** of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from –(i) the seashore; (ii) the littoral active zone, **an estuary** or a distance of 100 metres inland of the high - water mark of the sea or an estuary, whichever distance is the greater; or (iii) the sea; - **but excluding** where such infilling, depositing, dredging, excavation, removal or moving - **(g) is for maintenance purposes undertaken in accordance with a maintenance management plan**”.

LN2 Activity 24: “**The extraction or removal of peat or peat soils**, including the disturbance of vegetation or soils in anticipation of the extraction or removal of peat or peat soils, **but excluding where such extraction or removal is for the rehabilitation of wetlands in accordance with a maintenance management plan.**”

LN3 Activity 12: “The clearance of an area of 300 square metres or more of indigenous vegetation **except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan**”

- **Western Cape** (i) Areas on the estuary side of the development setback line or in an estuarine functional zone where no such setback line has been determined; (ii) In a Protected area identified in terms of NEMPAA; or (iii) In an aquatic critical biodiversity area.”

Water use considerations

Given that a portion of the proposed maintenance area lies upstream of the Onrus Estuarine Functional Zone (EFZ), therefore classified as a “watercourse” under South African Legislation, certain maintenance activities listed in this MMP also require approval under the National Water Act (NWA, Act 36 of 1998). The Competent Authority (CA) in this respect is the local Catchment Management

Agency (CMA) responsible for managing the watercourse/ catchment in question, being the Breede-Olifants Catchment Management Area (BOCMA).

Appendix C of the Section 21(c) and (i) of the General Authorisation (GA) Regulations (GN 509 of 2016) under the NWA makes allowance for emergency incidents and situations under the “Emergency protocol”. An “Emergency Incident” is defined as “an unexpected sudden occurrence leading to a potential or serious danger to the public”, whilst an “Emergency Situation” is “any emergency that developed that require immediate intervention for continuation of existing essential service delivery”. The regulations can allow for rapid commencement of maintenance activities prior to the submission of all required supporting documentation and stakeholder engagement processes associated with a GA application provided that permission is granted by the CA.

Given the urgent need to conduct dredging activities in the Onrus Estuary and the considerable timeframes (~1 year) required to complete the proposed dredging operations, BOCMA has agreed that processing of a WUL for this MMP can be undertaken under the auspices of the Emergency Protocol. Thus, the structure and monitoring/ reporting requirements of this MMP have been drafted to comply with those stipulated within the protocol, to both demonstrate the commitment to compliance with the NWA, and to streamline the process of meeting any additional requirements that BOCMA or DWS may request within the three-month submission deadline.

Dredging and dewatering plan

Proposed dredging area and depths

The primary aim of the proposed dredging and dewatering plan is to restore and maintain a deep estuarine channel and deepwater basin, which can act to improve the flood mitigation potential of the estuary whilst also enhancing tidal flushing. This is predicted to dramatically improve the total suitable habitat for estuarine invertebrate, fish, bird, and amphibian species. The creation of a deepwater basin and tidal channel will also have numerous anthropogenic benefits, with saline conditions being hostile to faecal bacteria and other pathogens (hence reducing health risks for recreational users), and the additional water depth providing suitable conditions for recreational activities such as swimming, canoeing, etc.

Dredging effort will focus largely on the middle-to-lower reaches of the estuary, with the total depth of sediment removed, decreasing with distance upstream. Dredging depths have been determined based off historical bathymetry data. This, in conjunction with analysis of the ecological conditions present at the time of each survey, have allowed for the determination of an ideal condition. Furthermore, elevation data from surveys in 2023 and 2024 were utilised to determine the current sediment bed level for the entire estuary and produce average depth ranges for different estuarine sections.

It is proposed that the outflow channel and a large central basin be dredged to a depth of 1 metre below mean sea level (MSL). These areas will then be contoured towards the banks to create a natural profile. Contextually, dredging to 1 m below MSL in these areas amounts to the vertical removal of around 3 m of sediment in the outflow channel and 3.5 m in the central estuarine basin.

The depth of sediment to be dredged decreases in an upstream direction, with an average of around 1 m of sediment needing to be removed from the upper estuarine channel between the Old Bridge (now washed away) and the R43 Service Road Bridge.

Available dredging equipment for bulk dredging and dewatering

Dredging is proposed to utilise the following pieces of equipment

- 1 x Amphibious 20 tonne Excavator
- 1 x Remote Controlled dredger
- 1 x 350 kVA Diesel generator
- 1 x 23 tonne Excavator
- 1 x 23 tonne Excavator
- 2 x 10 m³ Tipper Truck
- 1 x Tractor Loader Backhoe (TLB)
- 1 x D6 Bulldozer
- 4 x Motor Vehicles (cars)
- 2 x Articulated Dump Trucks
- 1 x 10–20 tonne Roller

Bulk dredging methodology

Dredging is to be conducted primarily using a portable remote-controlled suction dredger, with a cutter head, which will allow for sediment to be dislodged and pumped as a semi-liquid slurry into a 200 mm diameter, 100 m long, flexible pipeline, which will then connect to a stationary 1-1.5 km long 200 mm High Density Polyethylene (HDPE) pipeline. This pipeline will be used to transport sediment to the proposed dewatering site. To improve the efficiency of the dredging activity, a variety of excavators (listed above) will be used to loosen material from the area surrounding the dredger and place it within range of the pumping apparatus. This will act to both increase the rate at which sediment can be pumped from the system and reduce the frequency with which the dredger needs to be moved (during which it will not be operational). Furthermore, by pumping the material to the dredge site rather than delivering it via excavator/ truck, it will dramatically reduce the amount of bank disturbance and emissions generated during the process. This will additionally confine dredge disturbances to the area being dredged at a given time.

The above methodology will likely be suitable for the dredge works within the estuarine area, where much greater depths and volumes of sediment are proposed to be dredged and the required water depths for the dredger to operate are available. However, in the upper estuary, where only ~1 m of sediment is proposed to be removed, access by the dredger is likely not possible. Under such circumstances, it will likely be most appropriate for a tracked excavator to be utilised to remove the material, with support from a tracked bulldozer and other equipment.

Peat extraction methodology

An additional consideration for the bulk dredging operation is the proposed re-use of the peat soils for wetland restoration in the upstream Onrus Palmiet Peat Wetlands. Dredge material will therefore need to be separated into the broad categories of “sediment” or “peat”. Differentiating these two constituents is likely to be an approximate process, with visual inspections being conducted by the dredging/ environmental team to decide which category a particular deposit should fall into.

Management of these two deposit types needs to be handled in very different ways, with the reuse of peat being substantial constrained by the fact that peat soils break down rapidly when exposed to air and must remain moist to retain their structural integrity and value for wetland restoration. Furthermore, the peat will be destroyed if it's pumped to the dewatering site, thus rendering the latter

methodology inappropriate. As such, areas chosen for peat collection will be selected and excluded from the suction dredging process.

The physical process of harvesting the peat will need to take place mechanically, by use of excavators, bulldozers, TLBs, etc. Scoops of peat will need to be moved/ pushed to the banks where heavy vehicle access is possible. The peat will then need to be loaded into tipper trucks/ articulated dump trucks and transported to a sediment reuse site or to a storage area where it can be kept moist.

Given the complexities of keeping peat in a useable form, and the possible misalignment of the approvals process for the upstream wetland restoration project in the Onrus Wetland, it is proposed that peat-rich areas of the estuary be dredged during the latter portions of the operation, with the initial priority being to remove silt and sand deposits using the pumping methodology detailed above.

Proposed dredging order

From an ecological, flood-risk, and recreational perspective, the priority area for initial dredging should be the central estuarine basin, which will yield the greatest returns in the shortest period of time. From there, dredging efforts should be directed upstream up to the end of the Onrus EFZ and the Old Bridge. Note: It is important that the outflow channel of the estuary is not dredged prior to the dredging of the areas up to the upper area of the Onrus EFZ, as the current mass of sediment near the mouth is acting to prevent any saltwater intrusion into the estuary. The retention of this plug will therefore protect the dewatering area and any other upstream areas from being adversely impacted by high salt content. Once the remaining estuarine area is dredged, the deepwater mouth channel should be dredged in an upstream-downstream direction.

The final dredging area—deliberately left till last as it is the least pressing, and likely cannot utilise the same equipment/ workflow as the rest of the estuary due to lack of water depth—is the upper channel (from the old bridge to the R43 service bridge).

Dewatering plan

Dewatering, as the name implies, refers to the process of allowing a mass of sediment to dry out after being dredged, which typically occurs prior to removal to an approved disposal/ reuse site. Dewatering is necessary for several reasons. Firstly, estuarine and riverine sediment deposits are typically heavily saturated with water (depending on their composition), which increases both the total sediment volume and its total mass. Additionally, recently dredged sediment—particularly that which has been extracted in the form of a slurry—is largely un-constituted and is therefore unsuitable for transport on standard trucks or lorries. Furthermore, the NWA also stresses the importance of timeously returning water (the supernatant or leach water) back to the water resource from where it was sourced (the estuary). This is additionally important due to the relatively large volumes of water required for the continual pumping operation.

Dewatering the proposed sediment volumes is anticipated to require between 4–6 ha of open land. The proposed dewatering site is situated in the western portion of ERF 2834, located just to the east of the neighbouring Habonim Property (Figure 5.7). The proposed area (and the remainder of Erf 2834) is slated for a large-scale mixed-use development, known as De Zandt. To this end, Environmental Authorisation (EA) has been granted for development to occur on this property—which includes the removal of vegetation, flattening of land, etc (EIA Reference: 16/3/3/5/E2/35/1040/18). This EA was initially granted on the 29th of September 2010 and was later amended on the 7th of March 2019. To date, the only portion of the development to have commenced is the Curro Hermanus High School. As of November 2024, the Overstrand Local Municipality (OLM) and the developer are still finalising the ownership transfer of the remainder of ERF 2834. The

proposed dewatering area falls within the land slated for ownership transfer. De Zandt has been approached with the proposal to utilise a portion of ERF 2834 for the purposes of dewatering, with the developer having expressed interest in allowing dewatering to occur. Furthermore, they have also expressed interest in utilising some of the dewatered sand for various components of their development.

Post Dredging Rehabilitation

Should dredging and dewatering, disturb the riparian area/ dewatering site, it will be necessary to re-establish suitable indigenous vegetation within the cleared areas as this will minimize risks of soil erosion. Also, any open areas that have been disturbed and are devoid of vegetation will create the ideal conditions for alien re-colonisation, as aliens typically aggressively outcompete local indigenous species.

It is proposed that revegetation activities commence immediately following maintenance activities. Since alien seedbanks have no doubt established in these areas, revegetation activities should likely prioritise the planting of established seedlings, rather than seeding these areas. To this end, an operation to grow seedlings must be initiated at a local greenhouse service provider. Planting of the seedlings should ideally be conducted by trained teams. Furthermore, such planting activities will provide an additional opportunity to screen and remove alien seedlings from the revegetated areas.

Impact assessment

Identified potential impacts of the proposed maintenance activities on the Onrus Estuary were assessed as part of this study. Impacts have been separated into the negative and positive impacts (benefits) expected to be associated with the maintenance activities. Mitigation and/ or enhancement measures have also been provided to minimise the significance of negative benefits and maximise the significance of the assessed benefits.

A total of seven potential negative impacts were identified as being associated with the proposed maintenance activities, along with five positive impacts (benefits). An assessment of the No-Go Alternative—impacts associated with not conducting the proposed maintenance—as well as an assessment of the Cumulative Impacts (the combined impacts associated with conducting this, and similar works, within the broader Onrus Area), was also conducted.

The assessment found that all negative impacts could be easily mitigated through the implementation of suitable mitigation measures coupled with rigorous scientific monitoring and assessments prior to commencement of future maintenance activities. With the implementation of these measures, the assessed impact significance was reduced to ‘Very Low’ for all impacts aside from the risk of hazardous substance spills, which was reduced to ‘Insignificant’.

Conversely, the assessment found that all identified benefits were overwhelmingly positive for factors such as ecological health, estuarine function, flood risk, human health and safety, and the recreational viability of the estuary. In fact, all but two benefits were rated as ‘High’ positive significance with the implementation of appropriate mitigation/ enhancement.

The most significant benefit identified from the proposed maintenance activities pertains to the predicted improvements to ecological health and functioning, both within the Onrus System and surrounding areas. This benefit was rated to be of ‘Very High’ positive significance with appropriate mitigation and enhancements. This is principally because the maintenance activities are predicted to facilitate the creation of functional estuarine habitat, which was all but eliminated by flooding and sedimentation in 2023 and 2024. Furthermore, the maintenance activities may create habitat for

species which are of ecological significance at larger scales—including regionally significant estuarine-dependent marine fisheries species, as well as globally threatened wading bird species.

When the proposed maintenance activities were considered within the broader setting of the Onrus Catchment-to-Coast Project and other similar rehabilitation initiatives, the cumulative Impacts of this project were assessed to be of ‘High’ positive significance. The only factor detracting from this rating was the probability of these benefits occurring, which was assessed as ‘possible’, due to the complex requirements for the implementation of all the proposed enhancement measures. Potential complexities include permissions—such as Environmental Authorisations, Water Use Licenses, landowner consent—as well as potential funding and manpower constraints.

Finally, impacts associated with the No-Go Alternative were found to be of ‘Medium’ negative significance. This is predominantly because the estuary has crossed numerous “tipping points”, with its compromised state being predicted to further deteriorate without intervention, as well as increasing flooding/ human health risks with time. Consequently, whilst (by definition) the No-Go Alternative will not introduce any new threats to the estuary, the consequences of this inaction are unquestionably negative.

Summary of potential impacts associated with maintenance activities included within this MMP. Impacts were rated in terms of their consequences (Very high/High/Med/Low/Very low/Insignificant), probability of occurrence (Very low/Low/Medium/Nigh/Very high), status (+ve or -ve) and the level of confidence we had in the assessment (Very low/Low/Med/High/Very high).

	Impact identified	Consequence	Probability	Significance	Status	Confidence
Negative Impacts	Impact 1: Waste generation and disposal from maintenance operations	Medium	Probable	MEDIUM	-ve	High
	With mitigation	Low	Possible	VERY LOW	-ve	High
	Impact 2: Hazardous substance spills during maintenance operations	Low	Probable	LOW	-ve	High
	With mitigation	Very Low	Possible	INSIGNIFICANT	-ve	High
	Impact 3: Generation of turbidity plumes	Low	Definite	LOW	-ve	High
	With mitigation	Ver Low	Probable	VERY LOW	-ve	High
	Impact 4: Direct destruction of benthic and riparian habitat	Low	Definite	LOW	-ve	High
	With mitigation	Very Low	Definite	VERY LOW	-ve	High
	Impact 5: Potential terrestrial impacts due to the dewatering of sediment	Medium	Probable	MEDIUM	-ve	High
	With mitigation	Low	Possible	VERY LOW	-ve	High
	Impact 6: Potential dust pollution impacts emanating from dredging and dewatering activities	Medium	Probable	MEDIUM	-ve	High
	With mitigation	Low	Possible	VERY LOW	-ve	High
	Impact 7: Noise impacts during dredging activities	Low	Definite	LOW	-ve	High
	With mitigation	Very Low	Definite	VERY LOW	-ve	High
Potential Benefits	Benefit 1: Improvements to water quality associated with increased estuarine circulation and hydrodynamic functioning	High	Probable	HIGH	+ve	High

Impact identified	Consequence	Probability	Significance	Status	Confidence
With mitigation					
Benefit 2: Improvements to flood mitigation associated with maintenance dredging of the Onrus Estuary With mitigation	High	Definite	HIGH	+ve	High
Benefit 3: Ecological Health Improvements associated with increased open water habitat, improved hydrodynamic functioning, and more saline conditions With mitigation	Very High	Probable	VERY HIGH	+ve	High
Benefit 4: Recreational opportunities emanating from the creation of an open estuarine channel and basin With mitigation	High	Probable	HIGH	+ve	High
Cumulative Impacts (Benefits)					
Cumulative impacts (benefits) resulting from similar restorative and management projects in the Onrus Catchment and surrounding areas With appropriate mitigation and implementation	Very High	Possible	HIGH	+ve	Medium
No-Go Alternative					
Assessment of the No-Go alternative Without maintenance activities	Medium	Probable	MEDIUM	-ve	Medium

Essential mitigation measures to Be Applied during Maintenance Activities in the Onrus Estuary and lower Onrus River should include the following:

Impact 1: Waste Generation and disposal and hazardous substance spills during maintenance operations:

- Inform all staff about sensitive estuarine species and the responsible disposal of waste.
- Suitable handling and disposal protocols must be clearly explained, and sign boarded.
- Reduce, reuse, recycle.

Impact 2: Hazardous substance spills during maintenance operations

- Intentional disposal of any substance into the environment must be strictly prohibited, while accidental spillage must be prevented, contained and reported immediately.
- A rigorous environmental management and control plan (including procedures for remediation) must be developed and implemented.
- All fuel and oil must be stored with adequate spill protection.
- No leaking equipment or vehicles are permitted on site.
- All hazardous substances must be accompanied by a permit, a hazard report sheet, and a first aid treatment protocol and may only be handled by suitably trained operators.

- Spill kits must be available on site at all times, and staff must be trained in their proposed use.

Impact 3: Generation of turbidity plumes.

- Dewatered soil piles must be either be secured with geotextile or shade cloth material to prevent wind mobilisation into the estuary.
- Silt curtains should be utilised once a large open water body is established to restrict the extent of turbidity plumes. Furthermore, silt curtains must be used to protect areas planned for exclusion from future maintenance dredging activities, to protect benthic habitat.
- A filtration mechanism must be utilised on the downslope end of the dewatering site to prevent suspended fine (silty) sediments from flowing back into the estuary and causing localised turbidity plumes.

Impact 4: Direct destruction of benthic and riparian habitat.

- Dredging should only be conducted when necessary, and according to prescribed triggers.
- Vehicle movement should be constrained to dredge areas, and areas proposed for dredging, wherever practically possible.
- Estuarine and riverine banks should be left intact if not included in a dredging operation and should be suitably rehabilitated if avoiding disturbance is not possible.
- Repeat maintenance dredging activities must only occur if deemed necessary through detailed bathymetric and ecological surveys, and with agreement from relevant authorities, with areas where minimal sediment deposition has occurred being left intact from dredging and other related disturbances.
- Areas selected to be left intact during maintenance dredging activities must be left undisturbed by dredging equipment and machinery and must be protected from smothering by silt curtains.

Impact 5: Potential terrestrial impacts due to the dewatering of sediment.

Essential mitigation measures applicable to the De Zandt dewatering site

- There is sufficient space available for all dewatering activities to occur at a single site.
- The site is not located on the estuarine bank/ immediate riparian areas, hence maintaining the integrity of any indigenous fringing vegetation, and reducing the likelihood of bank destabilisation.
- The site is located close enough to the estuarine channel, which reduces complexity associated with sediment transport and minimises impacts associated with depositing sediment and water into the terrestrial environment.
- The selected site, and surrounding area, are heavily disturbed by alien species infestation and illegal dumping—as confirmed by a specialist site visit by Anchor in November 2024—and are therefore of little ecological value.
- The site falls within an area slated for a large mixed-use development for which EA has been granted.
- The entirely freshwater nature of the estuary under current conditions, means that there is negligible risk of any saltwater intrusion into the terrestrial environment by dewatering at this site.
- Sediment mounds must be secured with geotextile or shade cloth to prevent wind mobilisation and smothering of surrounding soils and vegetation.

Essential mitigation applicable to future dewatering activities

- If possible, future dewatering activities should occur on a portion of the De Zandt property.
- Dewatering should only occur in areas determined to be alien infested through satellite imagery analysis and ground truthing—intact stands of indigenous vegetation must be declared no-go zones.
- The site should ideally have sufficient space to contain all dewatering activities.
- If possible, the site should not be located on the estuarine bank/ immediate riparian areas, to maintain the integrity of any indigenous fringing vegetation, and reduce the likelihood of bank destabilisation
- The site should be located sufficiently close to the estuary to minimise the complexity associated with transporting sediment over long distances to the dewatering site and minimise associated impacts on the terrestrial environment.
- Sediment mounds must be secured with geotextile or shade cloth to prevent wind mobilisation and smothering of surrounding soils and vegetation.
- Supernatant water (water leached from the dewatering sediment) must be allowed to return to the estuary (the water resource) as rapidly as possible. This will assist in retaining sufficient water for estuarine function and for use in producing new dredge sediment slurry.
- Supernatant water drainage channels into the estuary must be lined with plastic to prevent the formation of erosion channels and introduction of sediment into the estuary.
- Should the dewatering site be located far enough from the estuary that a surface outflow channel is not viable, then the supernatant water must be channelled into a pipeline and returned to the estuary.
- Salinity testing must occur in the estuary prior to the commencement of dredging. Should the estuary have
 - a) very low salinity, then the impact of salt water on the dewatering site will be negligible and the site can have a permeable base.
 - b) a salinity exceeding 10 PPT, then dewatering must either occur in the open areas immediately surrounding the estuarine channel or, should a terrestrial site be selected, then the dewatering area must be lined with plastic sheeting or another impermeable layer, to prevent saline intrusion into the sediment.

Impact 6: Potential dust pollution impacts emanating from dredging and dewatering activities.

- The dewatering area and sediment storage mounds and piles must be covered using either a geotextile or shade cloth material, to prevent wind mobilisation.
- Water trucks may be required to spray the roads during sediment transit or it may be necessary to retain a small amount of surface moisture within dewatered sediment, to prevent wind mobilisation.
- Under conditions where the above methodologies are inappropriate—such as if dewatering occurs in a highly utilised public spaces—the use of geotextile tubes should be considered.

Impact 7: Noise impacts during maintenance activities.

Essential mitigation measures: general

- Effort must be made to reduce unnecessary noise or vibrations as far as possible.

- Implementation of “soft starts” to ensure fauna leave the immediate area prior to the commencement of very loud activities.
- Machinery should be subjected to noise testing throughout the project.
- Inform all staff about sensitive estuarine habitats and species.
- Restrict dredging activities to between the period from hour after dawn to one hour before dusk.
- No dredging activities can occur on public holidays, Sundays and between the hours of 13:00 and 14:00 on Fridays (during Muslim Prayers).
- No dredging can occur during important holidays for the Jewish Faith, due to the proximity of the Habonim Jewish Campsite and Conference Centre.

Essential mitigation measures specific to follow-up maintenance dredging activities

- Dredging activities should not occur during peak nesting season for waterbird species—between September and December.

Implementation, monitoring, and auditing responsibilities

Implementation of the proposed maintenance activities will need to occur in several phases over different time periods, with responsibility for the implementation of these activities varying likewise. To aid with the smooth adoption of this plan, an intensive environmental monitoring and auditing programme has been drafted to ensure that implementation of the MMP occurs to a sufficient standard, and complies with all stipulated environmental requirements.

At a high level, responsibility for implementing the proposed maintenance activities falls to the applicant, the Overstrand Local Municipality (OLM). OLM is therefore responsible for the delegation of responsibilities to other entities and contractors who will, in turn, be responsible for their respective components and/ or subcomponents. **Note:** a high level of detail has been provided with respect to the responsibilities regarding implementation, monitoring, funding, etc. for the initial three-year period following adoption of this MMP. However, it is not possible to assign a similar level of detail for subsequent years, as these have yet to be confirmed. This does not represent a responsibility void, as the ultimate responsibility for complying with the MMP will fall to the OLM as the applicant and prospective right holder.

The following tables include all currently acceptable information regarding responsibility, monitoring requirements, and triggers/ thresholds for future maintenance activities. Whilst it being critical that the core principles of this MMP are upheld during the years of its operation, it is expected that changes to methodologies and monitoring refinements will occur over its lifetime.

Responsibility assigned to various project aspects

Authorities	<p>Principal decision-making Competent Authority (CA):</p> <ul style="list-style-type: none"> • Western Cape Department of Environmental Affairs and Development Planning (DEA&DP), Directorate: Development Management (Region 2). <p>Supplemental decision-making authorities</p> <ul style="list-style-type: none"> • Breede-Olifants Catchment Management Agency (BOCMA)—the responsible Authority (RA) under the National Water Act. • Department of Water Affairs and Sanitation (DWS) • CapeNature: Marine and Coasts Department.
Overall Project Responsibility	<ul style="list-style-type: none"> • Overstrand Local Municipality (OLM): • Holder of the MMP

	<ul style="list-style-type: none"> Responsible for implementation of the MMP, and answerable to the Competent Authority and Responsible Authority.
Initial bulk dredging operation (years 0–1)	<p>Overall responsibility</p> <ul style="list-style-type: none"> Overstrand Local Municipality <p>Dredging and dewatering activities (including equipment procurement and sediment/ peat transportation)</p> <ul style="list-style-type: none"> Overstrand Local Municipality <p>Environmental monitoring, Environmental Control Officer (ECO) auditing, and reporting</p> <ul style="list-style-type: none"> OLM Anchor Environmental Consultants (Pty) Ltd
Maintenance Dredging Operations, Years 1-3	<p>Overall responsibility</p> <ul style="list-style-type: none"> OLM <p>Dredging and dewatering activities (including equipment procurement and sediment/ peat transportation)</p> <ul style="list-style-type: none"> OLM <p>Environmental monitoring, Environmental Control Officer (ECO) auditing, and reporting</p> <ul style="list-style-type: none"> Anchor Environmental Consultants (Pty) Ltd
Maintenance Dredging Operations, Years 4–onwards	<p>Overall responsibility</p> <ul style="list-style-type: none"> OLM <p>Dredging and dewatering activities (including equipment procurement and sediment/ peat transportation)</p> <ul style="list-style-type: none"> OLM to procure service provider. <p>Funding</p> <ul style="list-style-type: none"> OLM to procure funding from relevant sources. <p>Environmental monitoring, Environmental Control Officer (ECO) auditing, and reporting</p> <ul style="list-style-type: none"> OLM to procure ECO/ auditing/ monitoring services for future work.

ECO monitoring, reporting, and auditing requirements related to the 2025 bulk dredging and dewatering operation (Years 0–1).

ECO requirements (Years 0–1)
Site visits
<p>The first ECO site visit should be conducted in the week preceding the commencement of dredging activities, at which time the current state of the estuary must be photographed and documented, and the ECO must be shown all the proposed equipment and talked-through the plan by operators to ensure all is compliant with the MMP.</p> <p>Once dredging commences, site visits from the Anchor ECO and OLM Representative must occur once every two weeks, with the designated Anchor ECO alternating with the OLM representative, resulting in a total of two visits per month. Each site visit should include detailed photographing of the dredging operation and observations as to the compliance with the MMP. Should non-compliances be noted on site, these should be made aware of to the site operators, with guidance given as to how to make the work compliant. Should environmentally damaging activities be observed during these site visits—such as a continued oil leak—dredging operations should be halted until this is remedied. These site visits should occur, as indicated, for the entire duration of the maintenance activities, as well as the month (four weeks) following completion.</p>
Site photographs
<p>Must be taken weekly, starting one week before dredging commences, weekly during dredging operations, and weekly for four weeks following conclusion of dredging operations.</p> <ul style="list-style-type: none"> The Anchor ECO and OLM representative must keep a detailed photographic record during each fortnightly site visit. The dredging operator must additionally take detailed photographs of both the dredging and dewatering on a weekly basis, with it being preferential for this to occur on the same day every week. These photographs must be sent to the Anchor ECO weekly, for inclusion in the ECO reports.

- All site photographs (including those from the Anchor ECO, OLM Representative, and the dredging operator) must be dated and timestamped, and kept for use in ECO and auditing reports. The photographs must also be provided to the Competent Authority (CA) or Responsible Authority (RA) (DEA&DP/ BOCMA) on request.

Water quality testing

As per the requirements of GN4167 of the NWA, it is necessary for water quality (WQ) testing to be conducted weekly throughout the course of the maintenance activities. Under typical circumstances this would also warrant weekly testing for an entire month prior to the commencement of maintenance activities to establish the baseline water quality. However, given that the initial maintenance dredging/ dewatering is proposed to occur under the Emergency Protocol—in conjunction with the need for rapid commencement of dredging operations and the detailed baseline EHS study conducted to inform this MMP—it is considered appropriate that water quality testing only commence from one week prior to the commencement of dredging. This will then need to continue weekly for the entire dredging and dewatering operation, as well as for the entire month following conclusion of the dredging/ dewatering activities, in order to compare the water quality recovery with the baseline data. Specific requirements are as follows:

- Sampling must occur at a total of three sites, with sites located both a short distance upstream and downstream of the dewatering inlet channel, and the third site located in the lower estuary downstream of all maintenance dredging activities.
- Photographs must be taken of each during each sampling event, with images including the sampling point, the immediate environmental context, and the colouration of both the river water and water within the sampling bottles.
- Sampling can be conducted by either the ECO, OLM, or the contractor/ operator, yet should most-likely be conducted by the operator given their continued presence on site. However, ensuring that sampling and analysis occurs to the standard of the MMP will fall under the responsibility of the ECO.
- After collection/ in-field analysis, the samples should be delivered to a suitable laboratory for Total Suspended Solids (TSS) analysis.

Specific WQ parameters to be analysed are as follows:

- pH
- Electrical Conductivity (EC)/ Salinity
- Total Suspended Solids (TSS)
- Turbidity
- Temperature
- Dissolved Oxygen

Besides TSS, all of the above parameters can be analysed in-field using handheld instrumentation, such as a Hach HQ40d, hence the prescribed testing will be both quick, and relatively easy/ inexpensive to conduct. Furthermore, TSS can also be tested using an inexpensive and minimally time-intensive laboratory process.

ECO reports

ECO reports must be prepared monthly by the Anchor ECO, from the commencement of maintenance activities until completion of the activities, and must be submitted to DEA&DP/ BOCMA for comment. The ECO Reports must include:

- A description of the maintenance progress to-date, and how much progress was made during the month window.
- A detailed description of the activities undertaken, with photographic imagery to support the claims.

Should non-compliances be identified during the month, these should be described and documented, with photographic evidence provided to substantiate these claims. Additionally, a description of the process undertaken following the identification of the non-compliance must be provided. It is also necessary to include how this issue was resolved, how the responsible parties were informed of the issues, and what measures were taken to educate individuals. Measures taken to avoid similar issues from occurring in future must also be highlighted. Furthermore, it is considered critical that the process aids in assisting maintenance teams with being compliant with the MMP and protecting the environment, rather than the focus being to accuse/ incriminate.

The final ECO Report for the proposed dredging must be completed in the month following the completion of the activities and must take the form of a “Close-Out” report, in which a summary of the dredging and dewatering activities is provided. This report must include commentary on the efficacy of the maintenance activities and provide recommendations as to how the maintenance activities (and the associated) ECO/ monitoring/ reporting work can be refined for future maintenance activities.

Environmental auditing requirements

As per the requirements of GN 4167 of the NWA and environmental best practice, environmental auditing must be conducted in addition to the ECO site visits and reporting prescribed above. However, since the ECO reporting will largely fulfil the purpose of environmental auditing, it is only considered necessary to complete two audits pertaining to these activities, with each having discrete objectives. Furthermore, it is considered unnecessary for these audits to be conducted externally, with both audits being conducted internally by Anchor’s ECO and Specialist Team.

- **The first audit (Audit 1)** should be completed approximately halfway through the maintenance activities—approximately 6 months following commencement of the maintenance activities. This audit should integrate all available information from the activities to that date, and should consider the progress of the work, environmental concerns and issues identified during the ECO site visits and monthly reports. This audit should assess the efficacy of both the dredging methodology itself, the essential mitigation measures proposed within this MMP, as well as the environmental monitoring and ECO work. This analysis should consider both the retrospective efficacy of the above-mentioned criteria for mitigating again negative environmental impacts, and the effectiveness of the implementation of the plan and mitigation measures. By completing the audit at the midpoint of the maintenance operation, this may allow for refinement for both the second half of the maintenance operations, as well as feeding into future maintenance operations.
- **The second audit (Audit 2)** should be completed within 3–6 months following the completion of the maintenance dredging activities, as per the requirements of this GN4167 of the NWA. Similarly, this should contain a detailed analysis of the efficacy of the maintenance dredging and dewatering activities, and the efficacy of the employed environmental management protocols. This retrospective analysis should be used to better inform any future maintenance dredging processes. Furthermore, unlike Audit 1, a key component of Audit 2 will be an assessment of the stability of the estuary and river system following the completion of maintenance activities. To this end, a site visit should be conducted by the ECO and specialist team to document the systems condition throughout the entire maintenance dredging area, dewatering site, etc. This should include detailed photographic documentation. This site visit/ audit will prove to be a valuable tool for assessing and optimising the efficacy of the maintenance activities going forwards.

ECO monitoring, reporting, and auditing requirements related to future dredging and dewatering activities.

ECO requirements (Year onwards)

Preface

Should the need for repeat dredging and dewatering operation be established according to the stipulated requirements in Section 5.6, then the ECO requirements should proceed in alignment with those prescribed for the 2025 dredging operation. However, for proposed maintenance following the initial 3–year period, the main difference will be the potential replacement of an ECO from Anchor, with one from another consultancy.

Site visits

- The first ECO site visit should be conducted in the week preceding the commencement of dredging activities, at which time the current state of the estuary must be photographed and documented, and the ECO must be shown all the proposed equipment and talked-through the plan by operators to ensure all is compliant with the MMP.
- Once dredging commences, site visits from the ECO and OLM Representative must occur once every two weeks, with the designated ECO alternating with the OLM representative, resulting in a total of two visits per month. Each site visit should include detailed photographing of the dredging operation and observations as to the compliance with the MMP. Should non-compliances be noted on site, these should be made aware of to the site operators, with guidance given as to how to make the work compliant. Should environmentally damaging activities be observed during these site visits—such as a continued oil leak—dredging operations should be halted until this is remedied. These site visits should occur, as indicated, for the entire duration of the maintenance activities, as well as the month (four weeks) following completion.

Site photographs

Must be taken weekly, beginning one week before dredging commences, weekly during dredging operations, and weekly for four weeks following conclusion of dredging operations.

- The ECO and OLM representative must keep a detailed photographic record during each fortnightly site visit.
- The dredging operator must additionally take detailed photographs of both the dredging and dewatering on a weekly basis, with it being preferential for this to occur on the same day every week. These photographs must be sent to the ECO weekly, for inclusion in the ECO reports.
- All site photographs (including those from the ECO, OLM Representative, and the dredging operator) must be dated and timestamped, and kept for use in ECO and auditing reports. These photographs must also be provided to the Competent Authority (CA) or Responsible Authority (RA) (DEA&DP/ BOCMA) on request.

Water quality testing

As with the initial bulk dredging/ dewatering operation, weekly water quality testing must occur as per GN4167 of the NWA. However, since future maintenance will likely occur at a time when conditions are no longer classified as an emergency, the initiation of WQ testing should occur one month (four weeks) prior to the commencement of dredging activities, as per GN4167. WQ testing will thereafter follow the methodology presented in Table 7.2, as follows:

Once WQ testing commences, it will need to continue weekly for the entire dredging and dewatering operation, as well as for the entire month following conclusion of the dredging/ dewatering activities, to compare the water quality recovery with the baseline data. Specific requirements are as follows:

- Sampling must occur at a total of three sites, with sites located both a short distance upstream and downstream of the dewatering inlet channel, and the third site located in the lower estuary downstream of all maintenance dredging activities.
- Photographs must be taken during each sampling event, with images including the sampling point, the immediate environmental context, and the colouration of both the river water and water within the sampling bottles.
- Sampling can be conducted by either the ECO, OLM, or the contractor/ operator, yet should most-likely be conducted by the operator given their continued presence on site. However, ensuring that sampling and analysis occurs to the standard of the MMP will fall under the responsibility of the ECO.
- After collection/ in-field analysis, the samples should be delivered to a suitable laboratory for TSS analysis.

Specific WQ Parameters to be analysed are as follows:

- pH
- Electrical Conductivity (EC)/ Salinity
- Total Suspended Solids (TSS)
- Turbidity
- Temperature
- Dissolve Oxygen

Besides TSS, all of the above parameters can be analysed in-field using handheld instrumentation, such as a Hach HQ40d, hence the prescribed testing will be both quick, and relatively easy/ inexpensive to conduct. Furthermore, TSS can also be tested using an inexpensive and minimally time-intensive laboratory process.

ECO reports

Must be prepared monthly by the ECO, from the commencement of maintenance activities till once month following the completion of the activities and must submitted to DEA&DP/ BOCMA for comment. The ECO Reports must include:

- A description of the maintenance progress to-date, and how much progress was made during the month window.
- A detailed description of the activities undertaken, with photographic imagery to support the claims.
- Should non-compliances be identified during the month, these should be described and documented, with photographic evidence provided to substantiate these claims. Additionally, a description of the process undertaken following the identification of the non-compliance must be provided. It is also necessary to include how this issue was resolved, how the responsible parties were informed of the issues, and what measures were taken to educate individuals. Measures taken to avoid similar issues from occurring in future must also be highlighted. Furthermore, it is considered critical that the process aids in assisting maintenance teams with being compliant with the MMP and protecting the environment, rather than the focus being to accuse/ incriminate.
- The final ECO Report for the proposed dredging must be completed in the month following the completion of the activities and must take the form of a "Close-Out" report, in which a summary of the dredging and dewatering activities is provided. This report must include commentary on the efficacy of the maintenance activities and provide recommendations as to how the maintenance activities (and the associated) ECO/ monitoring/ reporting work can be refined for future maintenance activities.

Environmental auditing requirements

Like the initial dredging and dewatering operation, it will be necessary to conduct environmental auditing in conjunction with the required ECO reporting activities. However, the exact auditing requirements will vary based on the extent of the required dredging operation., as follows:

- Should maintenance activities be completed within a six month period, then it will only be necessary to conduct a single retrospective audit of the maintenance activities in the 3–6 month period following the activities (in accordance with "Audit 2") from Table 7.2.
- Should maintenance activities run over a period longer than six months, then two internal audits will be required, including a mid-operation audit (Audit 1), and a retrospective audit (Audit 2) both detailed in Table 7.2.

Thresholds and scientific requirements associated with repeat proposed future maintenance dredging of the Onrus Estuary.

Topographic/ bathymetry survey

Basic threshold/ details	Specific thresholds/ details
Topographical/ bathymetric survey	Detailed dredging threshold

Should maintenance dredging be proposed, a detailed topographical/ bathymetric survey must be conducted for the entire management area—from the mouth to the R43 Road Bridge.

Basic dredging threshold

Dredging is permissible if Average estuarine bed level >1 m above target depths.

- Even if the basic threshold is met, and dredging in the estuary is considered permissible, a given area must have an average sediment accumulation of >0.5 m above target depths for dredging to be permissible within the area.

Baseline ecological field survey and report

Basic threshold/ details

Basic overview

Prior to approval of a maintenance dredging operation, a baseline ecological field survey must be conducted by a suitably qualified estuarine specialist team. This survey team must prepare a survey report and provide a recommendation as to whether maintenance dredging should occur.

Specific thresholds/ details

The ecological field survey must be conducted for the entire maintenance area up till the R43 road bridge, and must include:

- A seine net fish survey at sites spaced throughout the estuary and channel.
 - Waterbird counts, with the area divided into segments
 - An aquatic and fringing vegetation survey
 - Sampling for benthic macrofauna (invertebrate) identification, quantification, and spatial distribution, at sites spaced throughout the maintenance area.
 - Sediment sampling for soil particle size, Total Organic Content (TOC), and trace metals, at site spaced throughout the maintenance area.
 - Water quality sampling and testing at sites spaced throughout the maintenance area, at a detection limit appropriate to the gazetted RQO values for the Onrus River and Estuary. Parameters include:
 - Total Suspended Solids (TSS),
 - Chlorophyll-a (Chl-a)
 - pH
 - Electrical Conductivity (EC)/ Salinity
 - Turbidity
 - Temperature
 - Dissolved Oxygen
- and the following nutrient species:
- Total Ammonia Nitrogen (TAN)
 - Nitrate (NO3)
 - Nitrite (NO2)
 - Dissolved Inorganic Nitrogen
 - Orthophosphate (PO4)
- Extensive photographic documentation of the current estuarine condition.
 - Visual survey of estuarine conditions and sediment deposits, to be used to discern between peat-containing areas and sand/ silt.

The ecological survey report must include:

- A current description of the species abundance, diversity, and spatial distributions of the fish, bird, vegetation and invertebrate populations recorded in the entire maintenance area.
- Analysis and descriptions of sediment quality, composition, etc.
- Detailed site photographs of the current estuarine condition.
- A comparison to a variety of historical reference conditions (both pre and post dredging events) to provide detail as to the health of the estuarine system. **Note:** a full, intensive, Ecological Health Assessment (EHS) for the estuary is **not** a requirement for such a report.
- Recommendations as to the ecological suitability of a maintenance dredging operation, including indications of suitable areas to be dredged, as well as identified “no-go”. No-go areas to be identified based on ecological sensitivities identified during the field survey and analysis.

Dredging method statement

Basic threshold/ details	Specific thresholds/ details
<p>OLM/ dredge contractor/ Environmental Consultant must prepare a detailed method statement detailing all proposed elements of a dredging/ dewatering operation, which must be supplied to DEA&DP/ BOCMA for approval. This method statement must be in alignment with the core principles of this MMP.</p>	<p>Specific details to include in the method statement include:</p> <ul style="list-style-type: none"> • Equipment to be utilised; • Personnel requirements; • Sediment removal methodology, including how the material will be transported to the dewatering site; • Details of the proposed dewatering site and dewatering methodology, including signed approvals of landowners if required; • Confirmation of the proposed reuse/ disposal site of the dredged material following dewatering, or a signed letter indicating that the material can be stored on the proposed dewatering site until such time as approval for re-use can be acquired. • Indicative strategy for medium-to-long term storage of dredged material on the dewatering site, and how this will be managed in a way which minimises potential environmental/ human health impacts. • Detailed Operational Health and Safety (H&S) plan to minimise risk to workers. • Plan to minimise undue impacts on the sensitive estuarine environment during dredging and dewatering activities—to align with mitigation measures stipulated within this MMP; • Confirmation from an Environmental Consultant/ Competent Authority (CA) that the proposed activities will not trigger any additional NEMA listed activities not covered within this MMP, or any additional water uses stipulated in the NWA, or similar, in other legislation.

Conclusions and recommendations

Preamble: This Maintenance Management Plan (MMP) and the supporting Ecological Health Assessment Report have both clearly indicated that the condition in the lower Onrus River and Estuary have been critically compromised through intense sediment deposition. Sedimentation, combined with intense flooding, has resulted in a near-total collapse in the ecological health of the estuary due to dramatic losses in available habitat, and related degradation of the small amount of habitat that remains.

Additionally, the estuary and surrounding areas are almost completely infested with alien invasive plants (AIPs) which are further stressing ecological health restricting the available habitat for remnant indigenous plant and animal species. Concerningly, both the alien coverage and intensity appear to have increased in recent years, which indicates that this pressure will continue to increase with time.

Beyond the ecological concerns, the sedimentation has also dramatically increased the risk of flooding of Onrus village itself, due to the loss of the energy-dampening and flood attenuation effects of the estuary, placing residents, landowners, and visitors at risk of both personal harm and damage to property should heavy rain/ a flood occur in the future.

The proposed MMP aims to address these concerns commencing with bulk dredging (sediment removal) operation as soon as possible. The plan also makes provision for future dredging should it be required and contains a stringent list of requirements which must be met before any future dredging can commence—thereby avoiding unnecessary impacts.

Reasoned opinion and recommendation

The precautionary approach, given in the National Environmental Management Act, 1998 (NEMA) (Act no. 107 of 1998), requires that, if there is a strong suspicion that a certain activity may have environmentally harmful consequences, it is better to control that activity now rather than to wait for incontrovertible scientific evidence. The same principle can likewise be applied to situations wherein

environmental harm/ risks to human health and safety are already present, and rapid remediation is required to prevent further degradation/ risk.

This document therefore presents a middle-ground between scientific and legislative best practice required to prevent the occurrence of activities that have the potential to cause adverse harm to environmental and human receptors. The preparation of the Ecological Health Assessment, as well as this detailed MMP and Impact Assessment, presents a strong, scientifically rigorous case and supporting methodology for the commencement of maintenance activities in the Onrus Estuary and lower Onrus river. The predicted benefits of these maintenance activities are overwhelmingly positive when compared to the relatively minor negative impacts assessed to co-occur with these benefits. Likewise, the consequences of inactivity/ slow or ineffectual responses to the threats to the Onrus System, are much more significant than any potential negatives associated with the proposed maintenance activities.

However, the severity of the situation does not imply that appropriate processes/ legislation need not be complied with but rather stresses the need to utilise all available legal tools to enable swift implementation—without compromising on established requirements.

It is therefore recommended that this MMP be the primary tool required to facilitate initiation of the maintenance activities, with the necessary parallel Water Use License Application (WULA), falling under the auspices of the Emergency Protocol described within GN 4167 of 2023. This protocol does not absolve the applicant from the need to acquire a Water Use Authorisation, yet does allow for the completion of the application retrospectively—following commencement of the maintenance activities. Likewise, it is proposed that the proposed Main Onrus Wetland stabilisation/ rehabilitation measures be conducted under a Landcare EMPr.

In conclusion, it is our scientific opinion that the maintenance activities proposed for the Onrus Estuary and Lower River **commence with all possible haste**, with this document being used as the primary instrument and methodology enabling these activities to occur in a manner which minimises undue environmental and social impacts, while maximising benefits.

ACKNOWLEDGEMENTS

The drafting of this Maintenance Management Plan was facilitated by extensive input from a wide variety of individuals and entities. Our experience was that everyone approached with requests for assistance or scientific data were extremely helpful and forthcoming, which facilitated the creation of a document that is scientifically rigorous and will hopefully provide the basis for similarly ambitious—multi-faceted—restoration projects in the future.

To this end, we would like to express our gratitude to the following individuals/ entities, in no particular order:

- Mr Johann Rupert and his team,
- Mr Pieter Badenhorst of Groenberg Environmental,
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- Mr Andrew Greef of Andrew Greef Architects,
- Mr Henrico Tossel of Terralinings,
- Mr Pieter Van Niekerk of the Onrus River Estuary Forum,
- Mr Sean Bailey of the South African Earth Observation Network (SAEON),
- Dr Liz Day of Liz Day Consulting,
- Mr Hans King of Hans King Remote Sensing,
- Mr Hennie Greef of the Onrus River Homeowners Association,
- Mrs Liezl de Villiers and Ms Danielle Smith of the Overstrand Local Municipality, as well as
- Extensive input from the following Authorities:
 - a) The Western Cape Department of Environmental Affairs and Development Planning (DEA&DP),
 - b) CapeNature,
 - c) The Breede-Olifants Catchment Management Agency (BOCMA), and
 - d) The Western Cape Department of Agriculture

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DECLARATION OF INDEPENDENCE

Anchor Environmental Consultants (Pty) Ltd is an independent consultant and has no business, financial, personal or other interest in the activity, application or appeal in respect of which the company was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. No circumstances arose during the course of the project that compromised the objectivity of the specialists that performed the work.

BACKGROUND AND QUALIFICATIONS OF SPECIALIST CONSULTANTS

This study was undertaken by Michael Armitage, Megan Jackson, Cheruscha Swart, and Dr Barry Clark

Michael Armitage holds an MSc in Environmental and Geographical Science (EGS) (with distinction), a BSc (Hons) in EGS (with distinction), and a BSc in EGS and Archaeology. His MSc research involved field research and comparative analysis on heavy metal contamination in the Knysna Estuary in South Africa and the Yangtze Estuary in China. His key focus areas are the integrated management of the environment, estuaries and water resources, with strong interests in pollution issues and archaeology. He is invested in pursuing integrated, “nature-based” solutions to problems traditionally solved with grey infrastructure design choices. Michael thrives on unpacking the complexities of dynamic systems and using this knowledge to optimise integrated management strategies.

Megan Jackson is an evolutionary ecologist with a BSc. (Genetics and Ecology & Evolution) and a BSc. Hons. (Biological Sciences) from the University of Cape Town, and an MSc. (Botany) from Stellenbosch University. Her BSc. Hons. thesis was focused on using a population genetics approach to assess whether cities act as barriers to movement and gene flow in caracals, thereby isolating populations and resulting in elevated levels of inbreeding. Megan’s MSc. used a Next-Gen sequencing approach and bioinformatic processing to look at the population genomics of Cape Dwarf eelgrass in estuaries around the South African coastline to inform conservation planning and preserve the genomic diversity of the species. Following the completion of her studies, she spent a year working on Bird Island in the Algoa Bay MPA, as a Seabird Monitor, to aid with the conservation of the endangered African Penguins and Cape Gannets. Megan has recently started working as a Junior Consultant at 2 Anchor Environmental Consulting, where she is involved in carrying out benthic species taxonomic IDs and Environmental Impact Assessments. She has broad research interests, and the combination of molecular and general biology has given her a unique perspective on conservation, as well as experience in both field and laboratory work across a diverse range of species in both marine and terrestrial environments.

Cheruscha Swart attained a Master of Science degree (MSc) in Zoology (Cum Laude) and an Honours (BSc Hons) and Bachelor of Science degree (BSc) in Biodiversity and Ecology from the University of Stellenbosch. She is a Registered Environmental Assessment Practitioner (EAP) with 12 years of research and consulting experience in several disciplinary fields, including conducting Basic and Scoping and Environmental Impact Assessments. Her training and experience have made her highly competent within a variety of disciplines, including environmental monitoring and impact assessments, terrestrial and marine biodiversity and ecology, invasion biology, conservation biology, plant and animal sciences and marine invertebrate taxonomy and biology. Within Anchor Environmental Consultants,

her primary role is that of EAP and leading Senior Consultant on several environmental specialist studies spanning the marine, coastal and terrestrial environment. Cheruscha manages a range of projects including applications for prospecting, ranching and other operational rights, environmental licenses and environmental authorisations; specialist impact assessments and baseline studies; environmental monitoring of important conservation and disturbed habitats; and monitoring environmental compliance of various operations. Projects include, amongst others, landbased and offshore prospecting operations; offshore mining operations; greenhouse agricultural projects; land- and sea-based aquaculture facilities; desalination plant projects; and monitoring the health of bays and ports along the South African Coast. Cheruscha is the author of three peer reviewed scientific publications and numerous scientific reports, with several other projects and publications in preparation.

Dr Barry Clark has a BSc Hons in Zoology and PhD in Marine Ecology. He founded Anchor in 1996 and has 33 years' experience consulting on coastal, estuarine and marine ecosystem and resources management. His particular interests are estuaries, fish (including freshwater) and corals as well as marine biodiversity and protected areas. This has taken him to tropical, subtropical and temperate marine and freshwater ecosystems throughout much of Africa and its islands, as well as into the Middle east (UAE) and Europe (Azerbaijan, Greenland). His work has involved conservation planning, monitoring and assessment of human impacts on estuarine, rocky shore, sandy beach, mangrove, and coral reef ecosystems as well as coastal and littoral zone processes, aquaculture and fisheries. Dr Clark is the author of 27 scientific publications as well as numerous scientific reports and popular articles in the free press. Dr Clark is also a registered Professional Natural Scientist with the South African Council for Natural Sciences Professions (SACNASP), for the "Ecological Science" and "Zoological Science" field of practice, SACNASP registration no.: 400021/05.

SIGNATURES OF SPECIALISTS

We, Michael Armitage, Megan Jackson, Cheruscha Swart, and Barry Clark declare that we:

- i. Act as the independent specialists in this application;
- ii. Have performed the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- iii. Declare that there are no circumstances that may compromise our objectivity in performing such work;
- iv. Have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- v. Will comply with the Act, Regulations and all other applicable legislation;
- vi. Have not, and will not engage in, conflicting interests in the undertaking of the activity;
- vii. Undertake to disclose to the applicant and the competent authority all material information in our possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority and the objectivity of any report, plan or document to be prepared by ourselves for submission to the competent authority;
- viii. The particulars furnished in this form are true and correct; and
- ix. Realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the NEMA.

The image shows four handwritten signatures in black ink. From left to right: Michael Armitage, Megan Jackson, Cheruscha Swart, and Barry Clark. The signatures are written in a cursive, flowing style.

Signed: Michael Armitage, Megan Jackson, Cheruscha Swart, and Barry Clark

Date: 12 December 2024

GLOSSARY

1: (20, 50, 100) year flood line: A flood event that has a 1 in (20, 50, 100) chance of being equalled or exceeded in any given year.

Alien species: Species that become established in areas outside their natural, native range.

Avifauna: The birdlife of a particular region or habitat.

Bioavailable: Refers to the potential for trace metals found within sediment to be assimilated into the tissues of organisms and enter the food chain.

Biodiversity: The variability among living organisms from all terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems.

Category 1b Listed Invasive Species: the species must be controlled (i.e. it must not be allowed to spread). The species should be removed.

Dredging: excavation of material from a water environment

Ecosystem services: The goods and services provided by ecosystems to humans.

Environment: The external circumstances, conditions and objects that affect the existence of an individual, organism or group. These circumstances include biophysical, social, economic, historical and cultural aspects.

Environmental Authorisation: Permission granted by the competent authority for the applicant to undertake listed activities in terms of the NEMA EIA Regulations, 2014.

Environmental Impact Assessment: A process of evaluating the environmental and socio-economic consequences of a proposed course of action or project.

Estuarine Functional Zone (EFZ): Delineated by at least the 5 m above mean sea level (MSL) contour as proxy indicator, the area in and around an estuary which includes the open water area, estuarine habitat (such as sand and mudflats, rock and plant communities) and the surrounding floodplain area.

Estuary: An estuary is defined in terms of the National Environmental Management: Integrated Coastal Management Act (ICMA) and the NEMA 2014 EIA Regulations as “a body of surface water a) that is permanently or periodically open to the sea; b) in which a rise and fall of the water level as a result of the tides is measurable at spring tides when the body of surface water is open to the sea; or c) in respect of which the salinity is higher than fresh water as a result of the influence of the sea, and where there is a salinity gradient between the tidal reach and the mouth of the body of surface water.”

Floodplain: Broad and relatively flat area on either side of a stream, river or estuary that are inundated by water during floods.

Impact: A change to the existing environment, either adverse or beneficial, that is directly or indirectly due to the development of the project and its associated activities.

Invasive species: Alien species capable of spreading beyond the initial introduction area and have the potential to cause significant harm to the environment, economy or society.

Nursery habitat: A subset of all habitats where juveniles of a species occur, having a greater level of productivity per unit area than other juvenile habitats.

Species: A category of biological classification ranking immediately below the genus, grouping related organisms. A species is identified by a two-part name; the name of the genus followed by a Latin or Latinised un-capitalised noun.

Strategic Water Source Areas (SWSAs): areas of land that either: (a) supply a disproportionate (i.e. relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered

nationally important; or (b) have high groundwater recharge and where the groundwater forms a nationally important resource; or (c) areas that meet both criteria (a) and (b). They include transboundary Water Source Areas that extend into Lesotho and Swaziland (Le Maitre et al. 2018).

LIST OF ABBREVIATIONS

AMSL	Above Mean Sea Level
Anchor	Anchor Environmental Consultants (Pty) Ltd
CBA	Critical Biodiversity Area
CSIR	Council for Scientific and Industrial Research
DEA&DP	Western Cape Department of Environmental Affairs and Development Planning
DFFE	Department of Forestry, Fisheries and the Environment
DIN	Dissolved Inorganic Nitrogen
DIP	Dissolved Inorganic Phosphorous
DO	Dissolved Oxygen
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA Regs	Environmental Impact Assessment Regulations (2014)
EFZ	Estuarine Functional Zone
EHI	Estuarine Health Index
EIA	Environmental Impact Assessment
EMP	Estuarine Management Plan
EMPr	Environmental Management Programme
EPWP	Expanded Public Works Programme
ESA	Ecological Support Area
ETP	Endangered, Threatened and Protected Species
GIS	Geographic Information System
GNEC	Guillaume Nel Environmental Consultants
IBA	Important Bird Area
IDP	Integrated Development Plan
ICMA	Integrated Coastal Management Act
mAMSL	Metres Above Mean Sea Level
MAR	Mean Annual Runoff
MLRA	Marine Living Resources Act
MMP	Maintenance Management Plan
MMR	Mean Monthly Runoff
MPA	Marine Protected Area
MSL	Mean Sea Level
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NEM: BA	National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
NEMP	National Estuarine Management Protocol
NEM: PAA	National Environmental Management: Protected Areas Act (Act No. 57 of 2003)
NFEPA	National Freshwater Ecosystem Priority Area
NGO	Non-Governmental Organisation
OLM	Overstrand Local Municipality
OMSPS	Onrus Main Sewage Pumping Station
PES	Present Ecological State
SANBI	South African National Biodiversity Institute
SWSA	Strategic Water Source Area

TPC	Threshold of Potential Concern
TSS	Total Suspended Solids
WCBSA	Western Cape Biodiversity Spatial Plan
WCNSB	Western Cape Nature Conservation Board

I INTRODUCTION

The Onrus Estuary, popularly known as the Onrus Lagoon, is situated on the southwest coast of South Africa, approximately 7 km northwest of Hermanus (Figure 1.1). It is a small temporarily closed estuary located within the cool temperate biogeographic region of South Africa, which is fed by the Onrus River System (Van Niekerk et al. 2019a).

The Onrus Estuary is a popular tourist destination and is closely fringed by human developments, including both high-end residential, tourist accommodation, campsites, and the Habonim Campsite and Conference Centre.

The Onrus River and Estuary are susceptible to periodic flood events, with the most recent large-scale flood event—which occurred in September 2023—leading to the erosion of a large upstream peat wetland which, in turn, led to mass sediment deposition within the lower river and estuary. This deposition raised the estuarine bed by an excess of 3 m in some areas and led to chronic inundation of portions of several surrounding properties.

The loss of the storage and flood attenuation capacity of the upstream peat wetland and estuarine body itself has led to concerns about dangerous flooding in the Onrus area. These concerns were grounded on the logic that, should large rainfall events occur whilst the altered estuarine conditions persist, the river would overtop its banks, and cause substantial flooding, which would threaten both human health and property. Flood risk is likely greatest on the western bank, where the river’s natural meander leads to the greatest flows and forces. Additional concerns relate to the location of the Onrus Main Sewage Pump Station to the northwest of the estuarine channel. Damage or inundation of this pump station has the potential to disrupt its function and cause the estuary to be polluted with liquid sewage—which is of concern for both human and ecological health.

Deposition of sediment in the Onrus estuary has also had a severe impact on the ecological health and functioning of the estuary. The most recent National Biodiversity Assessment (NBA) (2019) found that the condition or Present Ecological State (PES) of the Onrus Estuary was a “D” or “Heavily Modified”. This was based on findings of an Ecological Health Assessment that was completed for the Onrus Estuary as part of the process of determining the freshwater reserve for all significant water resources in the Breede-Gouritz Water Management Area in 2017. However, a re-evaluation of ecological health of the Onrus Estuary, completed this year after the floods and based on surveys undertaken in October 2024, suggests that the overall health of the estuary has declined dramatically (now 27% of natural overall = “E” category) (Clark et al. 2024). Declines in physical health (hydrodynamics, mouth condition, physical habitat alteration, and water quality) played a major role here, but the drop in all biotic health parameters was also significant. This is unacceptable in terms of the National Water Act (NWA, Act 36 of 1998) and must be addressed as a matter of urgency.

The Overstand Local Municipality (OLM) recently launched the Onrus Catchment-to-Coast (C2C) Rehabilitation and Restoration Programme together with other landowners, water resource users, government organizations and Environmental Non-Governmental Organisations (NGOs) in 2024. The C2C programme forms part of OLMs 2022-2027 Integrated Development Plan (IDP). The objective of the C2C programme is to adopt a holistic approach to watershed management. By rehabilitating the entire catchment corridor, the aim is to safeguard water resources, prevent land degradation, preserve biodiversity, and mitigate the effects of climate change to ensure the long-term resilience and sustainability of its people and nature.

Restoration of the Main Onrus Peat Wetland and the Onrus Estuary represent two of the major focal areas for the C2C programme. Restoration of these two ecosystems are also intricately linked. Sediment deposited in the estuary must be removed as a matter of urgency to restore the ecological health of the estuary and to mitigate against flood risk for the adjacent residential area and municipal infrastructure, while large quantities of sediment are required to rehabilitate the peat wetlands upstream. OLM would thus like to remove the accumulated sediment from the estuary, and temporarily store it at a site of the east bank of the estuary, until it can be returned to the wetland upstream. However, moving such a large quantity of sediment triggers a listed activity in terms of the 2014 National Environmental Management Act (NEMA, Act 107 of 1998) EIA regulations (EIA Regs) unless this is undertaken under the auspices of Maintenance Management Plan (MMP).

In the interests of time and efficiency, the Overstand Municipality has opted to prepare an MMP to address these requirements. It will enable the OLM to fast-track rehabilitation of both the Onrus Estuary and Wetland but will also enable maintenance dredging to be conducted in the estuary in future should this be required without the need for an emergency Section 30A application, or EIA.

This document is thus the MMP for the Onrus estuary. It sets out the applicable legal framework for development and adoption of an MMP, provides a detailed description of the affected environment, sets out the proposed approach for removing sediment that has been deposited in the estuary by recent floods, provides a detailed assessment of the potential impacts (both positive and negative) of sediment removal, sets out triggers and thresholds for future sediment removal, and stipulates requirements for monitoring and auditing of the sediment removal process.

The MMP is based largely on available information, including the 2018 National Biodiversity Assessment and supporting documents (Van Niekerk et al. 2019a) and the Draft EMP for the Onrus Estuary (Western Cape Government 2021), supplemented by numerous site visits and an ecological survey of the Onrus estuary conducted in October 2024. This survey incorporated a drone-based topographic survey of the estuary, as well as assessments of water and sediment quality, vegetation cover, and the invertebrate, fish, and avifaunal communities. Ground truthing of potential sensitive habitat was also conducted during various site visits to complement the available desktop spatial data. Extensive Geographical Information Systems (GIS) mapping data was made available by a number of independent agencies, which included detailed topographical/ bathymetric surveys from 1994 to the present; high quality orthophotos of the estuary derived from both plane and drone surveys; and alien invasive vegetation cover estimates derived from satellite imagery analysis.

2 APPLICABLE LEGISLATION

2.1 NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NEMA, ACT 107 OF 1998)

The National Environmental Management Act (NEMA) establishes principles for decision making on matters that affect the environment, to provide for cooperative environmental governance. It establishes statutory environmental duty of care obligations, imposing responsibilities to prevent and address pollution or environmental degradation. Activities that have the potential to impact on the environment, socio-economic conditions and the cultural heritage, need to be identified and assessed prior to their implementation. These activities should be reported to the organ of state, known as the Competent Authority (CA), and receive Environmental Authorisation (EA) prior to their commencement. An application for EA is conducted either by means of a Basic Assessment (BA) process or by means of an Environmental Impact Assessment (EIA) process.

2.1.1 ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS 2014

The EIA regulations promulgated in terms of Chapter 5 of NEMA control certain listed activities. These activities are published as Listing Notice 1 (LN 1) in Government Notice (GN) No. R983 of 2014 (as amended), as Listing Notice 2 (LN 2) in GN No. R984 of 2014 (as amended) and as Listing Notice 3 (LN 3) in GN No. R985 of 2014 (as amended). These activities are prohibited until EA has been granted by the CA.

Section 3 of LN 1, LN2, and LN3 state that **“the activities identified in Appendix I may not commence without environmental authorisation from the competent authority”** and that “the investigation, assessment and communication of the potential impact of activities must follow the procedure as prescribed in the relevant regulations (with the exact procedure varying between each Listing Notice) of the Environmental Impact Assessment Regulations published in terms of section 24(5) of the Act, unless otherwise indicated by the Minister in a government notice.” However, there are a number of potential exclusions to the aforementioned regulations specifically pertaining to dredging and other maintenance activities, which are discussed in the following Listed Activities specifically prevalent to such activities. Listed Activities pertinent to this MMP include Activity 19 and 19A of LN1 (GN R983 of 2014), Activity 24 of LN2 (GN R984 of 2014), as well as Activity 12 of LN3 (GN R985 of 2014).

The four Listed Activities potentially triggered by the proposed dredging of the Lower Onrus River and Estuary are:

Activity 19 of Listing Notice 1 (GN R983 of 2014):

“The infilling or depositing of any material of more than 10 cubic metres into, or **the dredging, excavation, removal or moving** of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a **watercourse; but excluding** where such infilling, depositing, dredging, excavation, removal or moving - (a) will occur behind a development setback; **(b) is for maintenance purposes undertaken in accordance with a maintenance management plan;** (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies; (d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or (e) where such development is

related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.”

Activity 19A of Listing Notice 1 (GN R983 of 2014)

“The infilling or depositing of any material of more than 5 cubic metres into, or **the dredging, excavation, removal or moving** of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from –(i) the seashore; (ii) the littoral active zone, **an estuary** or a distance of 100 metres inland of the high - water mark of the sea or an estuary, whichever distance is the greater; or (iii) the sea; - **but excluding** where such infilling, depositing, dredging, excavation, removal or moving -(f) will occur behind a development setback; **(g) is for maintenance purposes undertaken in accordance with a maintenance management plan** ; (h) falls within the ambit of activity 21 in this Notice, in which case that activity applies; (i) within existing ports or harbours that will not increase the development footprint of the port or harbour; or where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.”

Therefore, should an MMP be approved for the Onrus System, the OLM will be able to conduct the necessary maintenance dredging activities within the lower Onrus River and Estuary without committing an Environmental Offense or requiring an EIA—therefore allowing for the retention of the ecological, residential, and recreational value of the system.

Activity 24 of Listing Notice 2 (GN R984 of 2014)

“**The extraction or removal of peat or peat soils**, including the disturbance of vegetation or soils in anticipation of the extraction or removal of peat or peat soils, **but excluding where such extraction or removal is for the rehabilitation of wetlands in accordance with a maintenance management plan.**”

Activity 12 of Listing Notice 3 (GN R985 of 2014)

“The clearance of an area of 300 square metres or more of indigenous vegetation **except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.**

(i) Western Cape

(i) Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; (ii) Within critical biodiversity areas identified in bioregional plans; (iii) Within the littoral active zone or 100 metres inland from high water mark of the sea or **an estuarine functional zone**, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas; (iv) On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning; or (v) On land designated for protection or conservation purposes in an Environmental Management Framework adopted in the prescribed manner, or a Spatial Development Framework adopted by the MEC or Minister.”

2.1.2 LANDCARE PROGRAMME AND LANDCARE EMPR

The LandCare Programme was developed by the National Department responsible for Agriculture in 1997. The purpose of the programme was to enhance sustainable conservation of natural resources through a community based participatory approach, to create job opportunities through expanded public works programme (EPWP) model and to improve food security and the wellbeing of society.

Since initiatives to reverse environmental degradation of agricultural land will likely trigger Environmental Listed Activities under Section 24(2)(a) and (b) of NEMA—including conducting activities within 32 metres of a watercourse, clearing of more than 1 hectare of indigenous vegetation, etc.—Environmental Authorisation (EA) would typically be required from the competent authority (CA). Furthermore, some initiatives may also be classified as Water Uses under the National Water Act (NWA, Act 36 of 1998), and require a Water Use License (WULA) or General Authorisation (GA) under the NWA, with associated approvals from the relevant Responsible Authority (RA). Relevant water uses could include: “impeding or diverting the flow of water in a watercourse” (Section 21c), “altering the bed, banks, course or characteristic of a watercourse” (Section 21i), etc.

When Environmental Listed Activities are identified, Section 24(1) of NEMA requires that the potential impacts of these activities on the environment must be considered, investigated, assessed, and reported on. The manner in which these investigations, assessments and reports are to be undertaken is through an environmental impact assessment process prepared in accordance with the Environmental Impact Assessment Regulations (EIA Regs, GN R982 of 2014, as amended).

Under certain circumstances, NEMA allows for identified activities to be excluded from the requirement to obtain EA from the Competent Authority. One such method is presented in section 24(2)(e) of NEMA, which allows for the exclusion of activities from the requirement to obtain an EA, based on an **environmental management instrument**, adopted in the prescribed manner. As the nature of projects undertaken under the LandCare Programme are rehabilitation oriented, human resource intensive, and typically avoid using heavy machinery, they are not anticipated to cause significant detrimental impacts on the environment—unlike other, “more typical” forms of development. Additionally, Landcare rehabilitation interventions are similar across between projects, and have been consistently implemented for a 23-year period: meaning that their impacts and mitigation measures are well understood. As such, it is deemed appropriate that projects implemented under the LandCare Programme are excluded from the need to obtain environmental authorisation as provided for in section 24(e) of NEMA, based on adherence to this *Generic Environmental Management Programme for the LandCare Programme (version 0 of October 2020)*, which has been adopted as an environmental management instrument by the Minister.

As outlined earlier in this document, restoration of the Onrus peat wetland and the Onrus estuary represent two major focal areas for the Municipality’s C2C programme, with restoration of these two ecosystems being intricately linked. Sediment deposited in the estuary must be removed as a matter of urgency to restore the ecological health of the estuary and to mitigate against flood risk for the adjacent residential area and municipal infrastructure—while large quantities of sediment are required to rehabilitate the peat wetlands upstream. The Overstand Municipality thus intend to remove the accumulated sediment from the estuary, and temporarily store it at a site to the east of the estuary, until it can be returned to the wetland upstream. As is the case with the estuary rehabilitation

activities, restoration of the Onrus peat wetland will likely trigger certain listed activities in terms of the NEMA EIA Regulations and hence it has been agreed that these activities be undertaken under the auspices of the Generic Environmental Management Programme (EMPr) for the LandCare Programme.

Actions to be employed for the avoidance, management and mitigation of impacts and risks associated with rehabilitation actions to be undertaken in the Onrus peat wetland, and for compliance with the LandCare Programme EMPr, are addressed in a separate document and are not repeated here. Suffice is to say that compliance with these requirements will be monitored by the Department of Environment, Forestry and Fisheries: Compliance Chief Directorate, and the Compliance Unit of the Department responsible for water affairs respectively, and it is understood that non-compliance will constitute an offence in terms of section 49A(1)(d) of NEMA and section 151 of the NWA.

2.2 THE NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT (NEMBA, ACT 10 OF 2004).

The NEMBA provides legal protection and management of South Africa's biodiversity within the framework of NEMA. The Act seeks to protect species and ecosystems that require national-level safeguarding. It promotes the sustainable utilisation of indigenous biological resources and emphasises the fair and equitable sharing of benefits derived from activities involving such resources. The legislation also establishes the South African National Biodiversity Institute (SANBI), defining its roles and functions.

2.2.1 ALIEN AND INVASIVE SPECIES

The NEMBA also regulates all invasive organisms in South Africa, aiming to prevent unauthorised introduction and spread, and to manage and control alien and invasive species to minimise harm to the environment and biodiversity. The Act outlines a 'Duty of care relating to listed invasive species', specifying that landowners with listed invasive species must notify the CA, control and eradicate the species, and prevent its spread while minimising harm to biodiversity. An Alien and Invasive Species Management Plan might be required as part of the project approval conditions. It serves to guide the removal of existing invasive species, prevent their establishment, and monitor their presence and management success. It is crucial to read this Act in conjunction with the Alien and Invasive Species Regulations, 2020 (Notice R1020 of GG 43735).

2.2.2 THREATENED AND PROTECTED SPECIES REGULATIONS OF 2015

The Threatened or Protected Species, 2015 (TOPS; Notice 255 in GG 38600) regulations, established under NEMBA, aim to safeguard and preserve threatened and protected species. They outline the prohibition of specific restricted activities involving particular listed threatened or protected species. According to these regulations, obtaining a permit may be necessary for activities that involve the disturbance or removal of certain species.

It is the intention of the Onrus Municipality to take all precautions necessary to safeguard threatened and protected species in areas where maintenance activities are undertaken,

2.2.3 CONVENTION ON BIOLOGICAL DIVERSITY 1992

The Convention on Biological Diversity (CBD) is an international legal framework aimed at safeguarding biological diversity, promoting the sustainable utilisation of its components, and ensuring the just and equitable sharing of benefits derived from genetic resources. The Convention addresses biodiversity across various levels, including ecosystems, species, and genetic resources. South Africa became a signatory to the CBD on 4 June 1993 and has been a member state of the Convention since 2 November 1995.

South Africa has adopted several management categories for protected areas that align with the established classifications of the International Union for Conservation of Nature (IUCN). One of South Africa's key conservation objectives is to increase the extent of protected areas to meet the international benchmark of 10% of the nation's total land area. The DFFE collaborates closely with landowners to encourage their active participation in the Stewardship Programme. This initiative permits landowners to utilise their properties for biodiversity and conservation purposes, contributing significantly to the expansion of the country's conservation estate. The proposed C2C rehabilitation activities are likely to aid in Africa's alignment with the CBD, principally by proving habitat for IUCN Red list Species, and supporting biodiversity conservation efforts.

2.3 THE NATIONAL WATER ACT (ACT 36 OF 1998)

2.3.1 REQUIREMENTS FOR A WATER USE LICENCE (WUL)

The National Water Act (NWA, Act 36 of 1998) makes provision for the conservation and development of water resources. In terms of Section 21 of this Act, certain water uses and activities in or near a watercourse require a Water Use Licence (WUL). The DWS is the custodian of South Africa's water resources and is responsible for processing WUL applications. Before a full application is made, a freshwater or aquatic specialist is required to conduct a risk assessment to evaluate water uses and determines whether a WUL is necessary. The application process is governed by either Part 7 of the NWA or, in the case of integrated WULs, by the Water Use Licence Application and Appeals Regulations of 2017. Furthermore, the NWA establishes statutory environmental 'duty of care' obligations, imposing responsibilities to prevent and address pollution or environmental degradation (Section 19).

This MMP covers the whole of the Onrus estuary, as well as a section of river upstream of the estuary as far as the R43 Road Bridge (approximately 950 m). Removal of sediment in an estuary does not require a Water Use Authorisation, as it forms part of the marine environment and hence is not listed as a watercourse in terms of the NWA. However, the section of river from the top of the estuary to the R43 Road Bridge is considered to be a watercourse and permit requirements for this area are different to those for estuaries. The first key difference is the requirement that this MMP make provision for activities falling under Listed Activity 19 of Listing Notice 1 of the EIA Regulations (GN 983 of 2014), in addition to Activity 19A—which pertains to estuarine and coastal environments and is typically relevant to estuarine maintenance activities. Secondly, MMPs pertaining to watercourses also require Water Use Authorisation, either in the form of a Water Use License application (WULA), or an application for General Authorisation (GA)—assuming that the proposed activities only pertain to Sections 21(c) and 21(i) of the NWA, as follows:

- 21(c) “impeding or diverting the flow of water in a watercourse; and

- 21(i) altering the bed, banks, course or characteristic of a watercourse”

Water use authorisation is typically required prior to the final acceptance of the MMP and the commencement of the actual maintenance activities. The Responsible Authority (RA) responsible for ruling upon water uses is either the National Department of Water and Sanitation (DWS) and/or the local Catchment Management Agency (CMA) responsible for managing the watercourse/ catchment in question—assuming that the relevant CMA has been established and is functional. Given that the Onrus Catchment falls within the broader Breede-Gouritz Water Management Area (BGWMA), management primarily falls under the Breede-Olifants Catchment Management Agency (BOCMA)—the RA.

In certain circumstances, the principles of co-operative governance allow for the merging and streamlining of licensing requirements/ processes between authorities, with Section 22 (4) of the NWA reading as follows: “In the interests of co-operative governance, a responsible authority may promote arrangements with other organs of state to combine their respective license requirements into a single license requirement”. In fact, this is the way that watercourse MMPs are typically handled in the Western Cape—assuming that the proposed water uses fall under the Section 21(c) and (i) GA requirements—with the MMP application and document requirements being deliberately structured in such a way as to meet the requirements for both the NEMA and the NWA GA regulations.

2.3.2 THE EMERGENCY PROTOCOL

Given the severe time constraints associated with the proposed maintenance activities and the urgent need to dredge the Onrus estuary, it has been suggested that use be made of protocols contained within Appendix C of Section 21(c) and (i) of the General Authorisation (GA) Regulations (GN 509 of 2016) which make allowance for maintenance activities to be conducted under the “Emergency protocol”. An “Emergency Incident” is defined as “an unexpected sudden occurrence leading to a potential or serious danger to the public”, whilst an “Emergency Situation” is “any emergency that developed that require immediate intervention for continuation of existing essential service delivery”. Key components of the Emergency Protocol are as follows:

“This "Emergency Protocol" spells out what protocol needs to be followed to remedy "emergency situations and incidents ". In terms of Section 67 of the National Water Act" Dispensing with certain requirements of Act" the NWA states the following:

- (1) *In an emergency situation, or in cases of extreme urgency involving the safety of humans or property or the protection of a water resource or the environment, the Minister may*
 - (a) *dispense with the requirements of this Act relating to prior publication or to obtaining and considering public comment before any instrument contemplated in section 158(1) is made or issued;*
 - (b) *dispense with notice periods or time limits required by or under this Act;*
 - (c) *authorise a water management institution to dispense with*
 - (i) *the requirements of this Act relating to prior publication or to obtaining and considering public comment before any instrument is made or issued; and*
 - (ii) *notice periods or time limits required by or under this Act.*
- (2) *Anything done under subsection (1)*
 - (a) *must be withdrawn or repealed within a maximum period of two years after the emergency situation or the urgency ceases to exist; and*

(b) must be mentioned in the Minister's annual report to Parliament."

(3) An incident is an event that requires immediate attention that might lead to potential disruption of service delivery."

Importantly, this protocol does not absolve the Water User from compliance with the NWA or other legislation, yet does allow for rapid (appropriate) action, with an extensive retrospective reporting process being required within a period of three months following commencement of the activities. This reporting process is equally—and in some cases more—intensive than a pre-emptive GA or WULA Application and requires thorough documentation and demonstration of compliance with the GA/ WULA requirements. In cases where water uses are deemed to fall outside of the scope of a GA, a post facto WULA application would be required. Furthermore, contraventions of the protocol and other elements of the NWA or other legislation can still be constituted as an offence, with associated legal ramifications.

2.3.3 MOTIVATION FOR THE USE OF THE EMERGENCY PROTOCOL

This document clearly articulates the urgent need to conduct dredging activities in the Onrus Estuary, with concerns relating to flooding, human health, and ecological functioning all representing strong motivators. Additionally, given the considerable timeframes (~1 year) required to complete the dredging operations, there is a great deal of urgency associated with the commencement of these activities to both improve conditions in the estuary, and to protect the system and its residents against the dangers of future flooding events.

To this end, where possible, delays in initiating activities should be avoided to maximise progress prior to the start of the 2025 winter rainfall season. However, the importance of preserving and maintaining water resources and complying with the NWA is also considered to be imperative and therefore, the consulting team at Anchor has been working closely with the C2C freshwater ecologist, Dr Elizabeth Day, and the officials at BOCMA, to agree on an appropriate approach to ensure such compliance. The agreed-upon resolution is to follow the Emergency Protocol to ensure compliance, with the requisite "Risk Matrix" being completed as part of a post facto WUL application rather than a GA. It has also been agreed with BOCMA that the application process for removal of sediment from the section of river between the estuary and the R43 bridge be integrated with the rehabilitation of the main Onrus wetland under a single WULA. However, the remaining permitting for the upstream which will be undertaken under the auspices of the Landcare Environmental Management Programme Report (EMPr) rather than an MMP. The rationale for the latter is explained in detail in Section 2.1.2.

To aid in integrating the MMP and WULA processes, the structure and monitoring/ reporting requirements of this MMP have been drafted to (as closely as possible) comply with those stipulated within the Emergency Protocol, to both demonstrate the commitment to compliance with the NWA, and to streamline the process of meeting any additional requirements that BOCMA or DWS may request within the three-month submission deadline.

2.4 ESTUARY MANAGEMENT

This section provides an overview of legislation and policy applicable to management of estuaries in South Africa and specifically of the Onrus Estuary. South African policy and law as it pertains to estuaries has been summarised in detail elsewhere (Van Niekerk & Taljaard 2007) and are covered in brief here only. The key framework legislation for the management

of estuarine systems are the National Water Act (Act 36 of 1998) and National Environmental Management: Integrated Coastal Management Act (Act 24 of 2008) (ICMA). As such, estuary management falls mainly under two national government departments: the Department of Water and Sanitation (DWS), responsible for water resources, such as maintaining adequate and clean supply of water, and the Department of Forestry, Fisheries and the Environment (DFFE), responsible for other estuarine management aspects including land use and living resources. A summary of the most relevant policies is presented in Table 2.1.

Table 2.1. Summary of national policies which affect estuarine management, water quality and quantity in estuaries in general, land use, development and resource use in the estuarine environment.

White Paper (= Policy)	Bill or Act (= Law)	Lead agent	Implications
National Estuarine Management Protocol (as amended 2021)	National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008)	DFFE	The National Environmental Management: Integrated Coastal Management Act requires that estuaries be managed in a co-ordinated and efficient manner, in accordance with a National Estuarine Management Protocol through the development and implementation of estuarine management plans (EMPs). The EMPs seek to achieve greater harmony between ecological processes and human activities while accommodating orderly and balanced estuarine resource utilisation. The national vision for estuarine management is that “the estuaries of South Africa are managed in a sustainable way that benefits the current and future generations”.
Water quality & quantity			
White Paper on National Water Policy for SA (1997)	National Water Act 36 of 1998	DWS	Defines the environmental reserve in terms of quantity and quality of water; provides for national, catchment and local management of water
White Paper on Integrated Pollution and Waste Management for South Africa (2000)	Marine Pollution (Control and Civil Liability) Act (1981)	DFFE	Provides for the protection of the marine environment from pollution by oil and other harmful substances, the prevention and combating of such pollution, and the determination of liability in certain respects for loss or damage caused by the discharge of oil from ships, tankers and offshore installations.
	Integrated Coastal Management Bill (2007)	DFFE	Provides for the control of dumping of substances in the sea (including estuaries) (replaces the Dumping at Sea Control Act (1980) as amended).
Land use & management			
	Integrated Coastal Management Bill (2007)	DFFE / DEA&DP	Ownership of the seashore (includes the water and land between the low-water mark and the high-water mark in tidal rivers such as the Goukou Estuary) is vested in the State; currently used to control recreational boating activities in estuaries (replaces the Seashore Act (1935) as amended)
	Environmental Conservation Act (1989)		Most of the provisions of this Act have been repealed by NEMA, apart from the regulation on Sensitive Coastal Areas.
	National Heritage Resources Act (1999)	DFFE	Provides for managements of national heritage resources (including landscapes and natural features of cultural significance, and for participation of communities in the identification, conservation and management of cultural resources

White Paper (= Policy)	Bill or Act (= Law)	Lead agent	Implications
White Paper for Sustainable Coastal Development in South Africa (2000)	National Environmental Management: Integrated Coastal Management Bill	DFFE	Provides for integrated coastal and estuarine management in South Africa, and sustainable development of the coastal zone, defines rights and duties in relation to coastal areas; includes a National Estuarine Management Protocol for South Africa, and requires that estuarine management plans be developed and implemented for all estuaries
White Paper on Spatial Planning and Land-use Management (2001)	Local Government: Municipal Systems Act (2000)	Department of Provincial and Local Government (DPLG)	Requires each local authority to adopt a single, inclusive plan for the development of the municipality intended to encompass and harmonise planning over a range of sectors such as water, transport, land use and environmental management.
White Paper: Mineral and Mining Policy for South Africa (1998)	Mineral and Petroleum Resources Development Act (2002)	Department of Energy (DE)	Deals with environmental protection and management of mining impacts, including sand and coastal mining.
White Paper on the Conservation and Sustainable Use of South Africa's Biological Diversity (1998)			
Protected areas			
	National Environmental Management: Protected Areas Act (2003)	DFFE	Provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; and for establishment of a national register of national, provincial and local protected areas, describes the different types of protected areas that can be declared which may also apply to estuaries (repeals Section 43 of the Marine Living Resources Act (1998)).
	World Heritage Convention Act (1999)	DFFE	Provides for the incorporation of the World Heritage Convention into South African Law, and for the recognition and establishment of World Heritage Sites in South Africa.
	National Environmental Management: Biodiversity Act (2004)	DFFE	Provide for the conservation of biological diversity, and regulates sustainable use of biological resources.
Use of living resources & MPAs			
Marine Fisheries Policy for South Africa (1997)	Marine Living Resources Act (1998)	DFFE	Regulates living resource use within marine and estuarine areas, mainly through licensing.

Chapter 4 of ICMA aims to facilitate the efficient and coordinated management of all estuaries, in accordance with the National Estuarine Management Protocol (ICMA Section 33) (promulgated in 2013, with amendments finalised in 2021 as per Government Gazette Vol 672, Notice No. 44724, 2021) and estuarine management plans for individual estuaries (ICMA Section 34).

The purpose of the National Estuarine Management Protocol (NEMP) is to manage South Africa's estuaries in accordance with the national vision for estuarine management, which requires that "estuaries are managed in a sustainable way that benefits the current and future generations". As such, the purpose of the Protocol (as set out in the ICMA) is to:

- Determine a strategic vision and objectives for achieving effective integrated management of estuaries.
- Set standards for management of estuaries.
- Establish procedures or provide guidance regarding how estuaries must be managed and how the management responsibilities are to be exercised by different organs of state and other parties.
- Establish minimum requirements for estuarine management plans.
- Identify who must prepare estuarine management plans and the process to be followed in doing so, and
- Specify the process for reviewing estuarine management plans (EMPs) to ensure that they comply with the requirements of the ICMA.

The Draft Onrus Estuarine Management Plan (EMP) published by the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) comprises of a Situation Assessment Report and the Management Plan itself. The EMP sets out the Vision and Objectives for the Onrus Estuary and identifies management actions and objectives necessary to meet the requirement of the NEMP.

The Western Cape Government has also released a Coastal Management Policy which includes a suite of goals, objectives and strategies designed to achieve sustainable coastal development in the Western Cape Province. These goals and objectives are closely aligned with the National Coastal Management Policy and are organised within a number of themes. Various goals within each of these themes are of relevance to the management of the Onrus Estuary and are detailed in The promotion of wise use of estuarine resources and the protection and conservation of estuarine biodiversity requires not only the protection of estuarine habitat and biota, but also the protection of the physical processes/functions that sustain ecological and evolutionary processes. Therefore, to ensure the present and future health of estuaries, it is necessary to define the 'space' within which estuaries function over longer time scales—these areas are known as the 'Estuarine Functional Zone' (EFZ) (Van Niekerk & Turpie 2012a, Van Niekerk et al. 2013). The EFZ, as delineated by a 5 m above mean sea level (AMSL) contour as proxy indicator, is defined in Listing Notice 3 of the NEMA EIA Regulations (GN R985 of 2014) as "the area in and around an estuary which includes the open water area, estuarine habitat (such as sand and mudflats, rock and plant communities) and the surrounding floodplain area". The position of the EFZ for the Onrus estuary is indicated in Figure 2.1.

Table 2.2.

The promotion of wise use of estuarine resources and the protection and conservation of estuarine biodiversity requires not only the protection of estuarine habitat and biota, but also the protection of the physical processes/functions that sustain ecological and evolutionary processes. Therefore, to ensure the present and future health of estuaries, it is necessary to define the ‘space’ within which estuaries function over longer time scales—these areas are known as the ‘Estuarine Functional Zone’ (EFZ) (Van Niekerk & Turpie 2012a, Van Niekerk et al. 2013). The EFZ, as delineated by a 5 m above mean sea level (AMSL) contour as proxy indicator, is defined in Listing Notice 3 of the NEMA EIA Regulations (GN R985 of 2014) as “the area in and around an estuary which includes the open water area, estuarine habitat (such as sand and mudflats, rock and plant communities) and the surrounding floodplain area”. The position of the EFZ for the Onrus estuary is indicated in Figure 2.1.

Table 2.2. Summary of provincial policies pertaining to estuarine management.

Act/Ordinance	Lead agent	Implication
Municipal Ordinance (Cape) (1974)	DEA&DP	Grants local authorities in the province of the Western Cape the power ‘to drain storm water into any natural water course’.
Land Use Planning Ordinance (1985) as amended	DEA&DP	Provides for the establishment of the Western Cape Nature Conservation Board. Most planning applications received by the provincial department are in terms of this Act including applications for departure, rezoning or subdivision and appeals against planning decisions taken by a municipality.
Western Cape Planning and Development Act (1999)	DEA&DP	Provides guidelines for the future spatial development in province of Western Cape.
Nature Conservation Ordinance (1974)	Western Cape Nature Conservation Board (WCNCB)/ CapeNature	Provides for the establishment of provincial, local and private nature reserves and the protection of indigenous species of flora and fauna. Protected and endangered species of flora and fauna are listed in schedules to the ordinance. It is administered by the Western Cape Nature Conservation Board (WCNCB) and grants certain powers to the WCNCB.

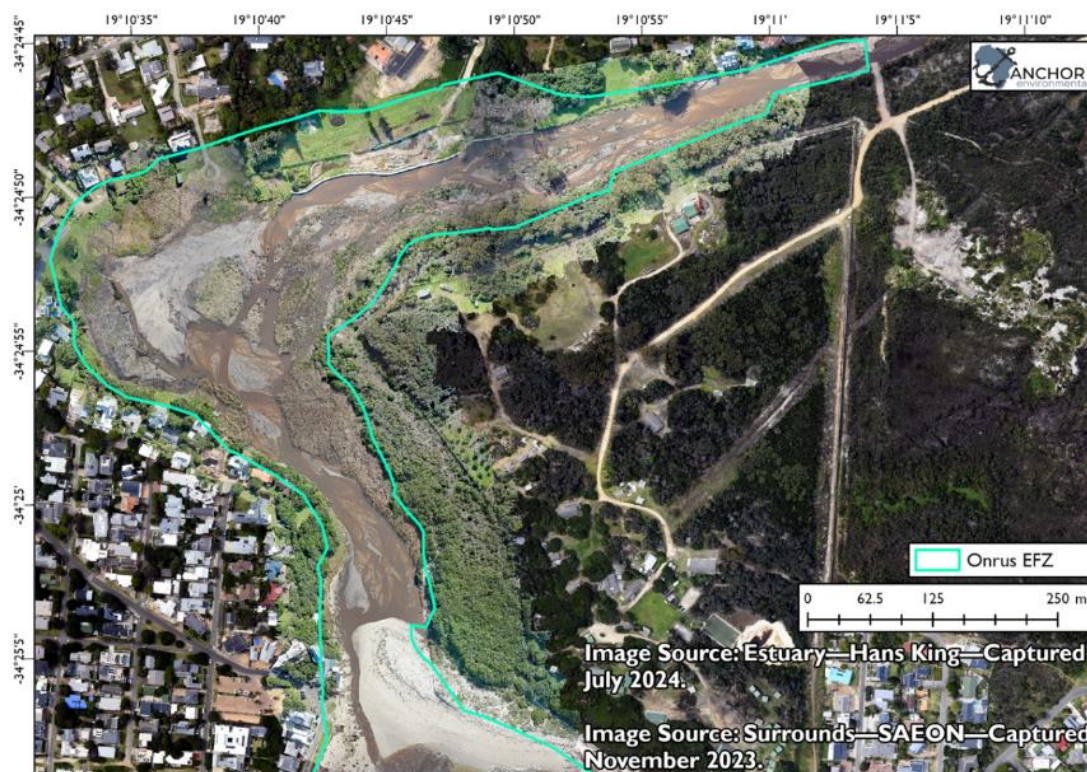


Figure 2.1. The Onrus Estuary, as captured in July 2024 via drone survey, with the surrounding area captured in November 2023 via aerial survey.

2.5 ESTUARY WATER QUANTITY AND QUALITY REQUIREMENTS

The White Paper on National Water Policy for SA (1997) promotes efficiency, equity and sustainability in the use of water resources through its slogan “some, for all, for ever”. The policy explicitly recognises the environment as a legitimate user of water and makes provision to protect the environment from overexploitation of water resources. Maintenance of an adequate supply of freshwater to estuaries is provided for under the National Water Act (NWA) (Act 36 of 1998). The NWA provides the legal framework for the National Water Policy making provision for a water “Reserve” required to meet basic human needs, as well as provision of water in the required quantity and quality to both support aquatic ecosystems and protect the natural functioning of a water resource. The latter portion of the reserve is known as the Environmental Reserve.

The DWS published classes and resource quality objectives of water resources for the Breede-Gouritz Water Management Area (BGWMA, of which the Onrus forms a part) in September 2020 (GN 1008 of 2020) under the NWA. It stipulated that the Onrus Estuary has a target minimum Ecological Category of “D” —Largely Modified. The relevant RQOs are summarised in Table 2.3).

Table 2.3. Summary of relevant RQOs for the Onrus Estuary (Gazette No. 43726, Notice No. 1008).

Sub-component	Indicator	RQO Narrative	RQO
Quantity			
Flow	MMR/MAR (% Nat)	Maintain a flow regime to create the required	MMR/MAR (%Nat) Apr: 49.7

Sub-component	Indicator	RQO Narrative	RQO
		habitat for birds, fish, macrophytes, microalgae and water quality	Oct: 55.6 Nov: 54.2 Dec: 53.8 Jan: 52.9 Feb: 51.2 Mar: 50.2 May: 49.0 Jun: 50.0 Jul: 49.8 Aug: 51.7 Sep: 54.8 Annual: 51.8
Quality			
Nutrients	DIN	Inorganic nutrient concentrations not to exceed Threshold of Potential Concerns (TPCs) for macrophytes and microalgae	Entire estuary and river inflow: DIN <300µg/l
	DIP		Entire estuary and river inflow: DIP < 25 µg/l
Salinity	Salinity	Salinity distribution not to exceed TPCs for fish, invertebrates, macrophytes and microalgae	10 < Salinity <40
System Variables	Dissolved oxygen	System variables not to exceed TPCs for biota	Entire estuary and river inflow: DO >5 mg/l
	Turbidity		Turbidity <5 NTU
Pathogens	Enterococci	Concentrations of waterborne pathogens should be maintained in an Acceptable category for full contact recreation	≤185 Enterococci/100 ml (90th percentile)
	Escherichia coli		≤500 E. coli/100 ml (90th percentile)
Habitat			
Hydrodynamics	Mouth state	Maintain connectivity with marine environment at a level that ensures water quality and habitat remains suitable for biota typically found in the estuary	Closed mouth state should not increase by >10% from established baseline
Sediments	Sediment characteristics, Channel shape/size	Flood regime is sufficient to maintain natural bathymetry and sediment characteristics	Channel shape/size, sediment grain size and organic matter must not change by >30% from established baseline
Biota			
Microalgae	Biomass and community composition of phytoplankton and benthic microalgae community	Maintain the composition and richness of phytoplankton and benthic microalgae groups and medium-low biomass	Control nutrient input from sewage spills to prevent microalgal blooms (> 20 µg l ⁻¹) and the occurrence of harmful algal bloom species; maintain the distribution of different phytoplankton groups (diverse community composition) and prevent dominance of Cyanophytes (blue-green algae) that occur under nutrient rich, freshwater conditions
Macrophyte	Extent, distribution and richness of macrophytes	Maintain extent, distribution and richness of macrophyte groups, limit colonisation/spread of the EFZ by alien species	Maintain the present area (2014) covered by the macrophyte habitats: open surface water area: 2.59, sand and mudflats: 1.86, reeds and sedges: 6.57, prevent further spread of reeds by reducing nutrient input and occurrence of aquatic invasive such as water fern Azolla.; prevent further disturbance and development in the riparian zone; remove alien plants from

Sub-component	Indicator	RQO Narrative	RQO
			the riparian zone and control the spread of garden invasive
Invertebrates	Macrofauna community composition, abundance and richness	Maintain composition, richness and abundance of different groups of benthic macrofauna and zooplankton	The estuary should have viable populations of <i>Callinassa kraussi</i> in sandy zones and <i>Upogebia africana</i> in muddy zones. Breeding in both species ceases at salinities lower than 17 ppt during prolonged mouth phase. In <i>U. africana</i> and export of larvae into marine and postlarvae back to estuary ceases; prolonged mouth closure should be avoided as this will result in a loss of marine species (e.g. <i>Pseudodiaptomus</i> spp.) from the zooplankton community.
Fish	Fish community composition, abundance and richness	Maintain composition, richness and abundance of different groups of fish, prevent colonisation/increase of alien species	Maintain fish assemblage that includes at least 2 estuarine breeding species (Category I), 2 estuary dependent marine species (Category II), 1 indigenous catadromous species (Category V) and two freshwater indigenous species (Category IV). Estuarine residents should dominate numerically (>50%), but estuary dependent marine species, indigenous catadromous and freshwater species should be present

The deposition of sediment in the Onrus estuary by recent floods has resulted in many of these RQOs not being met as of late 2024. For example, deposited sediment has raised the bed level of the estuary to such an extent that the entire estuary is now perched above the height of all but the highest spring tides, with the result being that sea water is barely able to penetrate into the estuary. Consequently, the RQOs for salinity, nutrient and other system variations such turbidity are either not being met at all or are being exceeded. Likewise, the RQOs for sediment and biota (microalgae, macrophytes, invertebrates, fish and birds) are also not being met. In summation, the health of the estuary, as of late 2024, has declined to an unacceptable low level of an “E” category which is below the established minimum requirement for this system.

Removal of sediment from the estuary by dredging has the potential to cause further short-term reductions in some of these parameters but these effects are likely to be short-lived and will be far outweighed by the long-term benefits of establishing a natural tidal regime for the estuary.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 OVERVIEW

The Onrus Estuary is a small temporarily closed estuary located within the cool temperate biogeographic region of South Africa (Van Niekerk et al. 2019a). The Onrus River Catchment (G40H) covers an area of only 59 km² and lies within the Overstrand Local Municipality (OLM, part of the Overberg District Municipality) in the Western Cape Province, and forms part of the Breede-Gouritz Water Management Area (BGWMA, Figure 3.1). The catchment is located within a winter rainfall region, where rainfall is brought by cyclonic low-pressure cells moving in an easterly direction south of the continent in winter (Heinecken & Damstra 1983). The region also experiences episodic heavy rainfall and flooding events in the early summer months, due to cut-off lows moving northwards from the South Atlantic. A cut-off low was responsible for the intense September 2023 Heritage Day floods. South-easterly winds prevail in summer, often resulting in seasonal drought conditions. River flow is therefore seasonal with interannual variability occasionally resulting in zero flow conditions during summer.

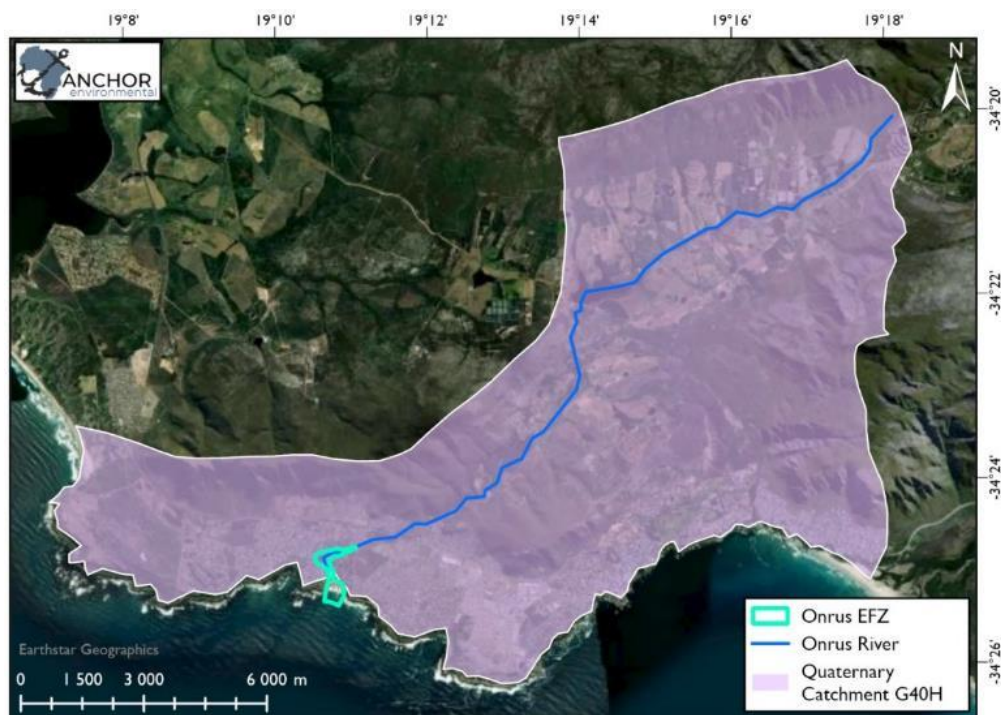


Figure 3.1. The location of the Onrus River and Estuarine Functional Zone (EFZ) within Quaternary Catchment G40H.

3.2 CHANGES IN SEDIMENTATION AND REEDBED EXTENT WITH TIME

The Onrus Estuary has undergone various changes in its form and bed level with time owing both to natural processes—such as erosion and deposition—as well as artificial processes, such as dredging.

Like many of South Africa's estuarine systems, the Onrus Estuary is influenced by upstream anthropogenic catchment alterations, such as farming, construction, etc., which has led to increases in the rate of sediment production and subsequent deposition within the downstream estuarine environment. In its natural state, the Onrus Estuary consisted of a large open water body largely devoid of sediment accumulation and encroachment from reeds (Figure 3.2). However, pressures, such as nutrient pollution—much of which is sewage-derived—and upstream catchment alterations and changes to the freshwater flow regime, have led to the proliferation nuisance-level of the freshwater reed *Phragmites Australis*, as well as rapid sedimentation. This *Phragmites* proliferation has had a further anchoring effect on estuarine sediment—leading to an increased rate of sediment accumulation as less is able to flush out into the nearby marine environment. A positive feedback loop is therefore created, wherein the *Phragmites* reeds trap more sediment and create new shallow-water areas in which these reeds can grow and proliferate—with water depths shallower than 1 m typically being identified as conducive for *Phragmites* growth. Over time, this has led to the advancement of the reedbeds into the estuarine area, which has increased sediment accumulation, decreased the estuaries flood attenuation capacity, and reduced the amount of seawater that can penetrate the estuary. These reedbeds further detract from the amenity value of the estuary for resident and tourist population, due to the limited open deepwater areas, and obstruction of views over the estuary, etc.

The following subsections consist of a discussion of the changes in estuarine form and depth in the historic period (1938-1989) as well as in recent decades (1990-2024). This includes a detailed GIS (Geographical Information Systems) mapping analysis of historical satellite imagery (sourced from Google Earth), as well as aerial photography (from multiple sources). Detailed GIS analysis of sediment accumulation and erosion was also conducted using survey data from 1994, 2002, 2014, 2021, 2023, and 2024. The data from 1994-2021 was kindly provided by Geomatics Africa and Gerrit Badenhorst; the 2023 data was kindly provided by the South African Earth Observation Network (SAEON) and includes both a high quality orthophoto and a digital elevation model (DEM) of the estuary captured during a plane-bound aerial survey conducted in November 2023 following the Heritage Day floods; finally, the 2024 data was provided by Hans King (of Hans King Sustainable River Stabilization) for Anchor Environmental and Mr Johan Rupert, and provides an up-to-date snapshot of estuarine conditions and includes a high quality orthophoto and DEM.

3.2.1 EARLY REEDBED EXPANSION AND SEDIMENT ACCUMULATION: 1938–1989

Reed encroachment and sedimentation was first documented in the estuary in a study conducted as part of the Estuaries of the Cape Series published by the CSIR in the early 1980's (Heinecken & Damstra 1983). The authors of this study found that large open water areas had been replaced with extensive reed growth between 1921 and 1976. Aerial photographs from 1938, 1961, 1973 and 1989 confirm this trend (Figure 3.2). In 1938, reeds were confined to isolated patches on the northern shore, but by 1961 reedbeds had spread along this shoreline, and by 1973, three years before the De Bos Dam was built, the main waterbody was largely covered by reeds. By 1989, the channels were being choked, and open water had been reduced to only 25% of the total estuary area, compared to 61% in 1938. It was therefore concluded that, in the absence of a good management policy, sedimentation would continue, and that the reedbeds would extend towards the mouth.

3.2.2 CHANGES IN CHANNEL MORPHOLOGY AND REEDBED EXTENT PRIOR TO THE SEPTEMBER 2023 FLOODS: 1990–2022

In 1991, a CSIR report compiled for the Save Onrus Lagoon Committee, recommended that the estuary be dredged to remove reeds and sediment build up (CSIR 1991). This dredging was undertaken between the end of 1992 and mid-1993, when approximately 30 000 m³ of material was removed from the system. The 1994 topographic survey conducted after the dredging revealed that water depths reached 1 m below Mean Sea Level (MSL) in a few areas (Figure 3.8, Figure 3.9, and Table 3.1).

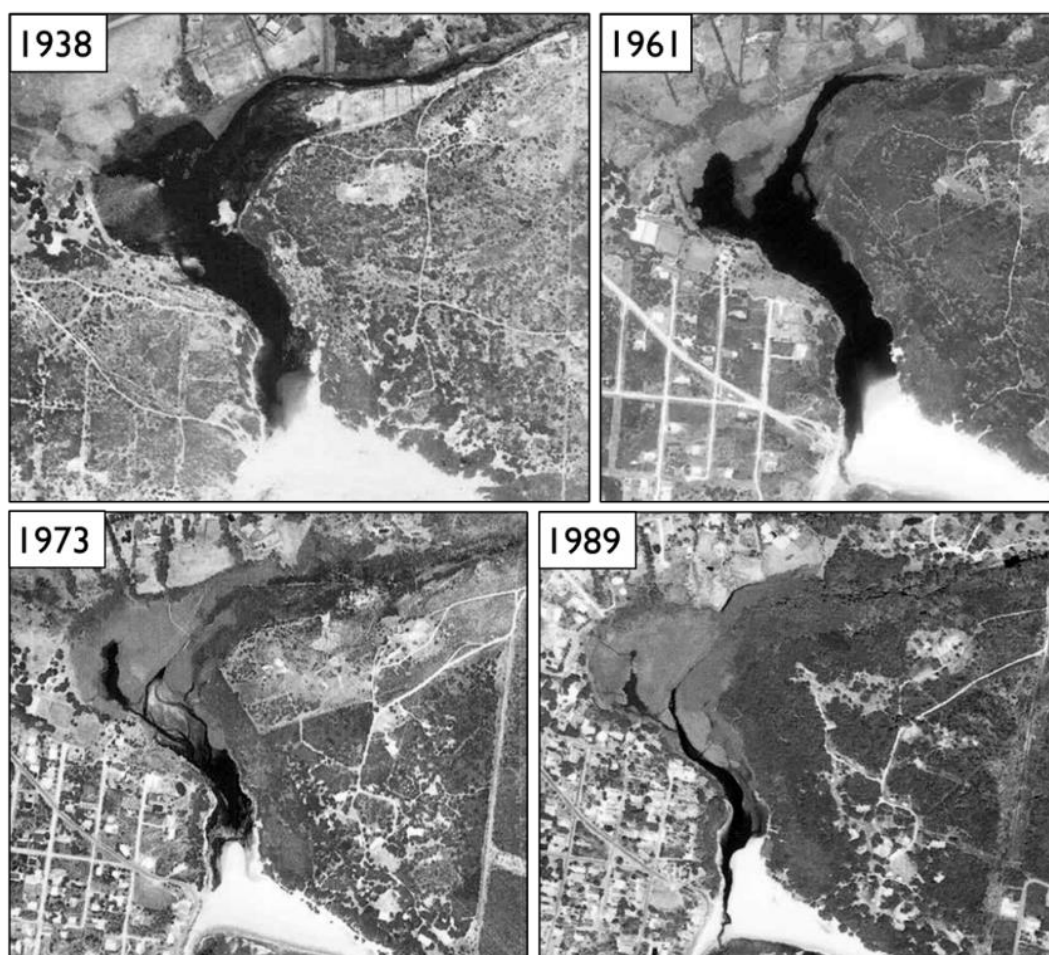


Figure 3.2. Historical aerial photography of the Onrus Estuary in 1938, 1961, 1973, and 1989.

In 2002, increased vegetation in the upper reaches of the lagoon and the lack of any major flood events meant that there had been no substantial change in sedimentation within the system—with much of the observed changes constituting the redistribution of sediments into the previously dredged areas—with a negligible change in average bed level of -0.13 Metres Above Mean Sea Level (mAMSL) (Table 3.1, Figure 3.6, Figure 3.8, and Figure 3.9). However, much of the overall estuarine form remained consistent. Furthermore, satellite imagery from 2004 shows a continuation of this sediment redistribution, particularly on the western edge of the central bend (Figure 3.6).

In 2014—12 years since the 2002 bathymetric survey—bathymetric data revealed that, while some sedimentation had occurred in the middle reaches of the estuary (specifically on the inner edge of the bend), there had been substantial scouring and erosion of a central estuarine

channel (with the bed level dropping by 0.58 m). This scouring resulted in an increase in the overall volume of the system and allowed for the intrusion of a larger tidal prism (the total volume of seawater able to penetrate the estuary from the sea) and therefore an improvement in estuarine health. These changes are clearly evident in Figure 3.6, Figure 3.8, and Figure 3.9, wherein a deep central channel had been scoured between 2002 and 2014 to an average depth of -0.5 mAMSL. In addition to providing suitable habitat for estuarine fish, bird, and invertebrate species, this deep channel also facilitated better recreational use of the estuary, such as swimming, boating, etc. Therefore, despite the deposition in the central channel, the 2014 conditions likely represent the most ideal estuarine conditions observed in recent decades.

The overall estuarine shape thereafter remained largely the same between 2014 and 2021/2022 (Figure 3.6). However, a notable amount of deposition was observed from the 2014 condition, with the estuarine bed level raising by +0.48 mAMSL (Figure 3.8 and Figure 3.9). Despite the raising of the bed level in the central channel to approximately mean sea level (-0.02 mAMSL) in 2021, a substantial tidal prism was still able to penetrate into the estuary, and proper estuarine function was retained.

Table 3.1. Left: Average estuarine channel bed level observed in surveys since 1994. Right: Average change in the estuarine channel bed level observed in surveys since 1994.

Year	Average Central Channel Elevation (m)	Time Period	Average Central Channel Elevation Change (mAMSL)
1994	+0.21	1994–2002	-0.13
2002	+0.08	2002–2014	-0.58
2014	-0.50	2014–2021	+0.48
2021	-0.02	2021–2023	+1.08
2023	+1.06	2023–2024	+0.45
2024	+1.51	2021–2024	+1.53
		2014–2024	+2.01
		1994–2024	+1.30



Figure 3.3. Aerial view of the Onrus Estuary before the 2023 floods (Onrus River Estuary Forum (O.R.E.F, No Date)).

3.2.3 THE SITUATION FOLLOWING THE SEPTEMBER 2023 FLOODS

The situation changed dramatically following the September 2023 “Heritage Day” flood event. This flood—which is estimated to have exceeded the 1/100 year flood recurrence interval due to its intensity—resulted in substantial erosion of the Palmiet Peat Wetlands located upstream (Table 3.1). These floods had significant estuarine impacts, and resulted in the infilling of the entire estuarine channel with sediment, with an excess of 1 metre of vertical sediment deposition occurring in most of the central channel since the 2021 survey, with deposition exceeding 2 metres in some areas (Table 3.1, Figure 3.8, and Figure 3.9). This led to almost the entire central estuarine bed area being infilled with sediment, with only a small channel present between the western bend and the mouth. The floods also resulted in the washing away and/ or burying of much of the Phragmites reedbeds, as well as erosion and destruction to property on the western edge of the estuary (Figure 3.4).



Figure 3.4. Aerial photograph of the Onrus Estuary following the September 2023 floods.

3.2.4 THE PRESENT CONDITION—2024

The highly impacted condition of the Onrus estuary following the 2023 Heritage Day Floods has largely persisted and intensified as of November 2024—with the entire estuary being characterised by expansive open mudflats, which are largely devoid of vegetation (Figure 3.5, Figure 3.7, Figure 3.8, and Figure 3.9). The primary observable changes between the 2023 and 2024 surveys are the addition of some sediment to the system (likely due to continued erosion of the upstream wetlands) as well as the redistribution of the sediments deposited in late 2023. This has resulted in the complete infilling of the lower estuarine channel (between the western bend and the mouth), with the average elevation in the channel now exceeding 1.5 mAMSL. The estuary is now characterised by perched sandflats and small, deltaic-like, channels with minimal depth of water (generally less than 10 cm) (Figure 3.5). Concerningly, the estuary bed level is now so high that it’s perched above the height of the twice-monthly Spring High Tides, therefore preventing saline ingress into the estuary. The result is that the estuary now has essentially no tidal prism, and is functioning as a freshwater riverine outlet. The absence of an

open body of water further means that there is essentially no available habitat for estuarine fish and invertebrate species—leading to knock-on effects for species that rely on them as a food source (such as waders and piscivorous birds, which is further discussed in Section 3.9). The system has consequently lost almost all of its true estuarine function due to the flood-derived sedimentation and its associated knock-on effects.

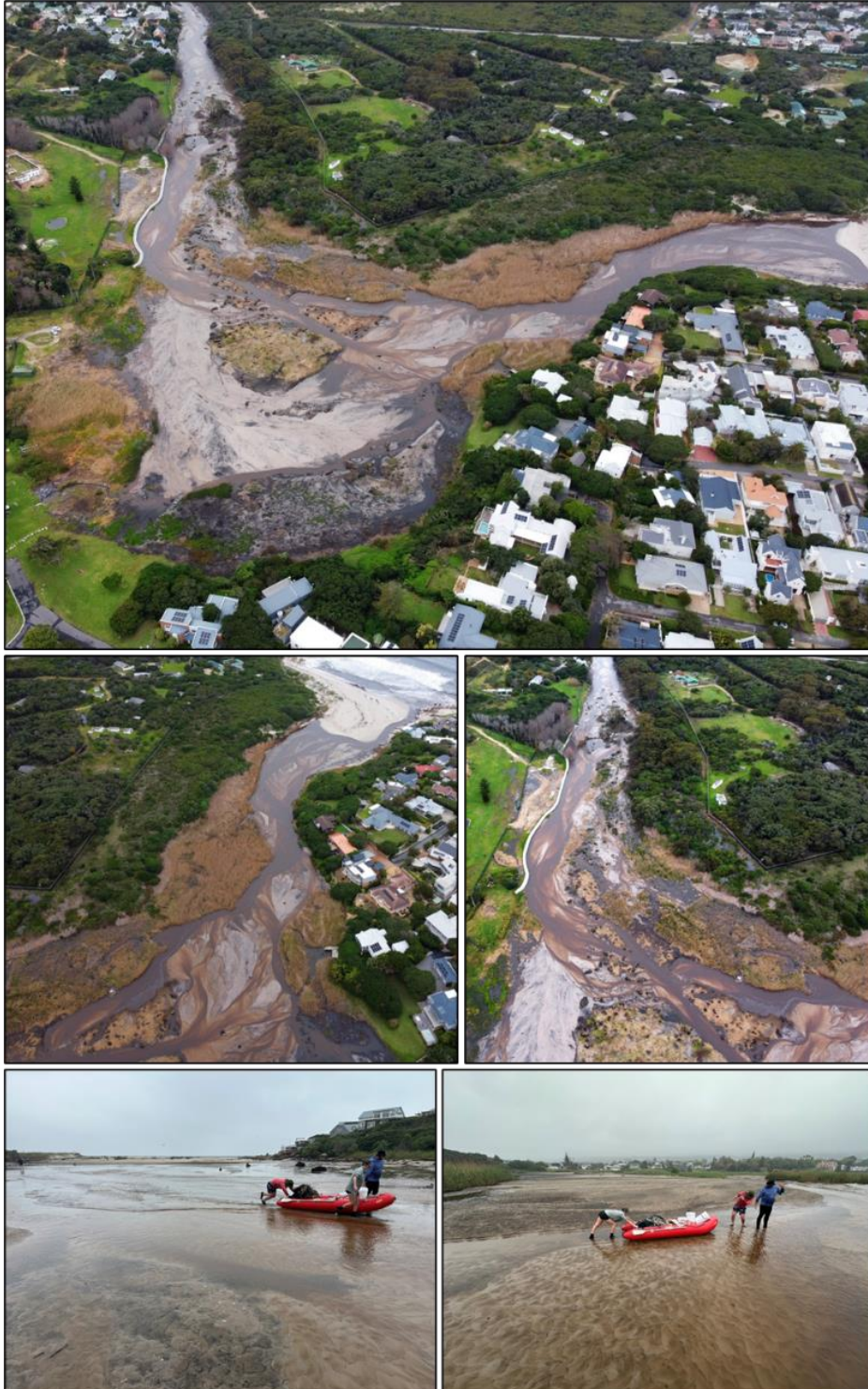


Figure 3.5. Top and Middle: Aerial drone photography of the Onrus Estuary captured in July 2024 (King 2024). Bottom: Images captured during the October 2024 Ecological Health Survey showing the extensive sedimentation and absence of an estuarine water body.

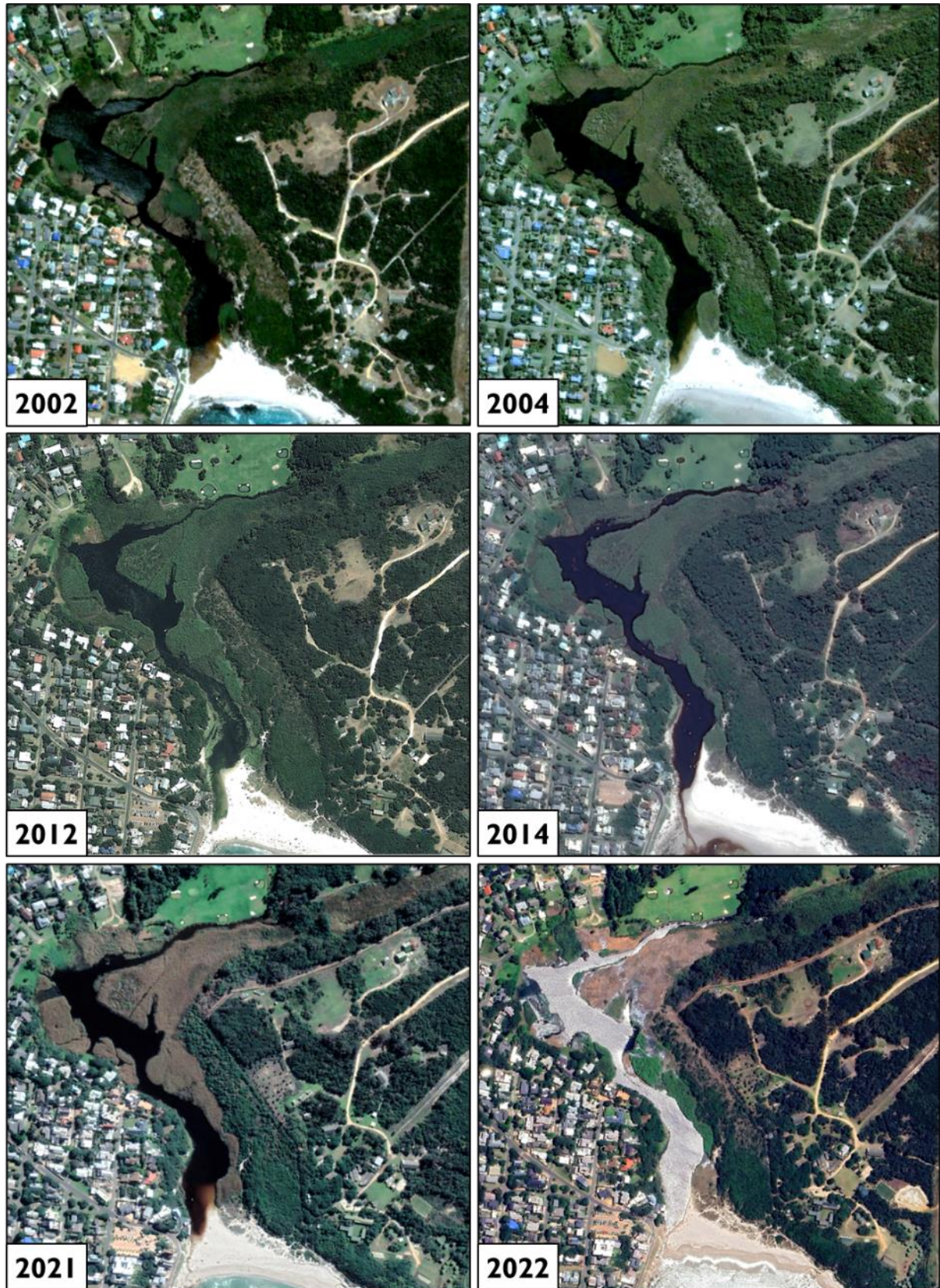


Figure 3.6. Google Earth Satellite imagery of the Onrus Estuary in 2002, 2004, 2012, 2021, and 2022.

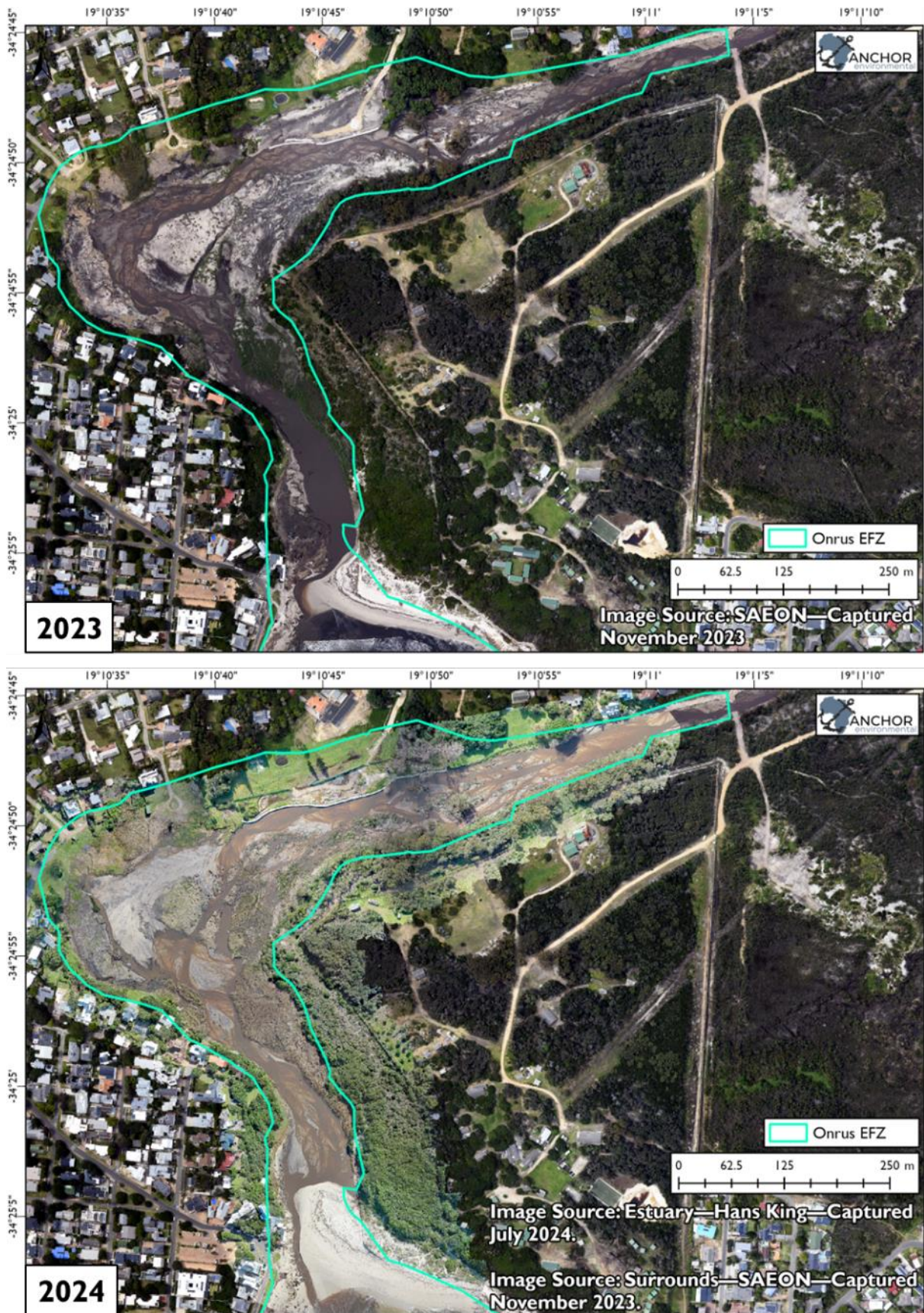


Figure 3.7. Top: Aerial imagery of the Onrus Estuary captured by the South African Earth Observation Network (SAEON) in November 2023 (SAEON 2023). Bottom: Aerial imagery of the Onrus Estuary captured by Hans King in July 2024, with the area surrounding the area being filled-in with the 2023 SAEON imagery (King 2024).

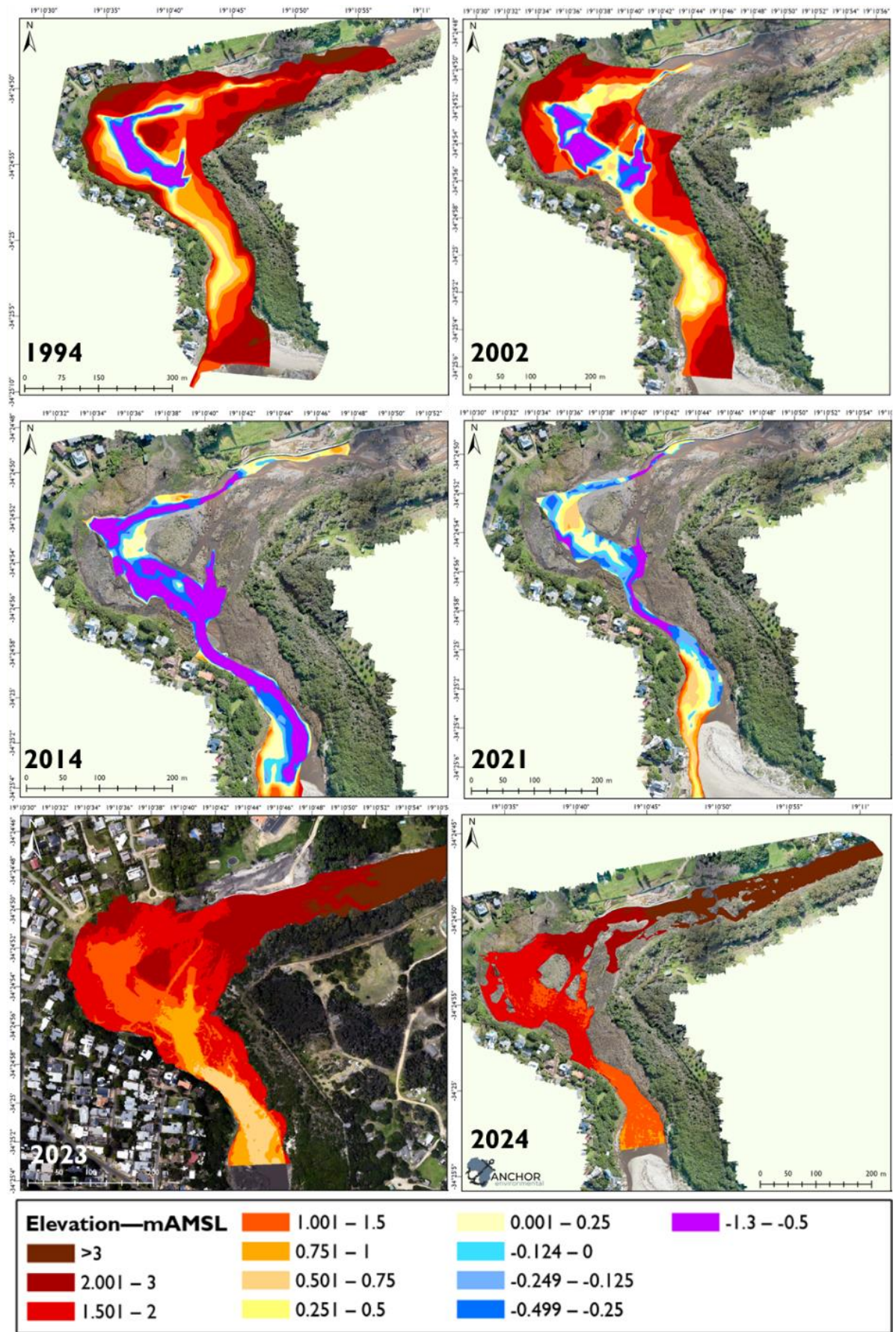


Figure 3.8. Estuarine bed level in 1994, 2002, 2014, 2013, 2023, and 2024 (Geomatics Africa 2021, SAEON 2023, King 2024).

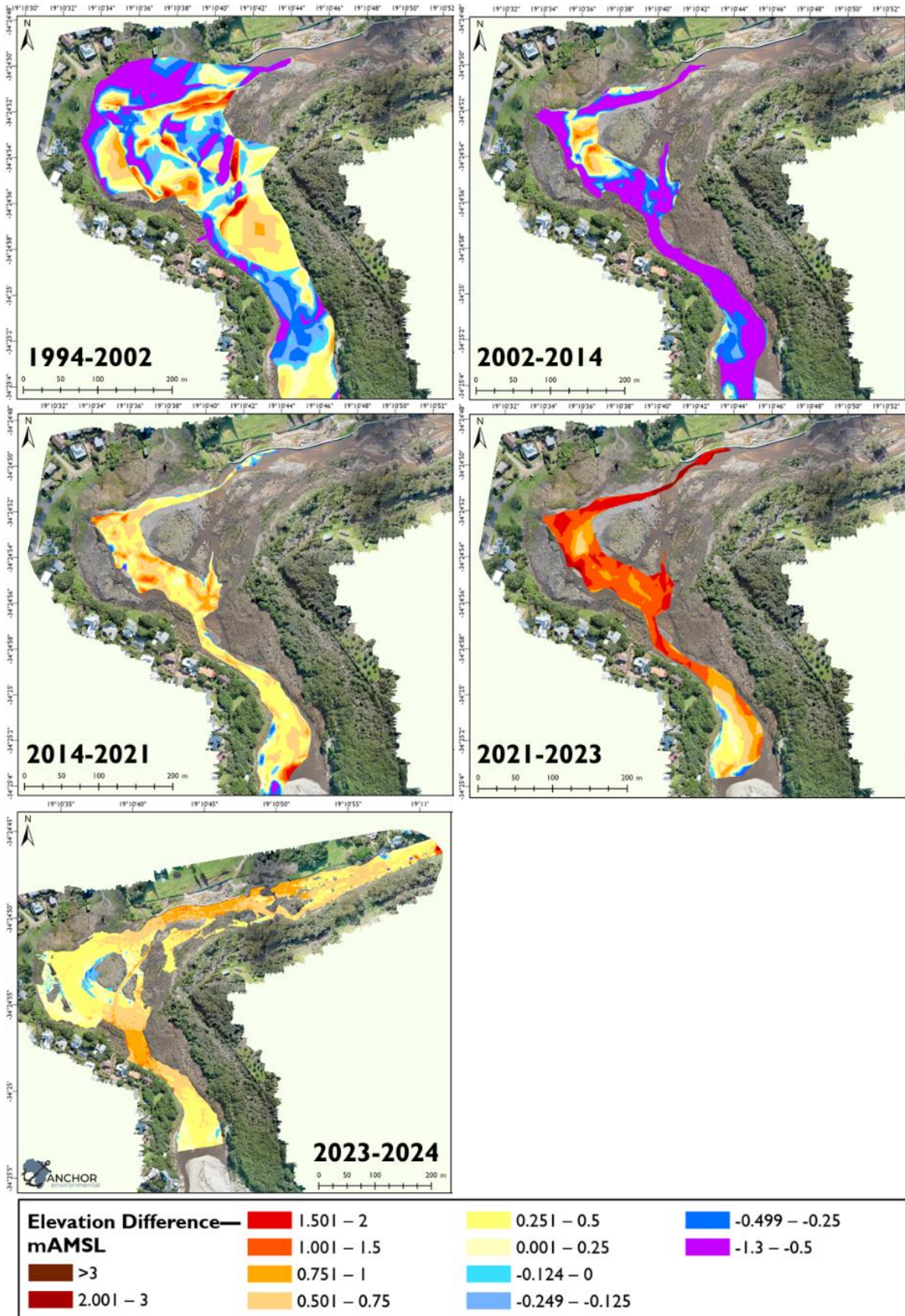


Figure 3.9. Change in estuarine bed level observed through GIS analysis of bathymetric survey data for the following time periods: 1994–2002; 2002–2014; 2014–2021; 2021–2023; and 2023–2024 (Geomatics Africa 2021, SAEON 2023, King 2024).

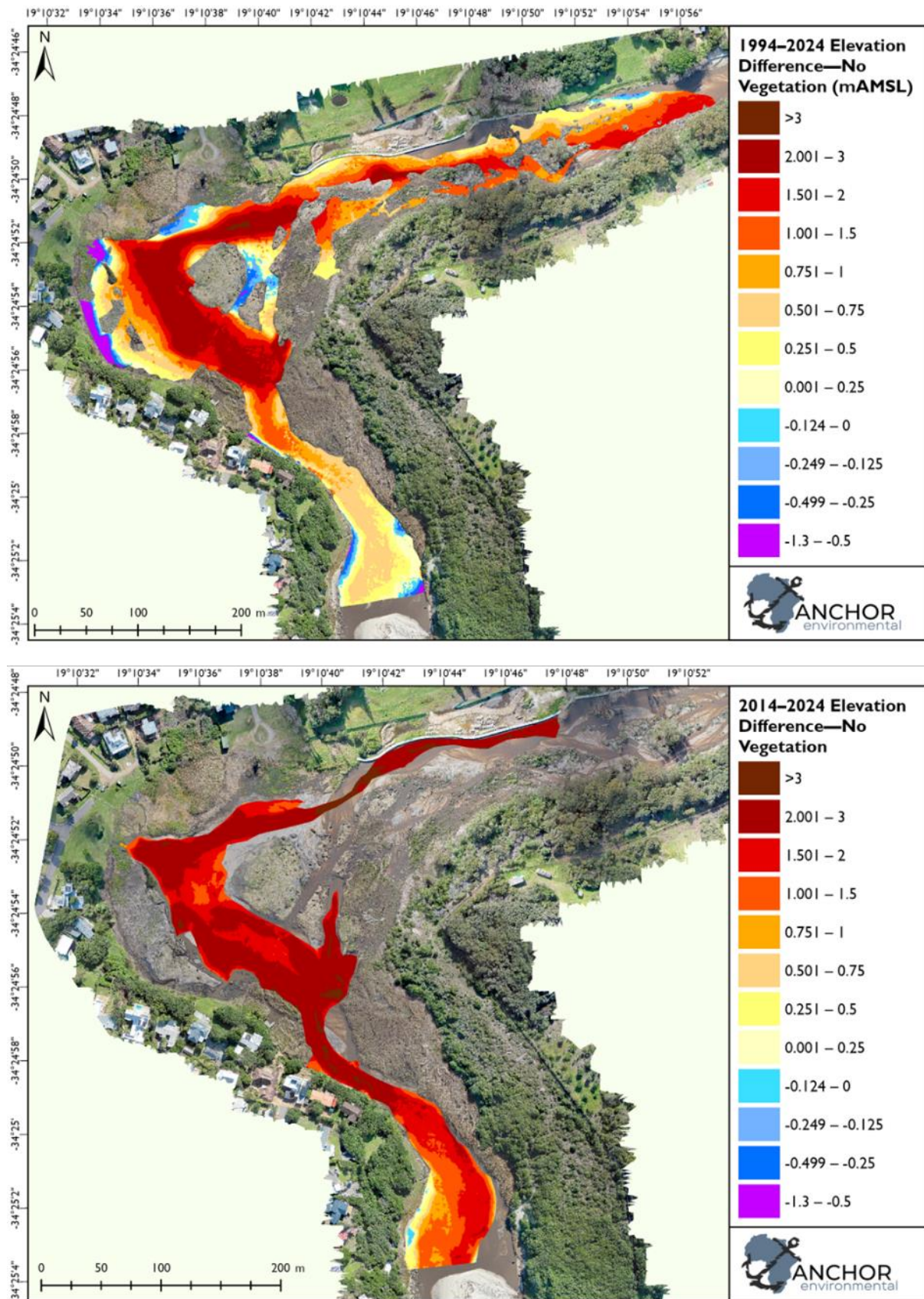


Figure 3.10. Change in estuarine bed level observed through GIS analysis of bathymetric survey data between 1994 and 2024 (Top), and between 2014 and 2024 (Bottom) (*Geomatics Africa 2021, King 2024*).

Of additional concern is that, while the estuary mouth was still open to the sea via a narrow channel on the western edge as of November 2024, this is likely to close as soon as rainfall and freshwater inputs decrease. The resultant reduction in flow rates could lead to further sedimentation within the estuary, therefore raising the bed level even higher and further reducing the volume of water the system can hold. Elevated bed levels in the estuary also pose a major risk to human health and properties and infrastructure that surround the estuary (see next section).

3.3 FLOOD RISK

Beyond the concerns to estuarine health and function described in the previous section, the current high estuarine bed level and lack of basin volume also poses a serious future flood risk and concern. This is evidenced by the fact that—although the Heritage Day floods were of extremely high intensity and caused substantial damage to the estuary and some adjacent infrastructure and property—the combination of the reedbeds and deep estuarine channel allowed for the slowing down (attenuation) and capture of much of the floodwaters, thereby preventing greater damage. During these floods, the sediment-laden inflowing water slowed down dramatically in the reeded areas and in the western estuarine bend, resulting in massive deposition of sediment in these areas, hence avoiding extreme levels of flooding in the town of Onrus (Figure 3.11). However, since these floods—and subsequent deposition and “flattening-out” of the estuary in 2024—the potential for meaningful attenuation of flood water within the estuary has been limited. Under present conditions, there is essentially no true bank slope in the middle reaches of the estuary, with the estuarine bed level being essentially at the same level as the surrounding town.

The above condition is greatly concerning, as future floods—even those of much lesser magnitude than those in 2023—can be expected to wash directly into the estuary with great velocity. These floodwaters will then directly overtop along the western estuarine bend due to the absence of a sizeable receiving basin and energy-dampening vegetation and (represented visually in Figure 3.11 below) and will likely flood the town of Onrus. Such flooding has the potential to damage residential properties and place residents at risk of drowning. Furthermore, local infrastructure will also be threatened—and potentially compromised—with the Onrus Main Sewage Pump Station (located to the west of the bend, and just out of shot in Figure 3.11) being particularly at risk. Should the pump station be compromised due to flooding, there would be a breakdown in sanitation infrastructure. This will likely result in sewage spills, both at the pump station itself, as well as from the surrounding sewage reticulation network which is dependent upon it. Such spills represent a threat to both human and ecological health due to pollution with bacteria, ammonia, and other nutrients. Finally, such a flood event will likely deposit large volumes of sediment in the town itself, therefore leading to an additional maintenance/ cleanup burden for local service providers and residents.



Figure 3.11. Blue: movement of sediment and floodwaters into the estuary during the September 2023 floods. Orange: anticipated flooding and sediment deposition within the Town of Onrus during future flood events should current conditions persist.

3.4 ESTUARINE AND FRINGING VEGETATION

3.4.1 PREAMBLE

Below follows a discussion of vegetation both within and fringing the Onrus Estuary, ascertained from both the recent Ecological Health Assessment (Clark et al. 2024) and historical resources. It must be noted that the 2023 Heritage Day floods have eliminated almost all estuarine vegetation aside from a few remaining stands of *Phragmites australis*. The following section therefore includes both a description of the current estuarine vegetation, as well as a review of available information on vegetation communities present in the estuary prior to the 2023 flood. A list of species recorded in the estuary as of the 2018 NBA and 2022 update of the Estuarine Management Plan, are listed in Table 3.2 below.

3.4.2 MICROALGAE

No information on typical micro-algal assemblages or chlorophyll concentrations is available for the Onrus Estuary. However, analysis of the dense detritus from an algal bloom collected from the shallows in June 2012 revealed a mixed assemblage of diatoms, with four species of blue-green algae present.

3.4.3 MACROALGAE AND MACROPHYTES

The filamentous algae *Cladophora* occasionally used to bloom in the system, forming dense floating mats. These mats constitute an unsightly sludge when they became stranded on the shoreline, and generated foul odours as they decomposed. The stonewort algae *Chara* has also historically been recorded to occur along with the fennel-leaved or sago pondweed *Stuckenia pectinata*, in the bottom mud of the upper parts of the estuary, where water depths were sufficiently shallow for these rooted plants (Heinecken & Damstra 1983). Under typical

conditions, these two species were the dominant macrophytes in the system and provided valuable sites for the attachment of aquatic fauna, and food for Red-knobbed Coot. The red water fern *Azolla filiculoides*, a floating alien invasive weed from South America, was occasionally found in patches amongst the reeds, but tended to die back without the need for intervention. The indigenous blue water lily *Nymphaea nouchali* was recorded on the estuary in summer 2011. Small quantities of kelp periodically also washed over the berm into the estuary during high seas, and would rot in the shallows.

Unfortunately, as of the October 2024 site visit, no submerged macrophytes were observed in the estuarine body, which can likely be attributed to a combination of these macrophyte beds being washed away and/ or smothered during the Heritage Day Floods, in addition to the water now being too shallow for their establishment.

Table 3.2. Estuarine vegetation recorded in the Onrus Estuary as of the 2018 NBA.

Macrophyte Species			
Scientific Name	Common Name	Scientific Name	Common Name
<i>Triglochin elongata</i> <i>Buchenau</i>	Upper tidal arrowgrass	<i>Typha capensis</i>	Common bulrush
<i>Juncus acutus</i>	Sharp Rush	<i>Pelargonium capitatum</i>	Rose geranium
<i>Juncus kraussii</i>	Salt Marsh Rush	<i>Tetragonia decumbens</i>	Dune spinach
<i>Stenotaphrum secundatum</i>	St. Augustine grass	<i>Tetragonia fruticosa</i>	Kinkelbossie
<i>Stuckenia pectinata</i>	Sago pondweed	<i>Carpobrotus acinaciformis</i>	Dune sour fig
<i>Phragmites australis</i>	Common reed	<i>Ficinia pygmaea</i> Boeck	Star grass
<i>Schoenoplectus corymbosus</i>	Common Sedge Basket Grass	<i>Phragmites australis</i>	Common reed
Alien Invasive Species			
<i>Cortaderia selloana</i>	Pampas grass	<i>Datura stramonium</i>	Jimsonweed
<i>Pennisetum clandestinum</i>	Kikuyu grass	<i>Myoporum tenuifolium</i>	Mousehole Tree
<i>Schoenoplectus triquetra</i>	triangular club-rush	<i>Paraserianthes lophantha</i>	Plume albizia
<i>Thinopyrum distichum</i>	Coastal Wheatgrass	<i>Acacia cyclops</i>	Red-eye wattle
<i>Canna indica</i>	African arrowroot	<i>Datura stramonium</i>	Jimsonweed

3.4.4 REEDBEDS

The Onrus Estuary has been consistently threatened by the encroachment of the highly competitive common reed *Phragmites australis*, which forms dense, homogenous, reedbeds. These reedbeds progressively encroach into the estuary with time—due to both nutrient pollution and sediment deposition—leading to significant changes to channel morphology and estuarine function.

Despite being heavily impacted by the Heritage Day Floods, these reedbeds are recovering rapidly—with the shallow, nutrient-rich, conditions facilitating this. However, despite the issues caused by these reeds, they do perform several functions, such as attenuating flood energies and acting as a sink for excess nutrients entering the estuary (and potentially improving water quality). Their function as a nutrient sink is most effective when these

reedbeds are harvested periodically—and therefore the nutrients are prevented from being recycled back into the system. Furthermore, as of the 2024 field survey, the *Phragmites* reedbeds represents the only plant in the estuary still capable of fulfilling this function, due to the loss of the submerged macrophyte populations (discussed above). However, the prolific nature of these reeds, means that they are likely to rapidly colonise the newly exposed mudflats, therefore resulting in further worsening of the estuarine condition.

3.4.5 TERRESTRIAL VEGETATION

The estuary would historically have been surrounded by Overberg Sandstone Fynbos, apart from Overberg Dune Strandveld on the western and eastern shores. These vegetation types have been completely transformed by residential development on the northern and western shores, but white milkwoods still occur between and in front of the houses. On the eastern bank, land donated to WWF (then Southern African Nature Foundation) in the early 1990s and demarcated a bird sanctuary, still has a rich plant community with species representative of Overberg Dune Strandveld. The sanctuary was previously cleared of invasive vegetation by the Onrus Lagoon Trust and Overstand Municipality, but follow-up work has not taken place for some time.

Much of the terrestrial environment surrounding the estuary is now dominated by alien plant species. Species identified in the 2018 NBA, and likely to constitute the majority of these invasions, are listed in Table 3.2. However, given that the invaded areas are mostly heavily forested, it is anticipated that the majority of the infestation is from invasive tree species including Red-eye wattle *Acacia cyclops*, Port Jackson *Acacia saligna*, Black wattle *Acacia mearnsii*, Plume albizia *Paraserianthes lophantha*, and Mousehole tree *Myoporum tenuifolium*. Indeed, it is known that the area to the east of the estuary—including both the Habonim Property and the Municipal land further north—is heavily infested with alien *Acacia* species. This alien infestation is further demonstrated by the Invasive Alien Trees (IAT) genus data presented on the Cape Farm Mapper by way of Dr Alanna Rebelo of the Agricultural Research Council (ARC), which shows that much of the Onrus area is most heavily infested with Wattle, followed by Pine, Gum, “Other” (likely indicating invasive shrub species), and Poplar (Figure 3.12). Concerningly, Figure 3.13 indicates that the extent of this alien infestation has increased in extent since 2021.

This screening affirms the understanding that the infestation is systemic, and that alien species are dominating the open areas in the vicinity of the estuary. A limitation of these forms of satellite analysis is that it is not possible to fully ascertain the extent of indigenous vegetation remaining in-and-around these alien stands. However, it is likely that—since much of these invasions are from acacia species, which are known to alter the surrounding soil chemistry and rendering it unsuitable for indigenous plants—little indigenous vegetation persists in these areas.

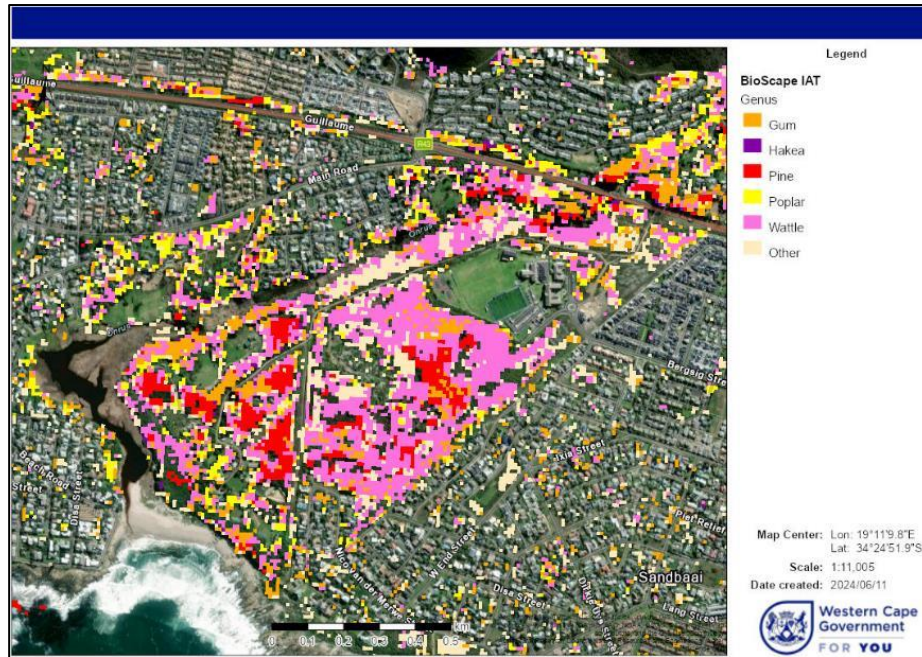


Figure 3.12. Alien Invasive Tree (IAT) Species present in the area surrounding the Onrus Estuary as per the Cape Farm Mapper (Rebello & Coertze 2024).

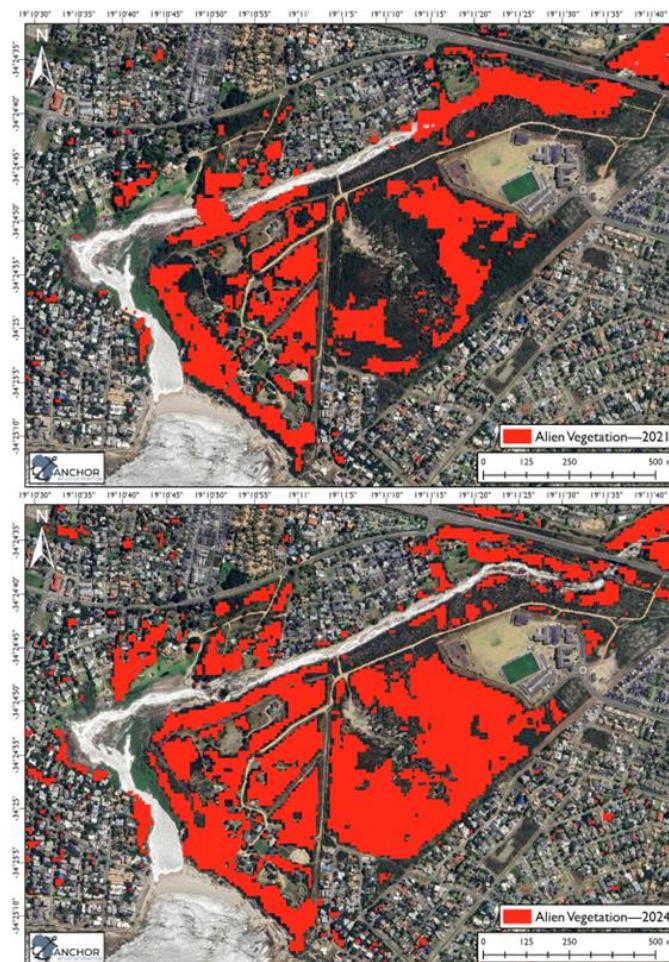


Figure 3.13. Change in the extent of alien invasive vegetation between 2018 and 2024—as delineated by satellite analysis.

3.5 WATER QUALITY

3.5.1 SALINITY

Under historical conditions, the mouth of the Onrus was predominantly closed, but did occasionally break open for short periods after heavy rainfall (Heinecken & Damstra 1983). A narrow channel that mostly functioned as an overflow from the estuary did scour deeper on occasions, resulting in brief periods of tidal influence before it closed again. Typically, seawater only entered the estuary via this overflow at spring tides and was washed out again relatively quickly by river flow. When the mouth was closed, seawater could also enter the lagoon when waves broke over the sand bar, particularly during storm conditions (Heinecken & Damstra 1983). Historical information suggests that the estuary has always been a freshwater-dominated system where instantaneous salinity measurements varied from 0-4 parts per thousand (ppt) during the closed state, to 31.7 ppt when the estuary was open to the sea (Heinecken & Damstra 1983, S. Lamberth, *Pers. Comment*, Overstrand Municipality 2013),

However, since the flood in September 2023 the estuarine bed level is now perched above the level of spring high tides—which means that essentially no salt water is able penetrate the estuary. This is substantiated by field testing in June 2024, as well as the estuary health survey undertaken in October 2024. Salinity levels at all sites except for Onrus 1 (located immediately upstream of the estuary outlet) displayed salinity values less than 0.2 parts per thousand (PPT) which is indicative of freshwater conditions. Furthermore, despite Onrus 1 being located immediately upstream of the outflow channel, it still had a recorded salinity of only 1.59 PPT, indicating that only a very small amount of seawater was able to penetrate the estuary. Of additional concern is that these salinities are much lower than what is stipulated in the RQOs for the Onrus estuary (RQOs require salinities between 10 and 40 PPT).



Figure 3.14. October 2024 Ecological Health Assessment Sampling Locations.

Table 3.3. Water Quality Parameters recorded for the Onrus Estuary on the 8 October 2024.

Site	Temperature	LDO (mg/L)	pH	Salinity (PPT)
Onrus 1	18.1	5.76	7.03	1.59
Onrus 2	17.6	8.7	7.62	0.19
Onrus 3	18.4	7.42	7.16	0.21
Onrus 4	17.8	9.08	7.74	0.17
Onrus 5	17.7	9	7.43	0.17
Onrus 6	17.8	9.12	7.25	0.17
RQO Requirements	n/a	>5	n/a	10-40

3.5.2 TURBIDITY AND VISIBILITY

The Onrus estuary is known to have relatively high turbidity (low water clarity) due both to the presence of suspended particular matter as well as dissolved tannins from vegetation within the catchment. Turbid conditions limit penetration of light through the water column and can limit growth of aquatic plants. Turbid conditions were observed in both the October 2024 field survey and June 2024 site visit, with low water visibility across all sites. This has likely been exacerbated by the continued erosion of the Onrus Palmiet wetlands upstream, which is likely adding to turbidity levels in the system and limiting regrowth of submerged macrophytes.

3.5.3 PH

The inflowing water from the Onrus river historically had relatively low pH (5.5-5.9 recorded at the R43 road bridge during the 2004-2005 River Health Programme monitoring, DWAF 2006) and a brown colour, typical of 'blackwater' rivers of the Southwestern Cape. A 2013 survey recorded higher pH values for the system, with recordings ranging from 6.5 in the river section to 7.3 in the mouth area (Massie & Clark 2016b).

The pH range observed in the October 2024 survey were similar to those seen in 2013, with values ranging from 7.03 near the mouth to 7.74 in the middle reaches of the estuary (Table 3.4). An interesting observation is that there no longer seems to be a trend of lower pH in the upper reaches, and higher pH near the mouth—which is likely indicative of how little seawater is able to penetrate into the estuary and raise the pH (since seawater typically has a pH of ~8.1).

3.5.4 DISSOLVED OXYGEN

Dissolved oxygen (DO) levels in estuarine systems are often linked to ecological productivity. Estuarine species typically need DO concentrations exceeding 2 mg/l to survive. Positively, DO in the Onrus Estuary was found to be at good levels during the October 2024 survey, with concentrations ranging between 5.76 mg/l at the mouth to 9.12 mg/l in the upper reaches. Additionally, all DO readings exceed the RQO guideline of 5 mg/l, indicating that the estuary is well-oxygenated, and is indicative of fast flowing, shallow, water. Furthermore, despite being above the 5 mg/l threshold, the DO at Onrus 1 (near the mouth) was much lower than the other sites, which is likely a product of the breakdown of organic matter in the channel at that point.

3.5.5 NUTRIENTS

The state of nutrient enrichment and contamination has varied substantially with time in the Onrus System. Nutrient concentrations were found to be low during the 1979 survey, with Heinecken & Damstra (1983) concluding that, there was no evidence of eutrophication, or nutrient input from sewage or of excessive fertilisation. Nutrient concentrations recorded in 1979 were as follows: Nitrate 0.008–0.08 mg/l (average: 0.03 mg/l); ammonia 0.01–0.04 mg/l (average: 0.02 mg/l); and phosphate 0.007–0.1 mg/l (average: 0.06 mg/l)

The October 2024 results show a similar trend to the above, with only two samples having Dissolved Inorganic Nitrogen (DIN) concentrations exceeding the 0.3 mg/l RQO Guideline concentration (Table 3.4). The same is likely true for Orthophosphate, with all samples having concentrations less 0.08 mg/l. However, the 0.08 mg/l analytical limit is higher than the RQO threshold of 0.025mg/l, which means that it is unclear if phosphorous concentrations exceed RQO guidelines or not.

Table 3.4. Nutrient results from the October 2024 field survey

Site	Total Ammonia Nitrogen (TAN) as N (mg/l)	Nitrate (NO ₃) as N (mg/l)	Nitrite (NO ₂) as N (mg/l)	Dissolved Inorganic Nitrogen (DIN)	Orthophosphate (PO ₄) as P (mg/l)
Onrus 1	0.11	<0.18	<0.01	0.205	<0.08
Onrus 2	0.11	<0.18	0.01	0.21	<0.08
Onrus 3	0.14	0.55	<0.01	0.695	<0.08
Onrus 4	0.12	<0.18	<0.01	0.215	<0.08
Onrus 5	0.12	0.18	<0.01	0.305	<0.08
Onrus 6	0.13	<0.18	<0.01	0.225	<0.08
RQO Guidelines				<0.3	<0.025

3.5.6 SEWAGE SPILLS

Despite not typically being historically characterised by eutrophic conditions, sewage contamination in the Onrus Estuary has been a long-standing concern. Sewage spills have occurred on occasion, and bacterial counts (indicators for faecal contamination) are frequently high. For example, in December 1999 only two pump stations were in working order and could not cope with the flows during the peak holiday season (Peter van Niekerk 2016 pers. comm.). The estuary has been closed to swimming at times, often during the peak summer season, due to unacceptably high faecal bacterial levels. A monitoring study in 2007-2008 by Dr Vic Hamilton-Attwell at five sites on the Onrus River downstream of De Bos Dam showed that faecal bacteria levels were relatively low at the dam outfall and Camphill, and increased towards the estuary—indicating downstream sources.

Water quality within the Onrus River and Estuary has been tested for *Escherichia coli* (*E. coli*) by the Breede-Olifants Catchment Management Agency, as part of their continuous monitoring programme. All available data for the period September 2024 to October 2024 is shown in Figure 3.15 and indicates that the system has been compliant with the RQO guidelines for much of this time, although there have been a number of large spikes in *E.coli* counts at the Onrus Mouth site in recent years—indicative of sewage spills. Bacterial concentrations seem to vary seasonally, with elevated concentrations in summer. This

phenomenon is likely due to a combination of increased pressure placed on the local sewerage reticulation network during the summer months due to holidaymaking and tourist activities, as well as natural factors, such as decreased river flow, and closed mouth conditions. The latter two factors can act to increase counts by both reducing freshwater dilution of the bacteria and preventing tidal flushing.

There is some evidence to suggest that faecal bacterial levels in the estuary have increased in recent years, however, with the highest counts all being recorded from late 2022 onwards. The OLM is currently taking measures to improve the situation and reduce the frequency of sewage leaks, in part through upgrades to the Onrus Main Pump Station—located to the west of the main estuarine bend. This pump station services the surrounding network, which utilises a small-bore (solids free) system. The proposed upgrade of the OMSPS will include the construction of new structures, including a pumpstation, new overflow chamber and new pipelines, as well as the rerouting of existing pipelines and sewer line (Jackson & Wright 2024).

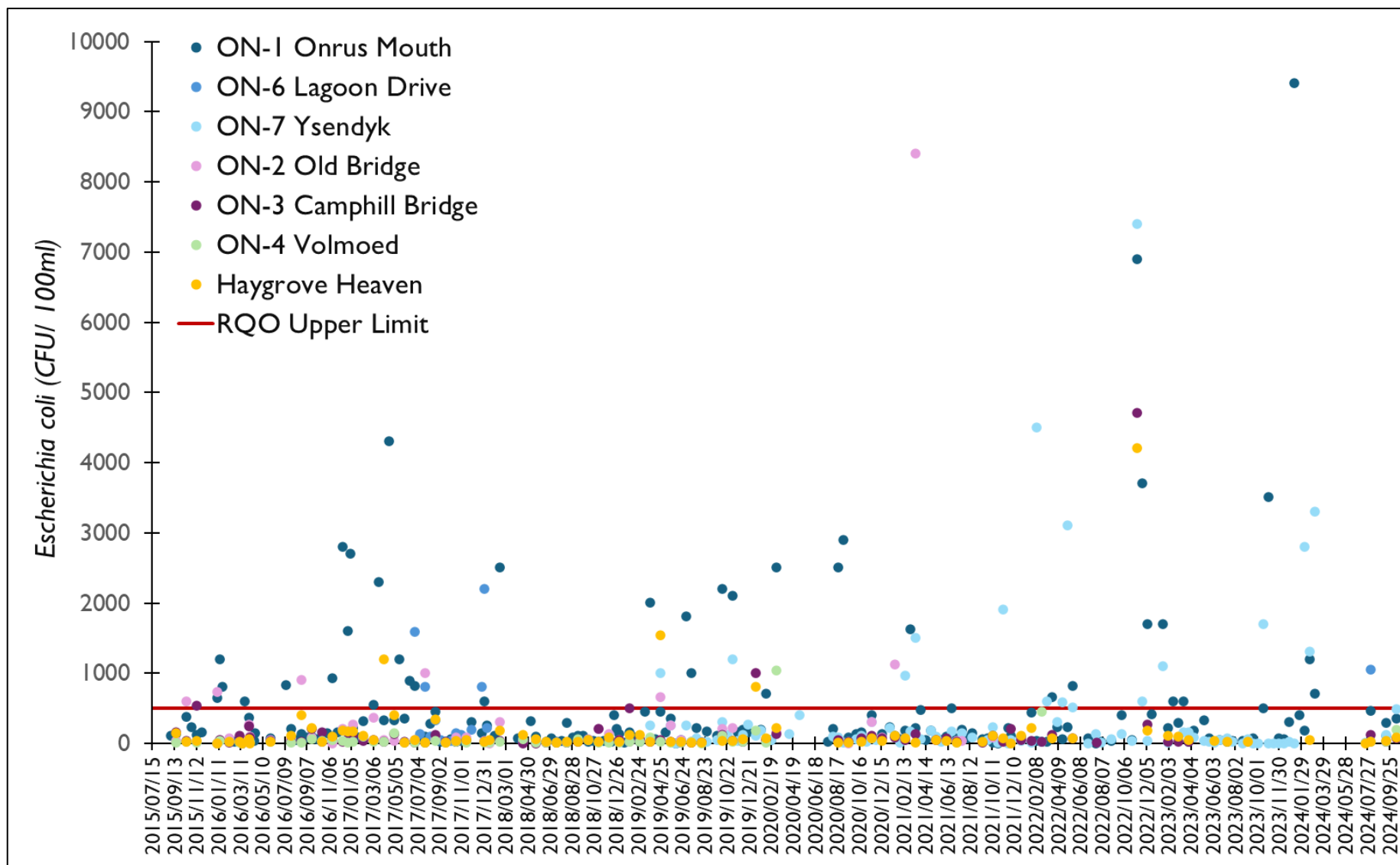


Figure 3.15. Recorded Escherichia coli counts for the Onrus River and Estuary between 2015 and 2024.

3.6 SEDIMENT QUALITY

Whilst it has been established that the Onrus Estuary is prone to sedimentation, and is, as of November 2024, completely infilled with catchment-derived sediment, it is also important to consider the quality of this sediment to inform its suitability for re-use.

The assessment of sediment quality typically consists of an analysis of metrics such as sediment particle size, organic content, and trace metal/ heavy metal concentrations. Trace metals can be briefly defined as metals that typically exist in very low concentrations under natural conditions, yet can become elevated due to human activities, leading to contamination. Trace metal analysis is important in estuaries, as contamination can result in both chronic and acute health effects in aquatic organisms, which can have harmful knock-on effects.

Sediments with smaller particle sizes (commonly referred to as “mud”, <62.5 µm) are typically associated with higher heavy metal concentrations. This is frequently due to a combination of finer sediments having a higher surface area—thus being more conducive to metal absorption from the water column when compared to larger particles—, and due to the fact that smaller particles are frequently associated with clay minerals, which often have high concentrations of lattice-bound metals (Newman & Watling 2007). Metals absorbed onto the surface of sediment particles are of concern, as they can be re-dissolved into the water column and become bioavailable (can be assimilated into organisms and move up the food chain). Conversely, lattice-bound metals are typically non-bioavailable and do not present a threat to the surrounding ecosystem.

Results from the sediment analyses conducted on samples collected during the October 2024 Ecological Health Assessment, showed that the Onrus sediments were very sandy, with all samples consisting of more than 90% sand, with both mud and gravel content being very low (Table 3.5 and Figure 3.16). The total organic content (TOC) was also very low for all sites, with 2.46% being the highest recorded value. However, these low TOC values can likely be explained by the sampling occurring in the stream flow channels—where organic matter is likely to be mobilised from—and readings would likely have been higher had sampling occurred within the exposed peat sandflats. Additionally, all sites had trace metal concentrations far below any of the thresholds presented within South Africa’s: “National Action List for the Screening of Dredged Material Proposed for Marine Disposal” (GN 867 of 2011), which is currently South Africa’s only gazetted set of sediment quality guidelines (Table 3.5). These sediment data combined indicate that the Onrus sediments are non-contaminated and consist predominantly of clean sand and are therefore suitable for many forms of reuse.

3.7 INVERTEBRATES

Invertebrates inhabiting estuaries can be divided into a number of sub-groups based on where they reside in the estuary. Zooplankton live mostly in the water column, benthic organisms live in the sediments on the bottom and sides of the estuary channel, and hyperbenthic organisms live just above the sediment surface. Benthic invertebrates are frequently further subdivided into intertidal (those living between the high and low water marks on the banks of the estuary) and subtidal groups (those living below the low water mark).

No historic information is available on zooplankton and only limited information on some benthic and hyperbenthic species is available for the Onrus Estuary that was collected in the

1980s (Heinecken & Damstra 1983). Based on the information available, the health condition of invertebrates in the Onrus Estuary was rated as fair in the 2012 NBA, yet this rating was worsened to “Heavily Modified” in the 2018 NBA (Van Niekerk & Turpie 2012b, Van Niekerk et al. 2019b).

Table 3.5. Onrus sediment characteristics from the October 2024 sampling, with sediment trace metal guidelines from South Africa’s National Action List (GN 867 of 2011) being provided for reference.

	Onrus 1	Onrus 2	Onrus 3	Onrus 4	Onrus 5	Onrus 6	SA National Action List (mg/kg)		
							Warning Level	Level 1	Level 2
Organics and Particle Size (%)									
TOC %	2.46	0.57	0.91	0.64	1.09	0.83			
Gravel %	0.00	0.53	4.66	3.68	8.16	3.20			
Sand %	95.73	99.32	94.99	96.18	91.61	96.65			
Mud %	4.27	0.15	0.35	0.14	0.24	0.15			
Trace Metals (mg/kg)									
Aluminium (Al)	274.1	248.0	272.3	350.5	360.4	306.9			
Arsenic (As)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	42	57	93
Cadmium (Cd)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	5.1	9.6
Cobalt (Co)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0			
Chromium (Cr)	4.68	12.22	10.53	15.37	9.41	9.18	135	260	370
Copper (Cu)	0.50	1.68	1.02	4.16	0.50	1.73	110	230	390
Iron (Fe)	1867	5932	5354	7956	6049	5317			
Nickel (Ni)	1.56	3.87	3.81	5.23	3.61	3.42	62	140	370
Lead (Pb)	1.42	1.20	1.02	1.32	1.61	0.97	110	218	530
Vanadium (V)	1.37	1.33	1.00	0.50	1.46	0.50			
Zinc (Zn)	1.59	2.04	1.53	2.37	1.52	1.85	270	410	960
Mercury (Hg)	<0.01	<0.01	<0.01	0.01109	0.0141	<0.01	0.43	0.84	1.5

The 1979-1980 survey noted that the seaward end of Onrus Lagoon was inhabited by sandprawn *Callichirus kraussi* in the shallower water, while Crown crabs *Hymenosoma orbiculare* were also caught in the seine net in slightly deeper water (Heinecken & Damstra 1983). While the latter species has been recorded at salinities as low as 1 ppt in estuaries and even in the freshwater Lake Sibaya, *C. kraussi* cannot successfully breed in salinities below 17 ppt. However, no prawn holes have been identified in the lower reaches of the estuary in recent years due predominantly to decreasing salinities (Massie & Clark 2016a).

In early surveys, the estuarine amphipod *Corophium triaenonyx* was also found near the mouth, together with the estuarine polychaete *Ceratonereis keiskamma*, the tanaeid crustacean *Tanais philetaerus* and various species of chironomid (midge) larvae. In the upper part of the estuary, *C. triaenonyx* and *T. philetaerus* were found in low numbers in the muddy substrate, with *C.*

keiskamma, the amphipod *Melita zeylanica*, the isopods *Pseudosphaeroma barnardi* and *Cirolana africana*, corixids (water boatmen) and chironomid larvae also present. Numerous mussels *Musculus virgiliae* were attached to submerged rocks and branches. The aquatic plants *Chara* and *Stuckenia pectinata* also provided an attachment area for small invertebrates. The anoxic mud of the blind channel was found to be inhabited by chironomid larvae as well as low numbers of *C. keiskamma* and *C. triaenonyx*. The reed beds supported fewer estuarine fauna than the rest of Onrus Lagoon, but numerous chironomid larvae, *C. triaenonyx*, and the detritus-eating *M. zeylanica* and *P. barnardi* inhabited the reed bed detritus. Aquatic insects, especially whirligigs (*Gyrinidae*), were living among the submerged, decaying leaves, and spiders were found amongst the stalks (Heinecken & Damstra 1983).

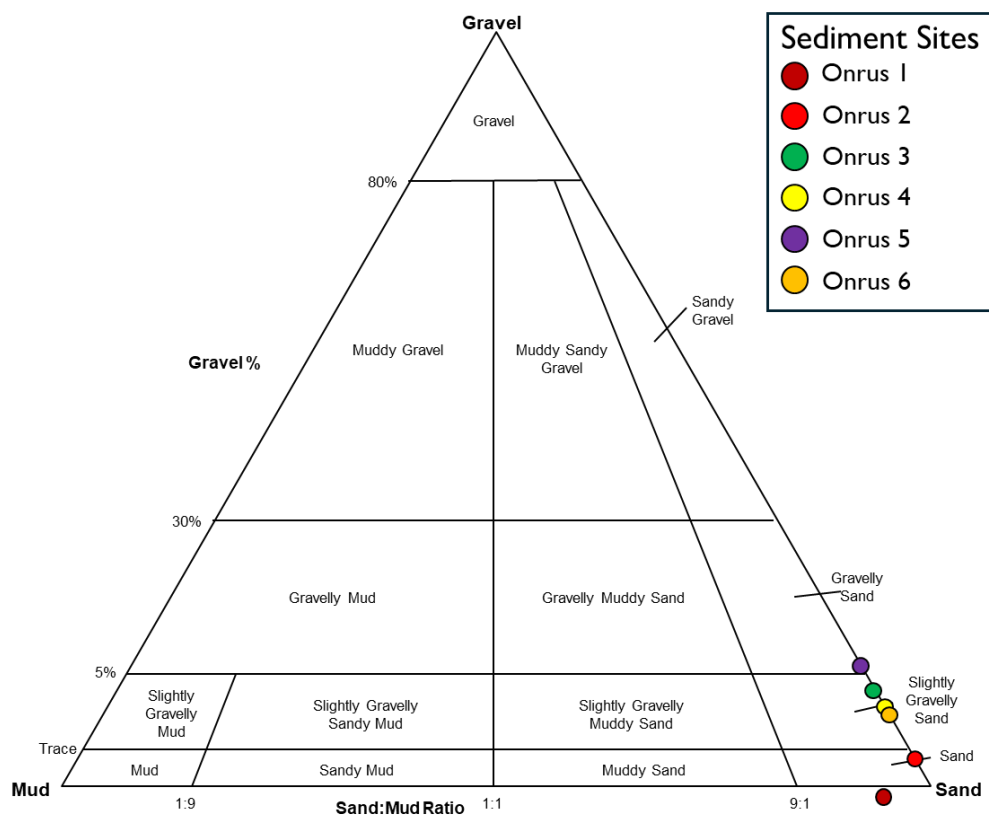


Figure 3.16. Ternary diagram indicating particle size distribution in the Onrus Estuary.

The October 2024 EHS indicated a further decline in the invertebrate communities in the estuary, with no estuarine prawns or crabs being sighted. Samples collected for benthic macrofaunal analysis reflected a near-completed collapse in the estuarine invertebrate community, with 11 out of 18 samples being entirely devoid of any benthic invertebrates (Table 3.6). The remaining seven samples were also highly depauperate (devoid of life). The highest invertebrate species abundance and biodiversity was seen at the estuary mouth (Onrus 1), likely due to the small amount of tidal penetration and persistence of a semblance of estuarine functioning. However, even at Onrus 1, the three macrofaunal samples only had a species richness—referring to the total number of species identified in the sample—of three for Sample A, three for Sample B, and two for Sample C. This works out to a combined species richness of only 6 species for the site. Total invertebrate abundance was also extremely low,

with only 21 individual invertebrates found between all three samples at the Onrus 1 site. The depauperate state of the estuary is further exemplified by the fact that Onrus 1 is the site with by far the highest species diversity and abundance. This survey highlights the severity of the collapse in the invertebrate community in the Onrus Estuary and provides the contextual foundation for the decline in predatory bird and fish species abundance and diversity described in subsequent sections.

Table 3.6. Invertebrate species identified in the Onrus Estuary in the October 2024 survey.

Species	Phylum	Class	Order	Onrus 1			Onrus 2			Onrus 3			Onrus 4			Onrus 5			Onrus 6			
				A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
Capitellidae sp.	Annelida	Polychaeta		3										1								
Oligochaeta sp.	Annelida	Oligochaeta							1	5			1									
Sipuncula sp.	Annelida	Sipuncula																			1	
Hymenosoma orbiculare	Arthropoda	Malacostraca	Decapoda	1																		
Caridea sp.	Arthropoda	Malacostraca	Decapoda		1																	
Talorchestia quadrisinasa	Arthropoda	Malacostraca	Amphipoda			8																
Podocerus sp.	Arthropoda	Malacostraca	Amphipoda						1													
Chironomus larvae	Insecta			4	2	1																
Insect larvae	Insecta				1																	
Total Species Richness (Sample)				3	3	2	0	0	0	0	2	1	0	0	2	0	0	0	1	0	0	
Total Species Richness (Site)				6	0	0	0	2	2	0	1	0	0	0	0	0	0	1	0	0	0	
Total Benthic Invertebrates (Sample)				8	4	9	0	0	0	0	2	5	0	0	2	0	0	0	1	0	0	
Total Benthic Invertebrates (Site)				21	0	7	0	7	2	0	1	0	0	0	0	0	0	1	0	0	0	

3.8 ICHTHYOFAUNA—FISH

Estuaries provide an extremely important habitat for fish in southern Africa. The vast majority of coastal habitat in southern Africa is directly exposed to the open ocean, and as such is subject to intensive wave action throughout the year (Field & Griffiths 1991). Estuaries in southern Africa are thus disproportionately important relative to other parts of the world, in that they constitute the bulk of the sheltered, shallow water inshore habitat in the region. Juveniles of many marine fish species in southern Africa have adapted to take advantage of this situation and have developed the necessary adaptations to enable them to persist in estuaries for at least part of their life cycles. There are at least 100 species that show a clear association with estuaries in South Africa (Whitfield 1998, 2019). Most of these are marine species that enter estuaries as juveniles, remain there for a year or more before returning to the marine environment as adults or sub-adults where they spawn, completing the cycles. Several other species also use estuaries in southern Africa, including some that are able to complete their entire life cycles in these systems, and a range of salt tolerant freshwater species and euryhaline marine species.

3.8.1 REFERENCE CONDITION

Very limited data is available for the Onrus Estuary and includes data collected during the ECRU survey (Heineken & Damstra 1983), by Harrison (1999) in 1994 (as part of a project where data was collected for 67% of South Africa's estuaries) and by Turpie & Clark (2007b) for a project where South Africa's estuaries were ranked based on conservation importance. In total, 11 species have been identified in the Onrus Estuary to date (Table 3.7).

Table 3.7. Estuarine fish species recorded in the Onrus Estuary in past surveys and their Estuary Association Category (EOC) according to Whitfield (2019).

Common name	Scientific name	Estuarine Dependence Category
Cape kurper	<i>Sandelia capensis</i>	Freshwater species
Cape galaxias	<i>Galaxias zebratus</i>	IV—breeds in both estuarine and freshwater systems
Mozambique tilapia	<i>Oreochromis mossambicus</i>	
Cape Silverside	<i>Atherina breviceps</i>	I—Estuarine resident species
Gilchrist's round herring	<i>Gilchristella aestuaria</i>	
Knysna sandgobi	<i>Psammagobius knysnaensis</i>	
Flathead mullet	<i>Mugil cephalus</i>	IIa—Juveniles dependent on estuaries as nursery areas.
Cape stumpnose	<i>Rhabdosargus holubi</i>	
Southern mullet	<i>Chelon richardsonii</i>	IIb—Juveniles occur mainly in estuaries, but also at sea
Freshwater mullet	<i>Pseudomyxus capensis</i>	
White stumpnose	<i>Rhabdosargus globiceps</i>	IIc—Juveniles sometimes occur in estuaries but are more abundant at sea

Of these 11 species, only one, Cape kurper *Sandelia capensis*, is known to be a true freshwater species. A further two species, Cape galaxias *Galaxias zebratus* and Mozambique tilapia *Oreochromis mossambicus* are known to be able to tolerate a wide salinity range and are able to survive and breed in both freshwater and estuarine environments. Historically, the Onrus estuary was also home to three estuarine resident species (meaning they spend their entire lives in estuaries), including Gilchrist's round herring *Gilchristella aestuaria*, Cape Silverside *Atherina breviceps*, and the Knysna sand goby *Psammagobius knysnaensis*. The remaining fish species that have been recorded in the estuary are all marine species. This includes flathead mullet *Mugil cephalus* and Cape stumpnose *Rhabdosargus holubi*, both known to breed at sea, yet depend on estuaries as nursery areas as juveniles, Southern mullet *Chelon richardsonii* and freshwater mullet *Pseudomyxus capensis* which breed at sea, but are known to use both estuaries and the nearshore marine environment as nursery areas as juveniles, and white stumpnose *Rhabdosargus globiceps*, known to have lesser estuarine associations than the former species, with juveniles typically being more common at sea, but sometimes utilising estuaries as nursery habitats.

The fish composition described above demonstrates that even with limited interaction between the sea and the estuary, the Onrus Estuary did play an important role as a nursery area for marine species. This nursery function would have been comprised to some extent by continuous reedbed encroachment and loss of an open basin due to ongoing sedimentation.

3.8.2 CONDITION AS OF OCTOBER 2024

Unfortunately, even the relatively modest fish community that was historically present within the Onrus Estuary is now essentially gone in the wake of the 2023 Heritage Day floods. This has been demonstrated through the recent seine net survey conducted as part of the EHS update of the estuary, wherein the only site to have any meaningful fish population was Onrus 1—located just upstream of the mouth channel (Table 3.8).

The fish community at Onrus 1 was dominated by juvenile mullet, mostly southern mullet *C. richardsonii*, with a small number of Gilchrest’s round herring *G. aestuaria* also being caught—albeit in much lower numbers than would be expected (96 total). Finally, a small number of flathead mullet *M. cephalus* (18) and Knysna sandgoby *P. knysnaensis* (4) were also caught. Besides the Onrus 1 site, only Onrus 2 and 3 had any fish present at all, and these were all juvenile mullet, with counts of 33 and 16, respectively, which likely stemmed from a recent spawning event. Concerningly, no fish were caught at the three sites further upstream, which emphasises the lack of suitable habitat for these species in the estuary.

Table 3.8. Fish species caught during the October 2024 seine net survey

Site	Juvenile Mullet and Southern Mullet <i>Chelon Richardsonii</i>	Knysna sandgoby— <i>Psammodobius Knysnaensis</i>	Flathead mullet— <i>Mugil cephalus</i>	Gilchrest’s Round Herring— <i>Gilchristella aestuaria</i>
Onrus 1	264	4	18	96
Onrus 2	33	0	0	0
Onrus 3	16	0	0	0
Onrus 4	0	0	0	0
Onrus 5	0	0	0	0
Onrus 6	0	0	0	0

The results of this survey indicates an almost complete collapse in the estuarine fish community, with only very small numbers of juveniles and small—predominantly mullet—being able to survive at all, and then only near the mouth. This is almost certainly a direct result of the infilling of the estuary with sediment, and the loss of a deepwater estuary basin. The absence of suitable deepwater habitat means that fish have no protection from piscivorous birds in the estuary. Furthermore, the perched nature of the estuary due to the sedimentation, has prevented almost all saline intrusion into the system—further rendering the system unsuitable for estuarine fish species.

With the above considered, it would be appropriate to say that the Onrus Estuary has lost essentially all of its value as a nursery area for marine fish. Aside from consequences for the fish species themselves, this has almost-certainly had knock-on effects on other species which depend upon these fish—such as piscivorous bird and mammal species—further elaborated below.

3.9 AVIFAUNA—BIRDS

3.9.1 REFERENCE CONDITION

A total of 143 bird species have been recorded over the last two decades in the estuary, of which 81 are considered water associated species. Sixty-five water associated bird species are resident in South Africa, thirteen are migratory, and two are exotic species (Mallard duck *Anas platyrhynchos* and its hybrids). The most species-rich taxa observed on the estuary in the past were the Charadriiformes (waders, gulls and terns) and Passeriformes (warblers, wagtails, bishops, canaries, weavers etc.). The Onrus Estuary is/ has been home to species that are fairly difficult to find in many parts of the Overberg such as the Little Bittern *Ixobrychus minutus*, Purple Heron *Ardea purpurea*, Black-crowned Night-Heron *Nycticorax nycticorax* and African purple swamphen *Porphyrio madagascariensis*, and Southern tchagra *Tchagra tchagra*. Furthermore, large numbers of Barn Swallows *Hirundo rustica* were known to roost in the reedbeds in summer, while the many eucalyptus trees and other exotics along the Onrus River are used for breeding by a variety of raptors that include African Goshawk *Accipiter tachiro*, African Harrier-Hawk *Polyboroides typus*, Black sparrowhawk *Accipiter melanoleucus* and Little sparrowhawk *Accipiter minullus* (Massie & Clark 2016b).

The Onrus Estuary is classified as a small, black water, sandy estuary, where few coastal bird species would be expected to occur—indeed, the lack of tidal influence means that the estuary is not particularly important for wader species (Turpie & Clark 2007a). Regardless, the 2018 NBA rated the birdlife health condition in the Onrus Estuary as “C”, as the avifauna that was utilising the estuary has been impacted by reduced flow rates as well as poor water quality due to sewage and stormwater flows to the lagoon (Van Niekerk et al. 2019a, Western Cape Government 2021).

3.9.2 CONDITION AS OF OCTOBER 2024

Unfortunately, the avifaunal community also appears to have been impacted by the recent loss in estuarine function, clearly evident in data from two field surveys conducted in 2024.

During the June 2024 site visit, both species diversity and counts were low, with species consisting predominantly of waders, including the black-headed heron *Ardea melanocephala* (juvenile), Intermediate egret *Ardea intermedia* and African sacred ibis *Threskiornis aethiopicus* (Table 3.9).

Table 3.9. Birds observed during 11 June 2024 site visit in the middle estuary.

Common name	Species	Count
African Sacred Ibis	<i>Threskiornis aethiopicus</i>	3
Intermediate Egret	<i>Ardea intermedia</i>	2
Black-headed Heron	<i>Ardea melanocephala</i>	1
Fiscal Flycatcher	<i>Sigelus silens</i>	1
Egyptian Goose	<i>Alopochen aegyptiaca</i>	6
Weaver species	<i>Ploceidae sp.</i>	10

The October 2024 field survey again showed the estuary to have very low bird species diversity and abundance (Table 3.10). The majority of estuarine-associated species present consisted of waders, such as the Curlew sandpiper *Calidris ferruginea*, Sacred ibis *Threskiornis aethiopicus*, Hadeda ibis *Bostrychia hagedash*, and Water dikkop *Burhinus vermiculatus*—likely feeding upon invertebrates on the extensive exposed sandflats. Small numbers of coastal species, such as Hartlaub’s gulls *Chroicocephalus hartlaubii* and Kelp gull *Larus dominicanus* were seen near the mouth, although they are likely feeding off marine sources or opportunistically feeding off discarded food on the beach. Two species of duck, the Egyptian goose *Alopochen aegyptiaca* and Yellow-billed duck *Anas undulata*, were also recorded.

What is noticeably absent from the two recent site visits/ surveys are any piscivorous waterbirds, with only a single Black-headed heron and two Intermediate egrets recorded in the June 2024 visit, and no piscivorous species being seen anywhere in the estuary during the October 2024 field survey. This lack of piscivorous species is likely a direct result of the collapse Onrus’ fish population.

Table 3.10. Birds observed during the October 2024 field survey

Common Name	Scientific Name	Onrus 1	Onrus 2	Onrus 3	Onrus 4	Onrus 5	Onrus 6
Hartlaubs Gull	<i>Chroicocephalus hartlaubii</i>	11	0	0	0	0	0
Curlew sandpiper	<i>Calidris ferruginea</i>	0	0	11	0	0	0
Egyptian goose	<i>Alopochen aegyptiaca</i>	8	0	0	0	0	0
Kelp gull	<i>Larus dominicanus</i>	1	0	0	2	0	0
Sacred ibis	<i>Threskiornis aethiopicus</i>	0	0	1	5	1	1
Hadeda ibis	<i>Bostrychia hagedash</i>	0	0	1	0	0	0
Wagtail sp.		0	0	1	0	2	0
Yellow-billed duck	<i>Anas undulata</i>	0	0	0	2	0	0
Water dikkop	<i>Burhinus vermiculatus</i>	0	0	1	0	0	0

3.10 MAMMALS

Documented information on mammals in the Onrus estuary could not be found, but a variety of rodents, including the vlei rat *Otomys irroratus* and the dune mole rat *Bathyergus suillus* are likely to be present. Mongooses and genets are probably present in the area, and insectivorous bats have been seen feeding over the water in the evening. A family of Cape clawless otters *Aonyx capensis* was believed to be living in the estuary as of 2016 (Massie & Clark 2016a). Given the recent collapse in the estuarine fish community, however, it is unclear whether conditions still support this species.

3.11 AMPHIBIANS AND REPTILES

Only eight amphibian species have been recorded in the Overberg Municipal area. These are listed in Table 3.11. The presence of Cape river frog *Amietia fuscigula* was confirmed in the

upper reaches of the estuary (in the vicinity of Onrus 6) during the October 2024 field survey. No species of reptile have been formally recorded in the vicinity of the Onrus Estuary. However, it is possible that some populate the surrounding environments as three tortoise species, 21 snake species and 16 lizard species have been identified that have either been recorded or are likely to occur in the area extending from Kleinmond to Hermanus and 6-12 km inland (Heinecken & Damstra 1983).

Table 3.11. Amphibian species recorded in the Overberg Area

Common Name	Scientific Name	Status (L=likely to occur, X=recorded, O=recorded in Onrus Lagoon)
Cape platanna	<i>Xenopus gilli</i>	X
Raucous toad	<i>Amietophrynus rangeri</i>	X
Leopard toad	<i>Amietophrynus pantherinus</i>	X, O
Cape river frog /Cape rana	<i>Amietia fuscigula</i>	L, O
Spotted rana	<i>Strongylopus grayii</i>	X
Cape grass frog	<i>Rana Montana</i>	X
Micro frog	<i>Microbatrachella capensis</i>	X
Arum frog	<i>Hyperolius horscockii</i>	X

3.12 SITE SENSITIVITY MAPPING

Estuaries are rich and productive systems that produce a wide range of benefits to society. They derive their richness and productivity from nutrient and sediment inputs received from river and sea water, combined with the relatively sheltered aquatic habitat that they provide. Their characteristic biodiversity assemblages have arisen from the need for biota to cope with strong gradients and fluctuations in salinity. These unique characteristics make estuaries among the most valuable types of ecosystems on earth (Costanza et al. 2014).

3.12.1 ECOSYSTEM TYPES AND ECOSYSTEM THREAT STATUS

Historically, the Onrus estuary would have been surrounded by Overberg Sandstone Fynbos and Overberg Dune Strandveld, with Cape Seashore vegetation being found to the northwest of the estuarine channel (Figure 3.17). However, the surrounding habitat has been heavily transformed by residential development on the northern and western shores, although white milkwood *Sideroxylon inerme* is known to still occur between—and in-front of—some of the houses. Furthermore, despite being relatively less developed, the areas to east of the estuary are heavily invaded by alien species, stands of indigenous vegetation are maintained and known to persist in certain areas.

Positively, the areas classified as Overberg Sandstone Fynbos in the 2018 NBA are considered to have an Ecological Threat Status of “Least Concern” (LC, Skowno et al. 2019a). Conversely, the Onrus Estuary and surrounding Overberg Dune Strandveld vegetation is considered to be “Endangered” (EN), meaning that the ecosystem type is at very high risk of collapse, and that remaining intact areas are of high conservation concern. Finally, the Cape Seashore Vegetation located to the northwest of the area, is considered to be “Critically Endangered” (CR), meaning that the ecosystem type is of extremely high risk of collapse (Skowno et al. 2019a).

The nearshore marine environment consists of five ecosystem types according to the 2018 NBA (Sink et al. 2019), including the surf zone component of the Onrus EFZ (EN); the Agulhas Exposed Rocky Shore, Agulhas kelp forest, and the False and Walker Bay ecosystem types (all classified as Vulnerable (VU) meaning that the best available evidence indicates that the ecosystem is at high risk of collapse); and finally there is the Agulhas Mixed Shore ecosystem type which is classified as Near-Threatened (NT), meaning that, although not qualifying as threatened, it is close to qualifying or is likely to qualify in the near future)(Sink et al. 2019).

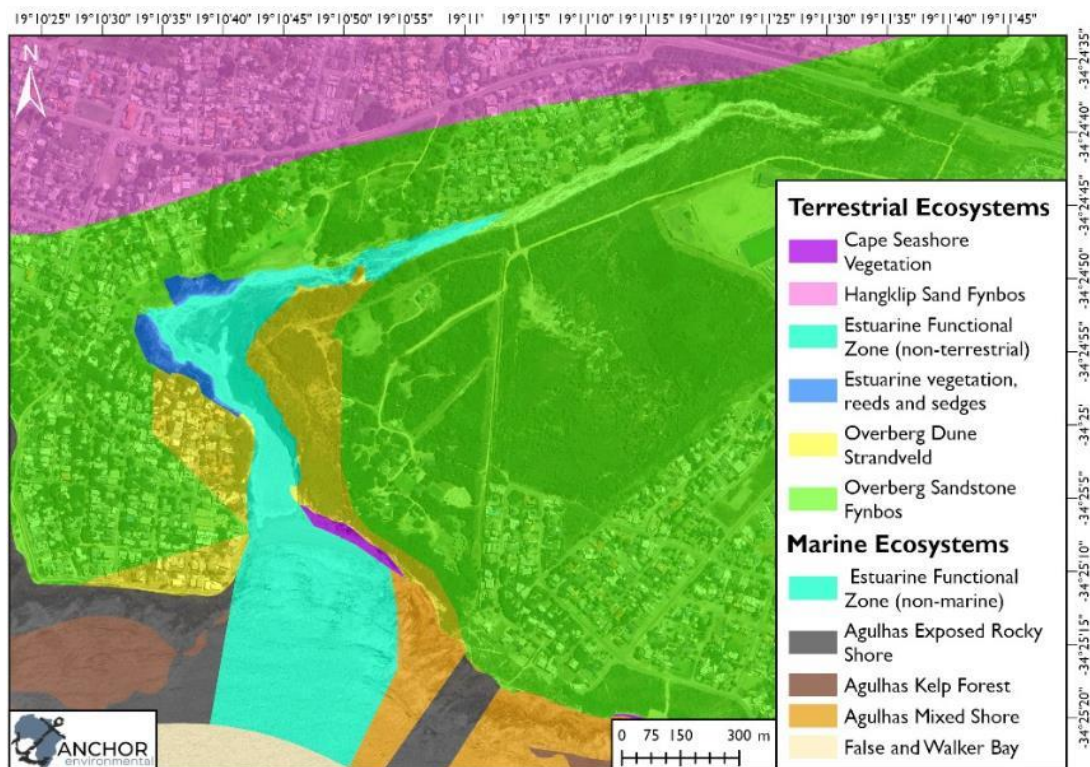


Figure 3.17. Marine and Terrestrial Ecosystems, according to the 2018 NBA (Skowno et al. 2019a)

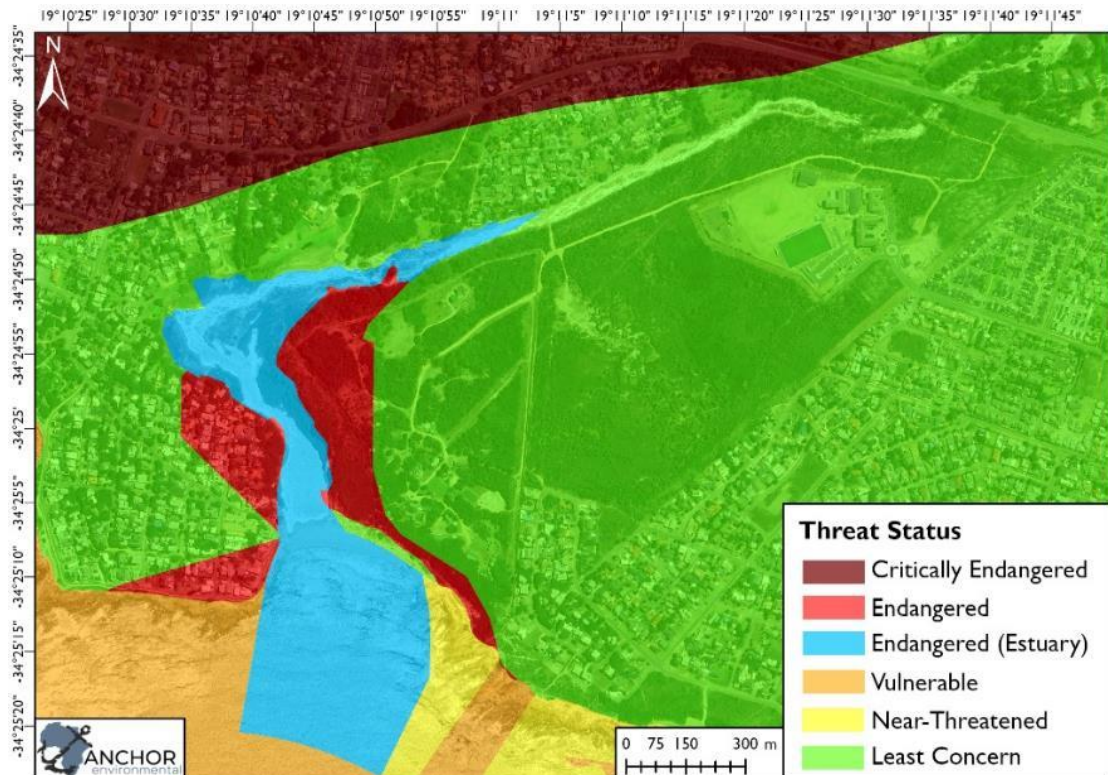


Figure 3.18. Terrestrial and Marine Ecosystem Threat Status according to the 2018 NBA (Sink et al. 2019, Skowno et al. 2019b).

3.12.2 CRITICAL BIODIVERSITY AREAS

In a similar vein to Ecosystem Threat Status, the area surrounding the Onrus estuary has a number of delineated Biodiversity Zones according to the Western Cape Biodiversity Spatial Plan (Forsyth 2017). Description of the areas, and their management objectives, are summarised as follows (Pool-Stanvliet et al. 2017):

- **Critical Biodiversity Area 1: CBA1 (Irreplaceable)** are areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure. The management objective for these areas is to maintain in a natural or near-natural state, with no further loss of natural habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate
- **Critical Biodiversity Area 2: CBA2 (Restore)** are areas in a degraded or secondary condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure. The management objective is to maintain these areas in a natural or near-natural state, with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land-uses are appropriate.
- **Ecological Support Area 1: (ESAI)** are areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of Protected Areas (PAs) or CBAs and are often vital for delivering ecosystem services. The management objective is to maintain these sites in a functional, near-natural state.

Some habitat loss is acceptable, provided the underlying biodiversity objectives and ecological functioning are not compromised.

- **Ecological Support Area 2: ESA2 (Restore)** are areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of PAs or CBAs and are often vital for delivering ecosystem services. The management objective for these areas is to restore and/or manage to minimize impact on ecological processes and ecological infrastructure functioning, especially soil and water-related services, and to allow for faunal movement.
- **Other Natural Areas: ONA** are areas not currently identified as a priority but retain most of their natural character and perform a range of biodiversity and ecological infrastructure functions. Although not prioritised, they are still an important part of the natural ecosystem. The management objective for these areas is to minimize habitat and species loss and ensure ecosystem functionality through strategic landscape planning. This classification offers flexibility in permissible land-uses, but some authorisation may still be required for high-impact land-uses.

The Onrus Estuary and surrounds, fall within a number of categories, with the estuarine body itself predominantly being classified as a CBA I, whereas the western portion of the channel, and the surrounding grassed area, are classified as an ESA I (Figure 3.19). The stretch of channel immediately upstream of the main estuarine body is classified as an ESA I yet transitions back to a rating of CBA I after a distance of ~300 m, with the CBA I rating persisting almost up to the R43 Road Bridge. The areas surrounding the estuary consists of a mosaic of ESA I and ESA2. Conversely, the vegetated areas to the east of the estuary are almost entirely classified as ONA, which includes the alien infested areas of both Habonim and the adjacent De Zandt Property.

3.1.2.3 STRATEGIC WATER SOURCE AREAS (SWSAs) AND IMPORTANT BIRD AREAS (IBAs)

The Cape Whale Coast IBA includes the Stony Point penguin breeding colony as well as important estuarine habitat, including the Palmiet, Bot River–Kleinmond and Onrus River estuaries and Vermont salt pans. Other areas of interest include the Lamloch swamp, CapeNature's Rooisand Nature Reserve and Fernkloof Nature Reserve inland of Hermanus (Figure 3.20). The wetlands across this IBA historically supported up to 25 000 birds and on occasion even more than 40 000 (Birdlife South Africa 2015). Globally threatened species included coastal/marine species such as the African Black Oystercatcher, African Penguin, Cape Cormorant, Bank Cormorant, Crowned Cormorant and Cape Gannet. The Onrus estuary has historically been known to provide critical habitat to Cape cormorants in particular (Massie & Clark 2016b). Regionally threatened species included the Caspian Tern, Greater Flamingo and Great White Pelican, which are also associated with estuarine environments. These species often rely on estuaries in these areas when conditions are unfavourable elsewhere (Birdlife South Africa 2015).

The Onrus Estuary falls to the south of a Strategic Water Source Area (SWSA), specifically a groundwater source (Figure 3.21). These areas are important as the groundwater which forms here is a nationally important resource and the area has a high groundwater recharge potential (Le Maitre et al. 2018). The Onrus Estuary itself is fed by both surface water and ground water SWSAs located to the northeast of the estuary. However, given that the lower Onrus River and Estuary are located at the downstream end of all the above-mentioned sources, the

maintenance dredging of the estuary proposed within this MMP, will not impact upon these areas.

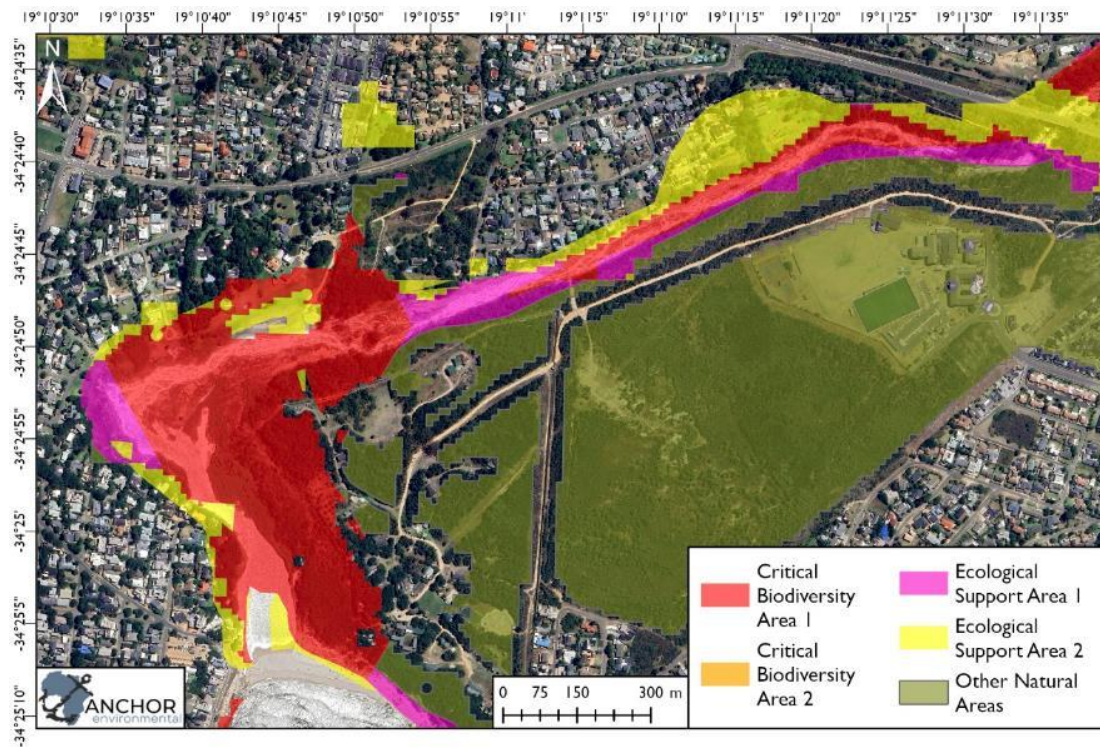


Figure 3.19. Delineated Terrestrial Critical Biodiversity Areas, Ecological Support Areas, and Other Natural Areas, according to the Western Cape Biodiversity Spatial Plan (Forsyth 2017).

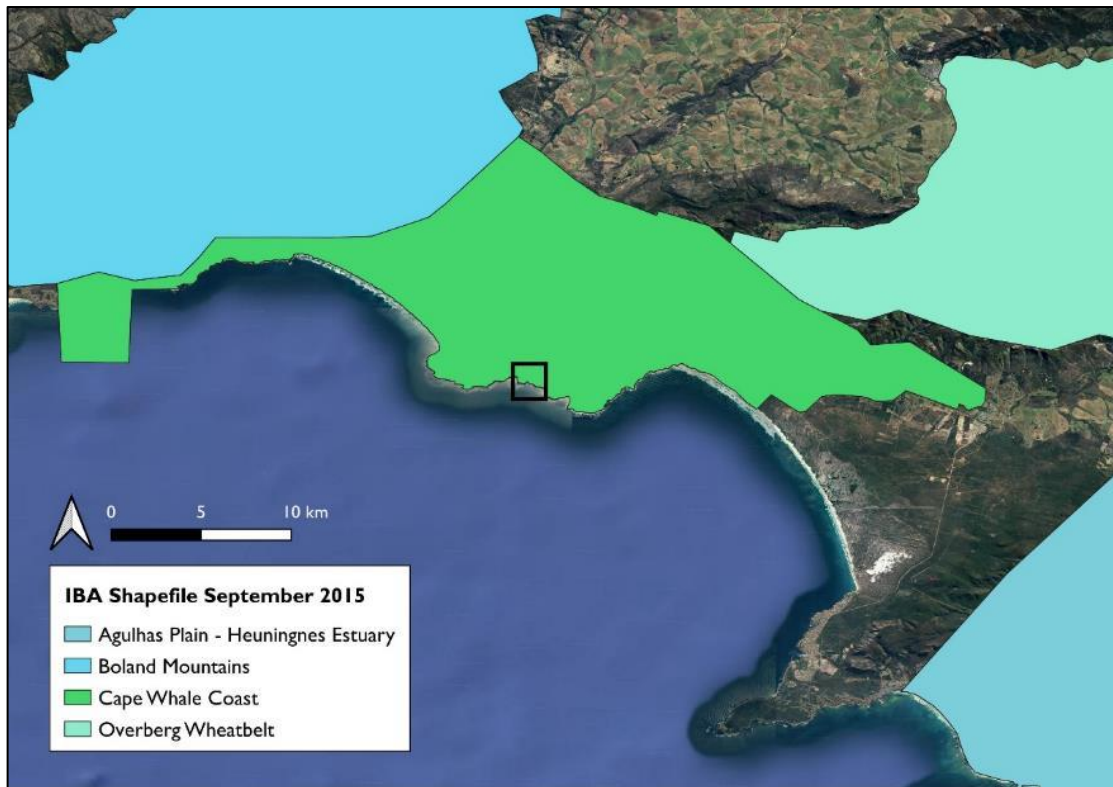


Figure 3.20. The Onrus Area in relation to Important Bird Areas (Mamewick et al. 2015).



Figure 3.21. The Onrus Area in relation to delineated Strategic Water Source Areas.

4 ESTUARY HEALTH STATUS

The Estuarine Health Index (EHI) is used to assess the condition or health of an estuary by comparing both abiotic and biotic components of the system in their present state to a reference state that is considered to be representative of natural conditions (Van Niekerk & Turpie 2012a) (Table 4.1).

Table 4.1. Estuarine Health Scores rating according to the 2018 NBA (Van Niekerk et al. 2019a)

Condition (% of pristine)	≥91%	90-75	75 - 61	60 - 41	40-21	≤20					
Continuum	A	A/B	B	B/C	C	C/D	D	D/E	E	E/F	F
Ecological Management Category (DWS)	A Natural	B Largely natural / few changes		C Moderately modified	D Largely modified	E Highly degraded	F Extremely degraded				
NBA Ecological modification	Natural/Near natural			Moderate	Heavily	Severe/Critical					
Functionality	Retain Process & Pattern (Representation)			Some loss of Process & Pattern	Significant loss of Process & Pattern	Little Process & Pattern					
Restoration cost	None/Low			Low/Medium	High	Very high, potentially irreversible structural changes					

4.1 2018 NATIONAL BIODIVERSITY ASSESSMENT (NBA)

The most recent National Biodiversity Assessment (NBA, 2018) rated the condition or Present Ecological State (PES) of the Onrus Estuary as a “D” or “Heavily Modified (Table 4.2). At the time of this assessment, the freshwater flow into the estuary had been reduced from pristine levels by the construction of the De Bos Dam. The estuary was also assessed to be heavily impacted by habitat loss and poor water quality (“D”). Water quality was identified to be affected by pollution, such as sewage discharge into the estuary, and agricultural return flows. Biotic elements of the estuary had been affected by changes to the physical components, with microalgae being the most affected (“E”), followed by macrophytes, invertebrates and fish (“D”). Bird diversity had also declined to moderately modified (“C”) (Table 4.2). The Onrus Estuary falls within the “Cool Temperate-Small Temporarily Closed” estuary type, which is considered to be “Endangered” by the 2018 NBA, yet is only of “Low to Average” importance from a biodiversity perspective (Van Niekerk et al. 2019c). Identified threats to the estuary included pollution, the loss of freshwater inflow and the loss of functional estuarine vegetation (and associated floodplain) due to development of urban areas.

Table 4.2. 2018 Present Ecological State (PES) of the Onrus Estuary (Van Niekerk et al. 2019a)

NBA 2018 Condition Status			
Present Ecological State (2018)	D	Microalgae	E
Hydrology	D	Macrophytes	D
Hydrodynamics	B	Invertebrates	D
Water Quality	D	Fish	D
Physical habitat	D	Birds	C

4.2 REVISED ESTUARY HEALTH STATUS—2024

As discussed at length within this document, the state of the Onrus Estuary has deteriorated substantially since the 2018 assessment, largely as a result of the 2023 Heritage Day flood event, and the subsequent sediment deposition throughout the Estuary. Consequently, a new Estuary Ecological Health Status (EHS) assessment was conducted in October 2024, and a draft EHS report compiled (Clark et al. 2024). This draft report is available as an appendix to this MMP.

The results of this EHS indicate a substantial deterioration in health and function of the estuary. In fact, the only criteria not considered to have dropped is the systems hydrology, with freshwater inflows remaining relatively consistent compared to previous years. The most dramatic deterioration has been in the estuary’s hydrodynamic functioning, which has been lowered from a “B” in 2018, to an “F”—Critically Modified in 2024—due to the loss of the deepwater estuarine channel and basin. Water Quality, Macrophyte, Invertebrates have all decreased from a score of “D” (Heavily Modified), to “E” Severely Modified. Finally, a large decline was also evident in the fish community, which was lowered from “D” to “F”—Critically Modified.

Table 4.3. Present Ecological State (PES) of the Onrus Estuary as of October 2024

October 2024 Condition Status			
Present Ecological State (2024)	E	Microalgae	E
Hydrology	D	Macrophytes	E
Hydrodynamics	F	Invertebrates	F
Water Quality	E	Fish	F
Physical habitat	F	Birds	E

The above ratings result in the PES of the Onrus Estuary being lowered from a rating of “D” (Heavily Modified) to an “E”—Severely Modified—which represents an effective collapse in estuarine function. This further speaks to the need for rapid restorative and rehabilitative action by the relevant authorities who are charged with the mandate of protecting and maintaining this environment under NEMAs “Duty of Care” Principle, as follows: “(1) Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment”.

5 MAINTENANCE MANAGEMENT PLAN

5.1 PREAMBLE

This maintenance management plan principally pertains to the bulk (and subsequent maintenance) dredging of the Onrus Estuary, and includes the dewatering and subsequent use of the dredged material.

This plan has been drafted by referencing the engineering process method statement provided by the dredging specialist. **Note:** the following method statement is largely descriptive, with required environmental mitigation measures being detailed in this report (Section 6), along with information pertaining to implementation, responsibility, environmental monitoring, etc. being tabulated in Section 7.

5.2 DREDGING PLAN

The dredging plan and dewatering plan for the Onrus estuary consists of four key components:

- the proposed dredging areas and volumes to be removed;
- the methodologies and equipment to be used to dredge and remove the sediment;
- the proposed dewatering methodology—how to remove excess moistures from the material to facilitate transportation and reuse; and
- proposals for reuse/ disposal of the sediment.

5.2.1 PROPOSED DREDGING SCENARIOS

A total of three dredging scenarios are outlined in this MMP, and are summarised below (Table 5.1). The first two scenarios have been included for basic reference and consist of removing the top 1 m of sediment across the entire estuary (Alternative 1), and removing 2 m from the estuary (Alternative 2). These two scenarios would result in the need to dredge 120 227 m³ and 240 454 m³, respectively. The third alternative, the “Preferred Alternative” represents a more nuanced midpoint between the two prior scenarios, and involves removing varying amounts of sediment from the estuary, depending on factors such as distance upstream, proximity to the riverbanks, etc. It must be noted that, of the three scenarios, only the Preferred Alternative is recommended, with Scenarios 1 and 2 only being included to give an indication of dredge area and volumes. As such, only the Preferred Alternative is discussed further.

Table 5.1. Summary of total surface area and volumes for each of the proposed dredging scenarios

Dredge Scenario	Total Surface Area (m ²)	Total Volume (m ³)
Alternative 1: Lower entire estuary by 1 m	120 227	120 227
Alternative 2: Lower entire estuary by 2 m	120 227	240 454
Preferred Alternative: Dredge the estuary in a contoured pattern, with the greatest volumes removed from the lower and middle reaches of the estuary.	80 128	190 480

5.3 THE PREFERRED DREDGING SCENARIO

The preferred approach to dredging of the Onrus estuary entails removing the largest amount of sediment from the lower reaches of the estuary—where a deepwater channel and basin existed historically—with the aim of restoring and maintaining this deepwater area (Figure 5.1, Figure 5.2, and Figure 5.3). This will allow for maximum entrainment of seawater, resulting in a sizeable tidal prism (total volume of seawater able to enter the estuary), and will therefore maximise salinity levels in the estuary. By maximising salinity levels and available deepwater habitat in the estuary, it will allow for the restoration of estuarine function for dependent fish, bird, and invertebrate populations. This will have the further benefit of facilitating recreation activities, such as swimming and canoeing, which will provide value to residents and bolster the local tourism economy.

The amount of sediment to be dredged will decrease with distance upstream in the estuary (Figure 5.1, Figure 5.2, and Figure 5.4). This has been selected to both optimise the dredging efforts—with the downstream area seen to be the most important dredge area, and also where the largest volumes of sediment accumulated over the 2023–2024 period (Figure 5.1, Figure 5.2, Figure 5.3, and Figure 5.4). Furthermore, whilst the upstream areas experienced lower levels of sediment deposition than the lower estuary, there was still a substantial degree of sedimentation, which is impacting the health of the system and is also placing the surrounding properties at risk of flooding. Finally, should the predominantly unconsolidated sediment not be removed from the upper estuary, it will most likely be remobilised during future rainfall events and redeposit in the lower estuary, which would effectively “fill in” the recently dredged area.

Precise depths to be dredged are presented in Figure 5.1–Figure 5.4, and have been determined based off historical bathymetry data, indicating the shape and depth of the estuarine body. Ecological conditions and estuarine function at times when the estuary was a certain shape/depth were also considered. Elevation data from surveys in 2023 and 2024 were utilised to determine the current sediment bed level for the entire estuary and produce average depth ranges for different estuarine sections.

It is proposed that the outflow channel and a large central basin be dredged to a depth of -1 m AMSL. This depth then contours to create a more “natural” estuarine bank. Dredging to -1 m AMSL in these areas amounts to the vertical removal of 3 m in the outflow channel and 3.5 m in the central estuarine basin.

The depth of sediment to be dredged then decreases in an upstream direction, with the lower and middle estuary ranging from 2–3.5 m of sediment being removed in the centre of the channel (Figure 5.1, Figure 5.2, Figure 5.3, and Figure 5.4). This then further decreases to an average removal of 1 m for the upper estuarine channel from the Old Bridge (now washed away) to the service road bridge.

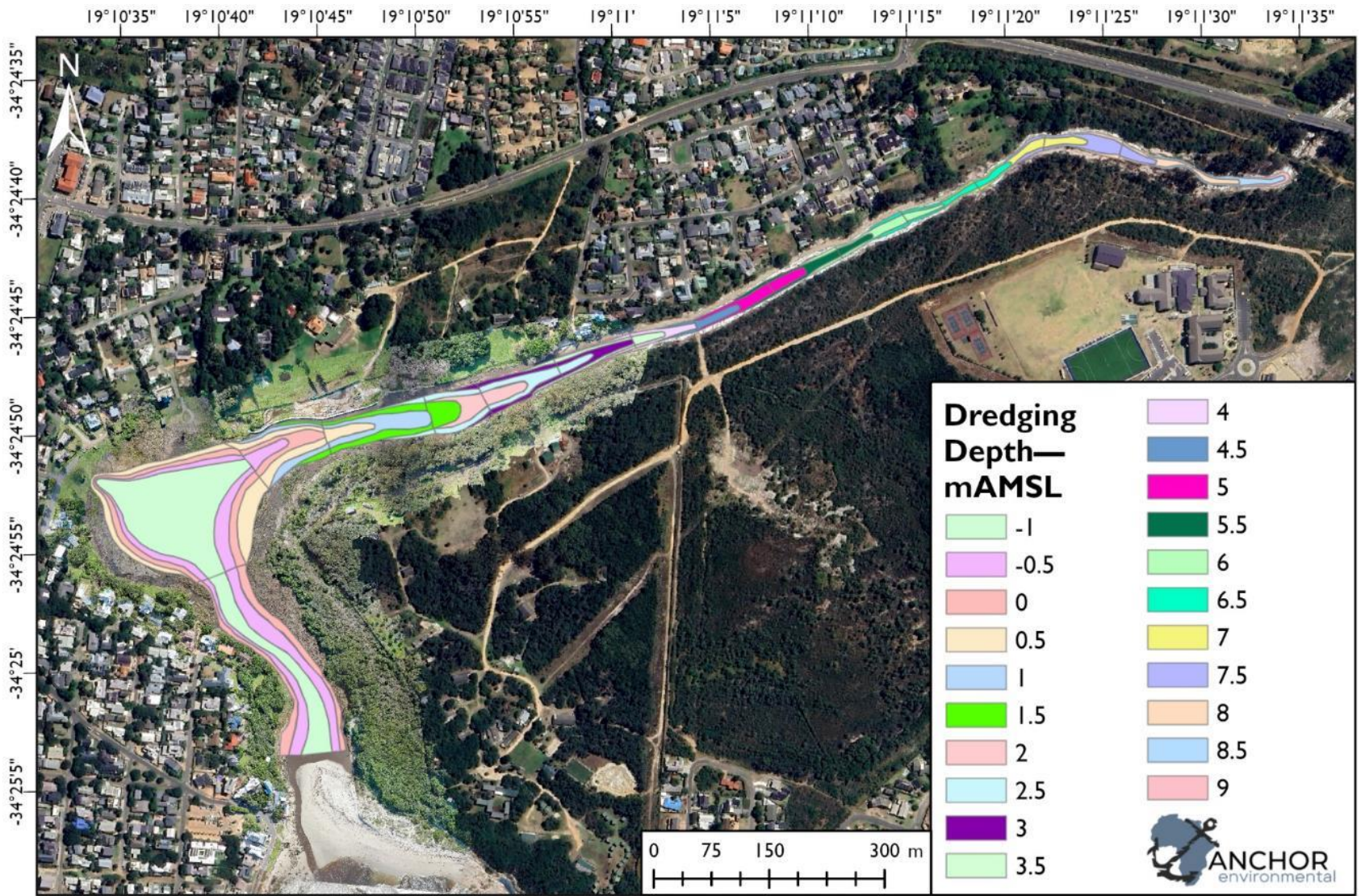


Figure 5.1. Proposed dredging depths in the Onrus Estuary.

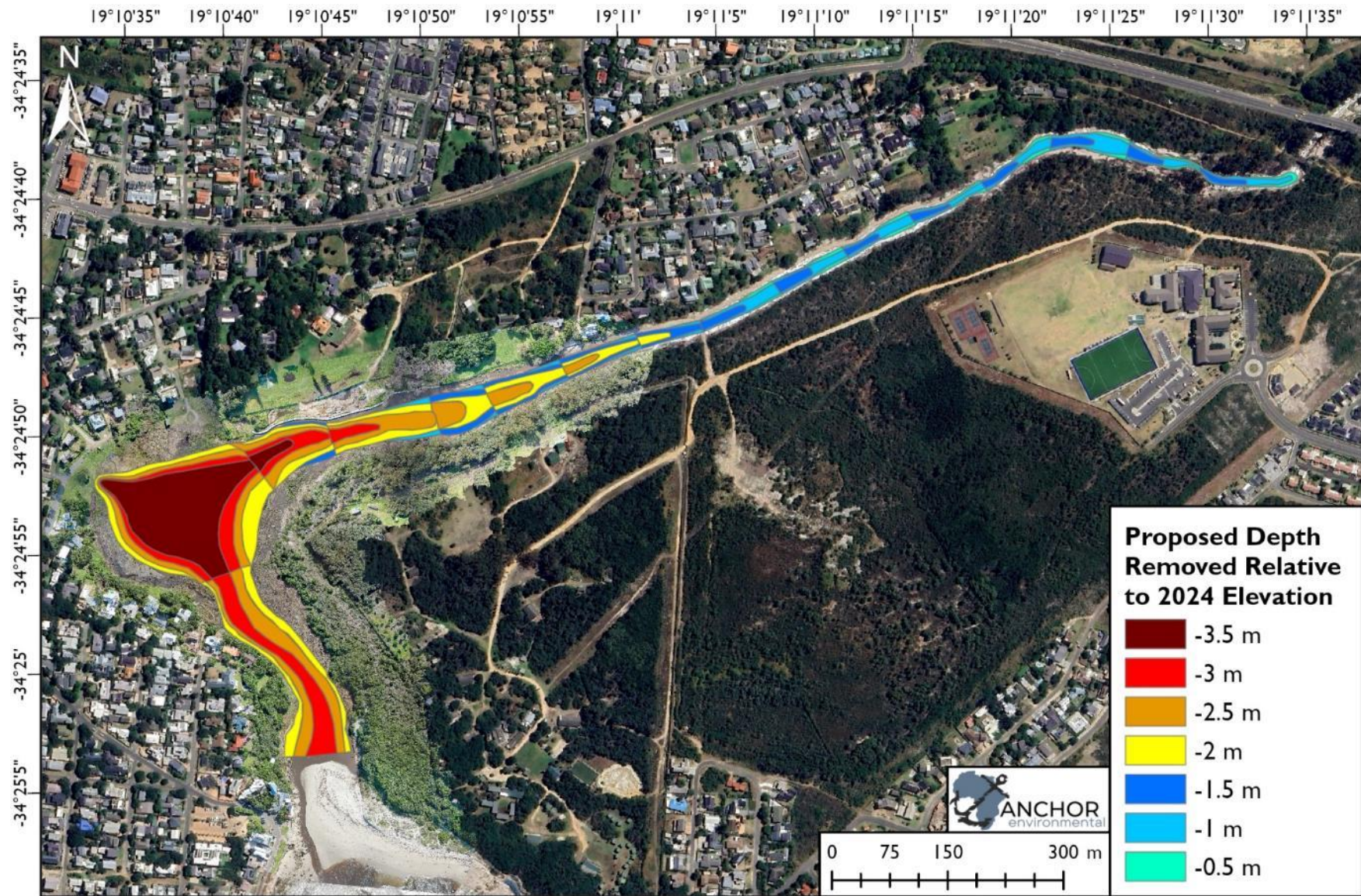


Figure 5.2. Proposed depth of sediment to be removed from the Onrus Estuary relative to the July 2024 elevations.

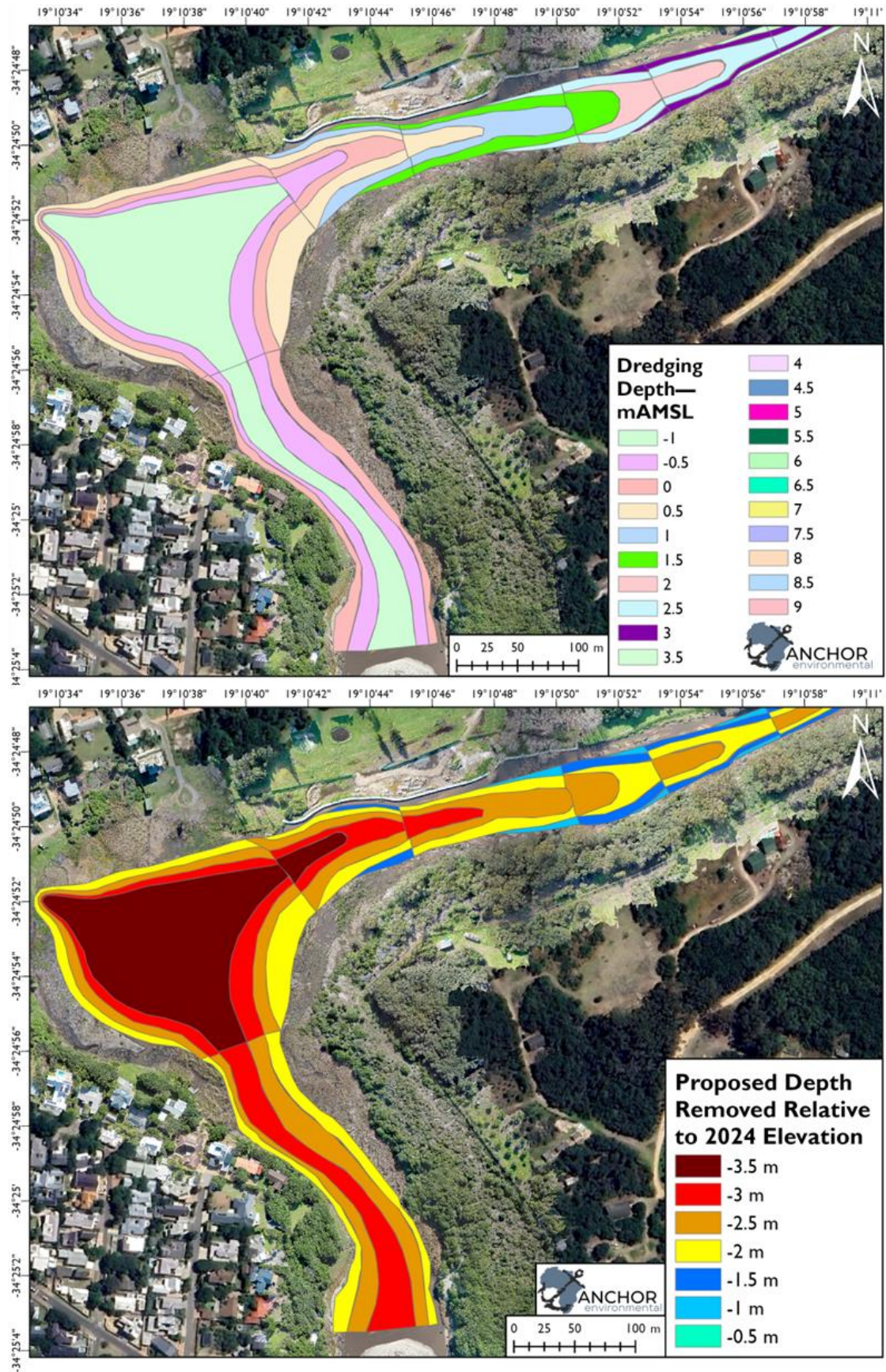


Figure 5.3. Top: Proposed dredging depths in the Lower Onrus Estuary. Bottom: Proposed depth of sediment to be removed from the Lower Onrus Estuary relative to the July 2024 elevations.

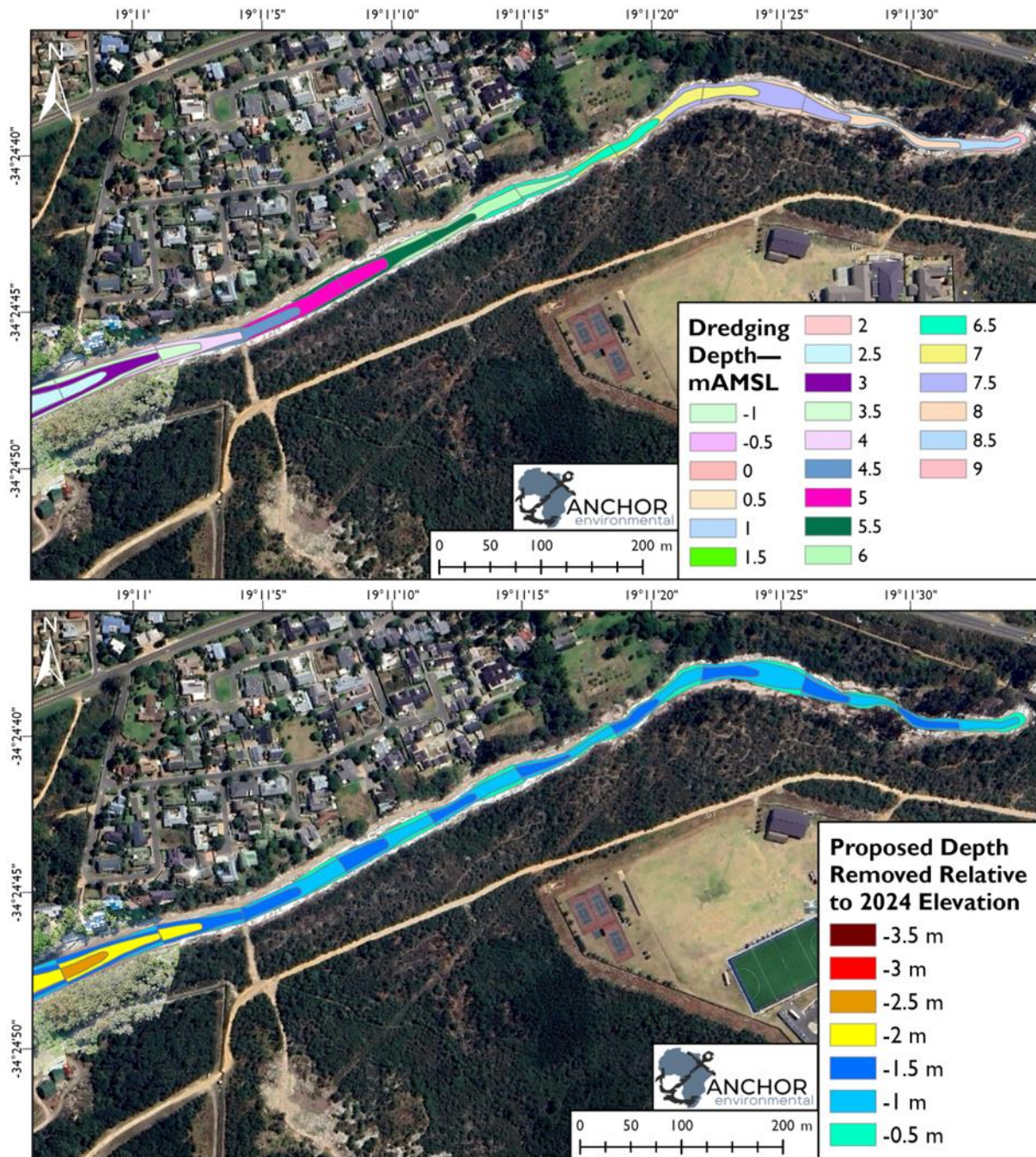


Figure 5.4. Proposed dredging depths in the Upper Onrus Estuary.

5.4 PROPOSED DREDGING METHODOLOGY

5.4.1 PREAMBLE

The physical dredging process is proposed to take place using a number of different methodologies, depending on factors such as location, standing water depth, etc. **Note:** the following methodology primarily pertains to the proposed bulk dredging operation required to remove the accumulated sediment following the 2023–2024 floods. This methodology has been prepared by the engineering contractor. However, it is unclear exactly what equipment

will be made available for repeat maintenance dredging surveys, therefore the precise methodology used is likely to change.

5.4.2 PROPOSED EQUIPMENT TO BE UTILIZED

Dredging is proposed to utilise the following items of equipment (Figure 5.5)

- 1 x Amphibious 20 tonne Excavator
- 1 x Remote Controlled dredger
- 1 x 350 kVA Diesel generator
- 1 x 23 tonne Excavator
- 1 x 23 tonne Excavator
- 2 x 10 m³ Tipper Truck
- 1 x Tractor Loader Backhoe (TLB)
- 1 x D6 Bulldozer
- 4 x Motor Vehicles (cars)
- 2 x Articulated Dump Trucks
- 1 x 10–20 tonne Roller



Figure 5.5. Dredge equipment proposed to be used to be dredged the estuary.

5.4.3 BASIC DREDGING METHODOLOGY

Dredging work is proposed to take place in such a way as to maximise the efficiency of the available equipment. Dredge equipment is to be used synergistically, with the moored amphibious remote-controlled dredger representing the primary dredge apparatus. This dredger will be towed/ pushed into position by means of 4 x 100 m remote-controlled winches and moored to prevent movement. The head of the dredger—likely fitted with a cutter-suction head to allow for breaking-up of the soil and subsequent pumping—will move in an arc and pump sediment from the channel. The pumped sediment will take the form of a semi-liquid slurry and will be composed of a mixture of river water and sediment—which will allow for the material to be pumped over distance due to the slurry having fluid-like characteristics.

Once taken by the dredger, the sediment will be pumped by means of a 100 m long (200 mm diameter) flexible pipeline, to connect with a stationary (200 mm diameter) High Density Polyethylene (HDPE) pipeline (with a length of 1.0–1.5 km), which will connect the dredging area to the proposed dewatering area (see below).

To improve the efficiency of the dredging activity, a variety of excavators (listed above) will be used to loosen material from the area surrounding the dredger, placing it within range of the pumping apparatus. This will act to increase the rate at which sediment can be pumped from the estuary and will reduce the frequency with which the dredger needs to be moved (during which it will not be operational). Furthermore, by pumping the material to the dredge site rather than delivering it via excavator/ truck, will dramatically reduce the amount of bank disturbance and emissions generated during the process. This will additionally confine dredge disturbances to the area being dredged at a given time, therefore retaining relatively calm conditions in the remainder of the estuary and river channel.

The above methodology will likely be suitable for the dredge works within the estuarine area, where much greater depths and volumes of sediment are proposed to be dredged—which will provide the required water depths for the dredger to operate. However, in the upper dredge area, where only ~1 m of sediment is proposed to be removed, access by the dredger is likely not possible. Under such circumstances, it will likely be most appropriate for a tracked excavator to remove the material, with support of a tracked bulldozer and other equipment.

5.4.4 SEPARATION OF PEAT AND SEDIMENT

An additional consideration for the bulk dredging operation is the proposed re-use of the peat soils for wetland restoration in the upstream Onrus Palmiet Peat Wetlands. Dredge material will therefore need to be separated into the broad categories of “sediment” or “peat”. Differentiating these two constituents is likely to be an approximate process, with visual inspections being conducted by the dredging/ environmental team to decide which category a deposit should fall into.

Management of these two deposit types needs to be handled in very different ways, with the reuse of peat being substantial constrained by the fact that peat soils break down rapidly when exposed to air and must therefore remain moist in order to retain its structural integrity and value for wetland restoration. Peat breakdown occurs very rapidly in dry conditions—within a few days—meaning that peat will need to be kept moist if it is to be used for upstream wetland rehabilitation. Furthermore, the peat will be destroyed if it is pumped to the dewatering site, thus rendering the above methodology inappropriate. As such, areas chosen for peat collection will need to be selected and excluded from the suction dredging process described in 5.4.3 above.

The physical process of harvesting the peat will need to take place mechanically, by use of excavators, bulldozers, TLBs, etc. Scoops of peat will need to be moved/ pushed to the banks where heavy vehicle access is possible. The peat will then need to be loaded into tipper trucks/ articulated dump trucks and transported to a sediment reuse site or to a storage area where it can be kept moist. If necessary, peat may need to be stored in temporary storage ponds within the estuary—essentially just deep holes with sediment piles around the perimeter—to keep the peat moist prior to transport.

Given the complexities of keeping peat in a useable form, and the possible misalignment of the approvals process for the upstream wetland restoration project in the Onrus Wetland, it is proposed that peat-rich areas of the estuary be dredged during the latter portions of the operation, with the initial priority being to remove silt and sand deposits using the pumping methodology detailed above. The ideal scenario would be for peat to be left in-situ in the estuary till the prerequisite approvals for wetland rehabilitation in the Onrus Wetland have been attained, and the peat can be removed and transported directly to the wetland area. This scenario would retain the integrity of the peat, whilst reducing the logistical challenges associated with its storage.

5.4.5 PROPOSED DREDGING ORDER

According to the principles of the NWA, it is also considered important, where possible, for dredging activities to start upstream and work downstream, so as to prevent recently dredged areas from experiencing impacts linked to the flowing of turbid water/ disturbed sediment downstream. However, given the complexities associated with this dredging operation, coupled with the degraded state of the estuary, this principle should be applied in a logical way, and should not substantially impede the operational workflow. A generalised dredging workflow is presented in Figure 5.6 below.

From an ecological, flood-risk, and recreational perspective, the priority area for initial dredging should be the central estuarine basin, which will yield the greatest returns in the shortest period of time. From there, dredging efforts should be directed upstream up till the end of the Onrus EFZ and the R43. **Note:** It is important that the deepwater outflow channel is not dredged before the upstream areas, as the current mass of sediment near the mouth is acting to prevent saltwater intrusion into the estuary. The retention of this plug will therefore protect the dewatering area and any other upstream areas from being adversely impacted by high salt content. It may in fact be beneficial to actively build up the berm at the mouth of the estuary prior to commencing with dredging to limit saltwater intrusion as far as possible during the dredging operations. (Note that salt intrusion will render the sediment from the estuary unsuitable for reuse in the wetland upstream). Once the remaining estuarine area is dredged, the deepwater mouth channel should be dredged in an upstream-downstream direction, till the channel depths shown in Figure 5.1 and Figure 5.3 have been achieved.

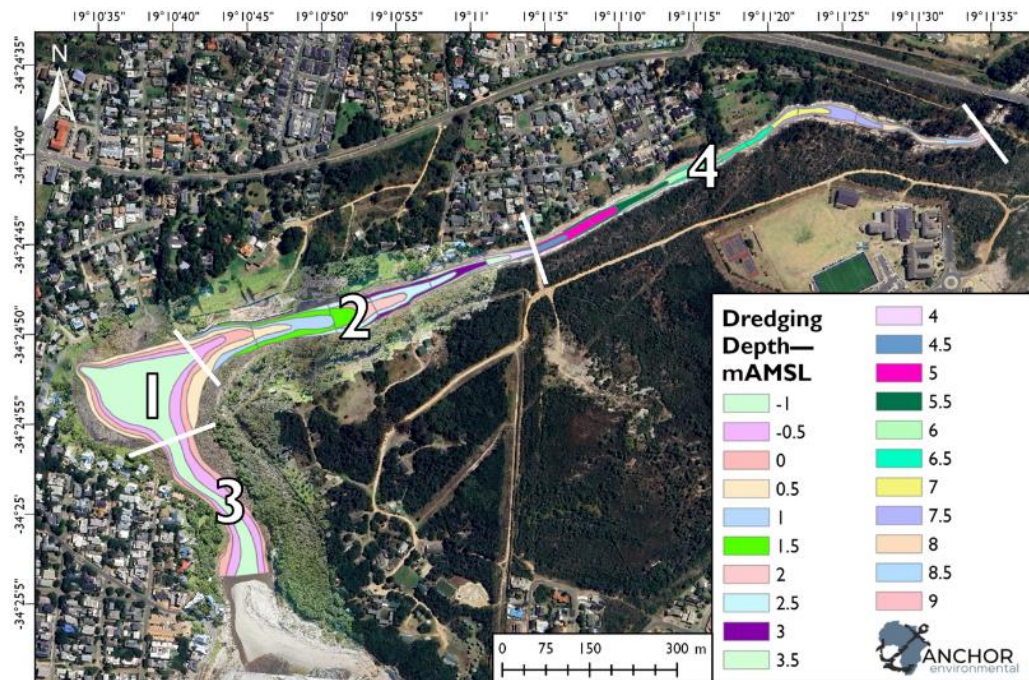


Figure 5.6. Proposed sediment dredging order for the initial dredging operation.

5.4.6 ADDITIONAL CONSIDERATIONS

A few further points need to be raised regarding the above dredging methodology:

- First, any methodologies requiring the dredge material to be pumped as a slurry will require access to a substantial volume of water to create a slurry with the desired consistency. The proportion of the total estuarine water volume required will initially be at its maximum (owing to the very small total surface water volume the estuary is currently holding). However, this will decrease with time as the dredging creates additional basin volume to fill from riverine inflows (which would otherwise flow out to sea under current conditions). Furthermore, ecological impacts associated with this water utilisation are of relatively low significance due to both the paucity of estuarine faunal still surviving, as well as the overwhelming benefits to estuarine ecology which the dredging is expected to introduce (see the Impact Assessment in Section 6 below).
- Second, the presence of emplaced/ floating slurry pipelines across the estuary would typically be of concern for recreational users, such as canoeists. However, since the estuary is currently of little recreational value and no such recreational activities are currently possible due to lack of available water depth, this is of little concern. Conversely, this will be an important consideration for future maintenance dredging operations.
- Dredging using any of the considered methodologies has the potential to disturb estuarine functioning. This can be in the form of direct disturbance and destruction of the benthic habitats, the creation of turbidity plumes (sediment clouds) in the water, and disturbance of estuarine species due to noise, vibration, etc. However, as with the previous considerations, the current state of the estuary is so heavily compromised due to the sedimentation problem, that these concerns (and their associated impacts) are very low relative to the expected benefits of dredging. However, these will all be important considerations for future maintenance dredging activities.

5.5 DEWATERING PLAN

5.5.1 BACKGROUND

A key component of most dredging plans is the dewatering of the dredge spoil. Dewatering, as the name implies, refers to the process of allowing a mass of sediment to dry out after being dredged, which typically occurs prior to it being moved to an approved disposal/ reuse site. Dewatering is necessary for several reasons. First: estuarine and riverine sediment deposits are typically heavily saturated with water (depending on their composition), which both increases the total sediment volume, and greatly increases its total mass. Second: recently dredged sediment—particularly that which has been extracted in the form of a slurry—is largely un-constituted and is, therefore, unsuitable for transport on standard trucks or lorries. Third: the NWA also stresses the importance of timeously returning water to the water resource from where it was sourced, indicating the importance of allowing as much of the supernatant (leached water) to return to the estuary. This is additionally important due to the relatively large volumes of water required for the continual pumping operation.

5.5.2 SITE SELECTION

Dewatering the proposed sediment volumes is anticipated to require between 4–6 ha of open land. The proposed dewatering site is situated in the western portion of ERF 2834, located just to the east of the neighbouring Habonim Property (Figure 5.7).

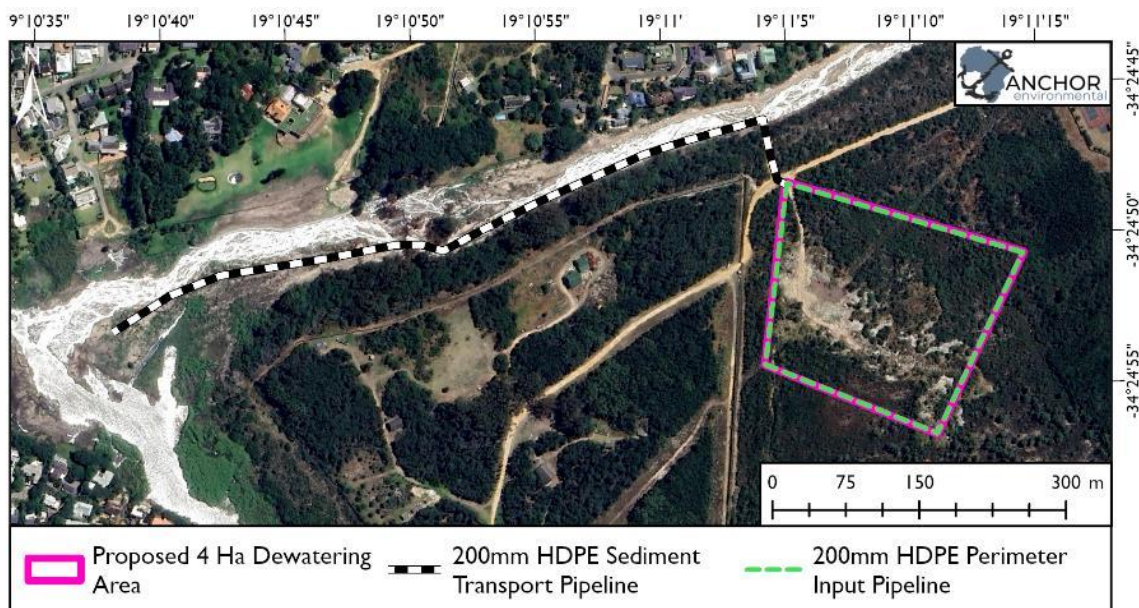


Figure 5.7. Proposed sediment dewatering area and supporting transport/ input pipelines.

The proposed area (and the remainder of ERF 2834) is slated for a large scale mixed use development, known as De Zandt. To this end, Environmental Authorisation (EA) has been granted for development to occur on this property—which includes the removal of vegetation, flattening of land, etc. (EIA Reference: 16/3/3/5/E2/35/1040/18). EA for this development was initially granted on the 29th of September 2010, and was later amended on the 7th of March 2019. To date, the only portion of the development to have commenced is the Curro

Hermanus High School. As of November 2024, OLM and the developer are still finalising the ownership transfer of the remainder of ERF 2834. The proposed dewatering area falls within the land slated for ownership transfer. De Zandt has been approached with the proposal to utilise a portion of ERF 2834 for the purposes of dewatering, with the developer having expressed interest in both the dewatering occurring on their land, and have further expressed interest in utilising some of the dewatered sand for their development.

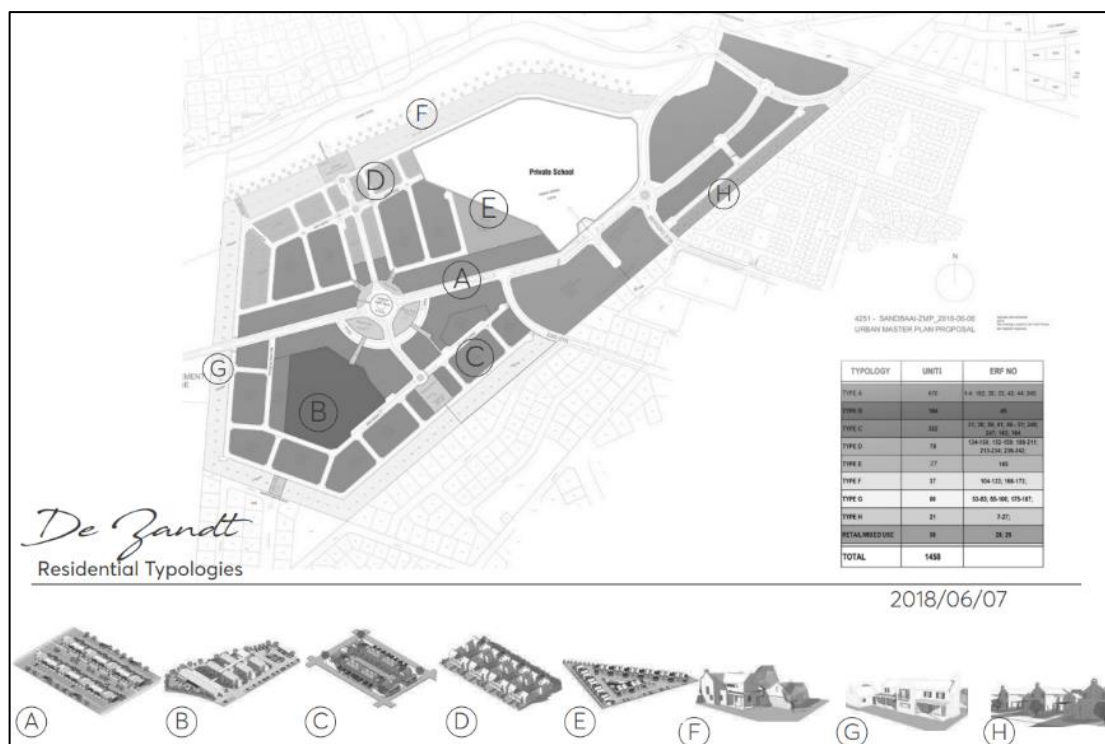


Figure 5.8. Layout of the De Zandt development, approved under EA Ref: 16/3/3/5/E2/35/1040/18 (Boogertman + Partners 2017).

A site inspection by a specialist from Anchor Environmental on the 12 November 2024, found the site to be heavily infested with Alien Invasive Plants (AIPs), with the dominant species being Port Jackson *Acacia saligna* (Figure 5.7).

SUMMARY OF SITE SUITABILITY

The dewatering site is therefore considered appropriate for the following reasons:

- There is sufficient space available for all dewatering activities to occur at a single site.
- The site is not located on the estuarine bank/ immediate riparian areas, and does not threaten the integrity of any indigenous fringing vegetation, or pose a threat of bank destabilisation.
- The site is located close enough to the estuarine channel, which reduces complexity associated with sediment transport and minimises impacts associated with depositing sediment and water into the terrestrial environment.
- The selected site, and surrounding area, are heavily disturbed by alien species, and is therefore of little ecological value.
- The site falls within an area slated for a large mixed-use development for which EA has been granted.

Note: It is considered essential that all proposed activities on the De Zandt site comply with the requirements of both the existing EA and its associated Environmental Management Programme (EMPr).



Figure 5.9. Proposed dewatering site on the De Zandt Property. Take note of the extensive infestation of invasive Port Jackson *Acacia saligna*, and signs of illegal dumping.

5.5.3 DEWATERING METHODOLOGY

Dewatering is proposed to occur via the use of a series of sedimentation ponds, according to the following step-by-step process:

- Prior to the commencement of dredging and dewatering, the proposed site will be cleared of vegetation and flattened using a TLB and/ or bulldozer. Vegetation, earth, and rubble will be piled in a continuous berm along the perimeter of the dewatering area, therefore enclosing the sedimentation pond. Smaller inner berms will also be placed within this area, creating several smaller ponds, allowing for segmentation of the dewatering area. Each dewatering pond will have drainage channels to allow for water to drain back into the estuary, with each channel being lined with plastic to prevent soil

erosion and the formation of unnatural flow channels/ gullies due to the dewatering process.

- Once dredging commences, the sediment will be pumped as a semi-liquid slurry through the ~1.5 km HDPE pipeline from the dredge site to the dewatering area. This pipeline will be placed along recent sediment deposits and will exit the channel at the location of the old bridge—now washed away—and will follow the existing dirt road to the dredge site. By following this route, there will be no need to unnecessarily disturb additional bank area.
- Once at the dewatering site, the sediment will be pumped through an additional length of 200 mm HDPE pipe, which will run along the perimeter of the site. This pipe will have three manually operated butterfly valves, each feeding 110 mm outlets (Figure 5.10). These outlets will be strategically placed around the dewatering area so that sediment inflows can be directed to specific components of the dewatering site.



Figure 5.10. Example of a manually operated butterfly valve (Image source: CMO Valves.com 2024).

- Sediment will then dry through the processes of evaporation and seepage, with the final product being dry and much reduced in mass, and suitable for transportation and re-use.
- Dry sediment can then be removed using handheld shovels and spades, or by using of heavy machinery, with the material being loaded onto trucks/ lorries and transported for reuse.

5.5.4 PROPOSED USES FOR THE DEWATERED SEDIMENT AND PEAT

PEAT SEDIMENTS

As discussed in prior sections, the peat removed from the estuary should ideally be used for restoration of the Onrus Main Wetland, located upstream. Rapid erosion of this wetland is the primary source of the peat which has deposited in the estuary. Like the Onrus Estuary,

the Main Onrus Wetland is in urgent need of rehabilitation and stabilisation, to prevent further desiccation (drying out). Activities pertaining to the Onrus Wetland fall outside of the scope of this MMP yet do influence the use of the peat soils. Since there may be a disparity in the granting of the required approvals for the dredging and wetland rehabilitation, it is possible that dredging may commence prior to approvals being granted for wetland rehabilitation. Given the stated urgency of the dredging of the channel, it is not considered appropriate for the initiation of the dredging to be delayed based on the approval status of the Onrus Wetland rehabilitation plan. As indicated in Section 5.5.4 above, the plan to ameliorate this issue is to focus initial dredging efforts on areas predominantly composed of sand/ silt, whilst intentionally leaving the peat deposits intact. Ideally, such a plan will allow for sufficient time to pass for the acquiring of all necessary approvals, and hence allow the peat to be transported directly to the Onrus Wetland after extraction. However, should the reuse of the peat for wetland rehabilitation be unfeasible, the peat can be dredged and dewatered with the sandy sediments, and be utilised in other ways.

DEWATERED SANDY SEDIMENTS

Several options have been proposed for the utilisation of the dewatered sandy sediments. The first option is to utilise the sand as infill material for the proposed wetland rehabilitation measures in the Onrus Wetland. Large sediment volumes are required for several of the proposed rehabilitation activities, including the infilling of the deep erosion gulleys and construction of gabion weirs, etc. Additionally, the De Zandt Property Developers have expressed interest in utilising the some of the sediment for their development.

SUMMARY STATEMENT

The presence of numerous options for sediment reuse/ disposal is highly beneficial, as potentially means that the proposed maintenance dredging activities within this MMP are not entirely bound by the approvals status of the Onrus Wetland Rehabilitation project. As such, despite the ideal scenario being that dredged material be used for wetland rehabilitation, this MMP is considered to be a completed, stand-alone plan.

5.6 TRIGGERS FOR FUTURE MAINTENANCE DREDGING WORK FOLLOWING THE INITIAL LARGE-SCALE DREDGING OPERATION

5.6.1 PREAMBLE

Despite the importance of ongoing maintenance dredging of the estuarine channel in the years following the bulk dredging and dewatering operation (described above), it is important to stress the importance of only conducting such maintenance activities when it is proved to be necessary by the exceedance of numerical thresholds and the conducting of specialist scientific studies.

Dredging is, by its nature, a fundamentally destructive process, wherein a sediment substrate is removed from a river, estuary, or the sea. Whilst the initial bulk dredging activities are assessed to be overwhelmingly positive (see the Impact Assessment in Section 6) and the destructive aspects considered acceptable due to the highly degraded current state of the estuary—negative impacts may be more pronounced for future maintenance dredging events.

It is therefore critically important to strike a balance between the benefits of future dredging activities, with the potential ecological impacts of too frequent dredge work. Since estuaries are dynamic environments, it is expected that upstream wetland and catchment erosion (and subsequent estuary sediment deposition) will continue going forwards, with the dredged areas filling again with time. It is also expected that estuarine and riverine sediments will be remobilised in the time during, and following, the 2025 bulk dredge operation, leading to an alteration in the overall estuarine form. Positively, the addition of new sediment into the system is expected to be greatly slowed by the proposed Onrus Wetland rehabilitation measures—which will ideally reduce the required maintenance dredging frequency.

5.6.2 REQUIREMENTS FOR FUTURE DREDGING

Triggers and requirements for future maintenance dredging activities are described in the paragraphs below and tabulated in detail in Section 7.

At a surface level, dredging will be considered permissible if the sediment base level in the estuary and lower river channel is, on average, 1 mAMSL or more above the dredging depths indicated in Section 5.3. Should sedimentation appear to match or exceed these depths through visual inspection, validation must take the form of a bathymetry/ topographical survey, which must include the entire area from the mouth of the estuary, up till the R43 Road Bridge. This survey will give both an indication of the total depths and volumes of accumulated sediment, which will allow for more accurate determination of whether dredging is actually required. Furthermore, should dredging be deemed necessary, the survey will also give an indication of which areas should be dredged, and which should be left intact. For the purposes of reducing the frequency of dredging events, it is considered acceptable to dredge any areas that have had 0.5 m of vertical sediment accumulation relative to the depths indicated in Section 5.3. However, dredging should not occur in areas where less than 0.5 m of vertical sediment deposition has occurred, to protect sensitive benthic communities. Furthermore, areas identified not to be dredged should be protected through the use of silt curtains when nearby areas are dredged—which will act to further protect these environments. Such “benthic islands” may also provide the seeding populations for re-habitation of the dredged areas with benthic invertebrates and macrophyte species. This bathymetric survey will also provide valuable information as to sedimentation rates and patterns in the preceding years, which can be used to inform future management actions and interventions in the Onrus system.

In addition to the above-mentioned bathymetry survey, it is also considered critical that a complete ecological survey be conducted prior to any dredging activity. This will serve both to inform the potential negative impacts of a large-scale dredging operation, and again provide valuable information on the efficacy of management activities in the system. This will further allow for the determination of appropriate dredging areas and no-go areas described in the previous paragraph.

5.7 RIPARIAN AREA REHABILITATION AND RESTORATION FOLLOWING DREDGING

Since the dredging activities are expected to disturb the estuarine and riverine banks, it is expected that indigenous vegetation will be disturbed and destroyed in the process, bank rehabilitation and replanting efforts will be required. The loss of indigenous vegetation is expected to have impacts on both local biodiversity, yet will likely also increase rates of bank erosion. This is because indigenous vegetation typically also has an anchoring effect on soil, resulting in a reduction in surface erosion and subsequent deposition into the estuary.

Additionally, any activity which leaves open areas disturbed and devoid of vegetation will simultaneously create the ideal conditions for alien re-colonisation, as aliens typically aggressively outcompete local indigenous species.

It is proposed that revegetation activities commence immediately following dredging and bank disturbance. Since alien seedbanks have no doubt established in these areas, indigenous revegetation activities should likely prioritise the planting of established seedlings, rather than seeding these areas. To this end, an operation to grow seedlings must be initiated at a local greenhouse service provider. Planting of the seedlings should ideally be conducted by trained planting teams. Such planting activities will further provide an opportunity to screen and remove alien seedlings from the rehabilitation areas.

6 IMPACT ASSESSMENT

6.1 INTRODUCTION

In the estuarine environment a disturbance can be relatively short-lived (e.g., an accidental chemical spill which is diluted in the water column to acceptable limits within hours). Conversely, disturbances may have a much longer lifetime, such as through the bioaccumulation of contaminants into the tissues of estuarine organisms (which then moves up the food chain through consumption by predatory organisms), or the accumulation of pollutants in estuarine sediments, which can re-enter the water column at a later stage due to changes in water chemistry or sediment disturbances.

The assessment and rating procedure described in Appendix I addresses the effects and consequences (i.e., the impacts) on the environment rather than the cause or initial disturbance alone. To reduce negative impacts, precautions referred to as 'mitigation measures' are set, and attainable mitigation actions are recommended.

Identified potential impacts of the proposed maintenance activities in the Onrus Estuary were assessed as part of this study. Impacts have been separated into the negative impacts and positive impacts (benefits) expected to be associated with the maintenance activities. Mitigation and/ or enhancement measures have also been provided to minimise the significance of negative benefits and maximise the significance of the assessed benefits.

6.2 ANTICIPATED NEGATIVE IMPACTS ASSOCIATED WITH THE MAINTENANCE ACTIVITIES

In total, the maintenance activities are anticipated to have seven negative impacts, as follows:

- Waste generation and disposal
- Hazardous substance spills
- Generation of turbidity plumes
- Direct destruction of benthic habitat
- Terrestrial impacts
- Dust pollution, and
- Noise impacts

6.2.1 IMPACT 1: WASTE GENERATION AND DISPOSAL AND HAZARDOUS SUBSTANCE SPILLS DURING MAINTENANCE OPERATIONS

The problem of litter (domestic waste) entering the environment has escalated dramatically in recent decades, with an ever-increasing proportion of litter consisting of non-biodegradable plastic materials. South Africa has laws against littering, both on land and in the coastal zone. Objects which are particularly detrimental to aquatic fauna include plastic bags and bottles, pieces of rope and small plastic particles. Large numbers of aquatic organisms are killed or injured daily by becoming entangled in debris or as a result of the ingestion of small plastic particles (Gregory 2009, Wright et al. 2013). These materials, being largely plastics, may be transported by currents for long distances out to sea or around the coast and do not breakdown or decompose for hundreds of years. Therefore, unlike fuel or sewage contamination, the spatial extent of the damage is, in theory, limitless and the duration long-

term. The impact on certain forms of marine life by floating or submerged solid materials cannot be overstressed. Most at risk are seabirds and fish, including rare or endangered species.

To reduce the impacts of pollution within the system, all domestic and general waste generated during dredging must be disposed of responsibly. All reasonable measures must be implemented to ensure there is no littering and that general waste is adequately managed. Staff must be regularly reminded about the detrimental impacts of pollution on aquatic species, and suitable handling and disposal protocols must be clearly explained, and sign boarded. The ‘reduce, reuse, recycle’ policy must be implemented. This impact is rated as “Medium” without mitigation, due to the long-life span of plastic, and likelihood long-distance transport, yet is reduced to “Very Low” with appropriate mitigation actions (Table 6.1).

Table 6.1. Impact 1: Waste generation and disposal from maintenance operations.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional 2	Low 1	Long term 3	Medium 6	Probable	MEDIUM	-ve	High
Essential mitigation measures:								
<ul style="list-style-type: none"> • Inform all staff about sensitive estuarine species and the responsible disposal of waste. • Suitable handling and disposal protocols must be clearly explained, and sign boarded. • Reduce, reuse, recycle. 								
With mitigation	Local 1	Low 1	Long term 3	Low 5	Possible	VERY LOW	-ve	High

6.2.2 IMPACT 2: HAZARDOUS SUBSTANCE SPILLS DURING DREDGING AND DEWATERING OPERATIONS

There is a risk of spillage of a variety of hazardous substances due to the use of heavy machinery and vehicles during dredging and dewatering activities.

For example, spillage may occur as a result of fuel leaks or during refuelling, and these substances could then be washed into the estuary or fall within the EFZ. Hydrocarbons are toxic to aquatic organisms and precautions must be taken to prevent them from contaminating the environment, especially given the proximity of the upgrade site to the mouth of the estuary. This impact can be mitigated successfully if a rigorous environmental management and control plan is implemented to limit ecological risks from accidents. All fuel and oil must be stored with adequate spillage protection and no leaking vehicles should be permitted on site. Intentional disposal of any substance into the aquatic environment is strictly prohibited, while accidental spillage must be prevented, contained, and reported immediately. After mitigation, the impact of accidental spillage is rated to be of “Insignificant” significance (Table 6.2).

Table 6.2. Impact 2: Hazardous substance spills during maintenance operations

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	High 3	Short term 1	Low 5	Probable	LOW	-ve	High

Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Essential mitigation measures:							
<ul style="list-style-type: none"> Intentional disposal of any substance into the environment is strictly prohibited, while accidental spillage must be prevented, contained and reported immediately. A rigorous environmental management and control plan (including procedures for remediation) must be developed and implemented. All fuel and oil must be stored with adequate spill protection. No leaking equipment or vehicles are permitted on site. All hazardous substances must be accompanied by a permit, a hazard report sheet, and a first aid treatment protocol and may only be handled by suitably trained operators. Spill kits must be available on site at all times, and staff must be trained in their proposed use. 							
With mitigation	Local 1	Medium 2	Short term 1	Very Low 4	Possible	INSIGNIFICANT	-ve High

6.2.3 IMPACT 3: GENERATION OF TURBIDITY PLUMES

The dredging of sediment and displacement of soil within the EFZ can result in the disturbance of sediments, resulting in localised turbidity plumes. Exposed soil, following the removal of vegetation, can also be blown or washed into the estuary, which would generate similar turbidity impacts.

The dredging of sediments from an estuary is, by definition, expected to result in the disturbance of sediments and result in the stirring up of localised turbidity (underwater dust) plumes. There is also a concern that piles of dredged/ dewatered sediment will be resuspended by the wind and enter the estuary, therefore, again leading to the creation of turbidity plumes. These plumes can negatively affect primary production, filter-feeding efficiency, the survival of suspension feeders and invertebrate larvae, which in turn may impact the availability and suitability of food for higher order consumers and can cause a cascade of negative effects through the estuarine food web (Lunt & Smee 2020). It is noted that estuarine faunal communities are generally tolerant of low visibility/high turbidity conditions as these are often experienced due to nutrient-rich waters and turbid freshwater input. However, given the extremely degraded state of the estuary, as of late 2024, and the almost complete lack of estuarine biota present, these plumes are unlikely to be of concern.

Due to the relatively short (<2-year) duration of the proposed dredging activities, and the dilution of these plumes within the estuary, the effects are likely to be short-term. Essential mitigation measures include erosion control measures such as securing dewatered sand piles with geotextile/ shade cloth, and utilising silt curtains where necessary when working within the estuary. This impact will likely be of greater concern during maintenance dredging following the initial bulk dredging operation, as it is anticipated that there will be an amount of ecological recovery by then. Consequently, the proposed mitigation measures will be of additional importance in the years following the proposed bulk dredging operation.

The impact is rated to be of “Low” negative significance without mitigation, with the duration assessed as “Medium term”, due to benthic habitats potentially taking two years or more to recover from intense smothering. However, this is reduced to a “Very Low” significance with the employment of appropriate mitigation measures (Table 6.3).

Table 6.3. Impact 3: Generation of turbidity plumes.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Medium 2	Medium term 2	Low 5	Definite	LOW	-ve	High
Essential mitigation measures:								
<ul style="list-style-type: none"> Dewatered soil piles must be either be secured with geotextile or shade cloth material to prevent wind mobilisation into the estuary. Silt curtains should be utilised once a large open water body is established to restrict the extent of turbidity plumes. Furthermore, silt curtains must be used to protect areas planned for exclusion from future maintenance dredging activities, to protect benthic habitat. A filtration mechanism must be utilised on the downslope end of the dewatering site to prevent suspended fine (silty) sediments from flowing back into the estuary and causing localised turbidity plumes. 								
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Probable	VERY LOW	-ve	High

6.2.4 IMPACT 4: DIRECT DESTRUCTION OF BENTHIC AND RIPARIAN HABITAT

Given that the dredging activities will involve the direct removal of sediment from the bed of the estuary and lower river channel, they will also lead to the direct destruction of any benthic habitat found within the substrate. This destruction will consequently lead to the removal (and death) of essentially all organisms found within the dredged sediment, as well as their removal from the estuary. However, the October 2024 survey has demonstrated that the Onrus Estuary is presently largely devoid of aquatic life—including estuarine invertebrates—and, therefore, there is relatively little intact habitat or species that can be harmed under present conditions. Furthermore, the 2023 Heritage Day floods and the subsequent smothering of the benthos by sediment in 2024, is considered to be the principal reason for the decline in the ecological integrity of the estuary, and the removal of such sediment is considered to be critical for the restoration of this ecological functioning.

There are no suitable mitigation measures which can prevent the direct destruction of benthic habitats in the initial bulk dredging operation. However, the primary method of minimising this impact in the years following the initial dredge will be to ensure that dredging activities only occur if strictly necessary. Frequent, unnecessary repeat dredging activities will deprive benthic communities of sufficient time to re-establish themselves following previous dredge disturbances and will ultimately impede ecological health. Furthermore, during maintenance dredging activities, silt curtains should be used to protect areas not proposed for dredging, to protect intact communities. To protect intact habitat, vehicle movement should be constrained to dredge areas, and areas proposed for dredging, if possible.

Table 6.4. Impact 4: Direct destruction of benthic and riparian habitat.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without Mitigation	Local 1	Medium 2	Medium term 2	Low 5	Definite	LOW	-ve	High
Essential mitigation measures:								
<ul style="list-style-type: none"> Dredging should only be conducted when necessary according to prescribed triggers Vehicle movement should be constrained to dredge areas, and areas proposed for dredging, wherever practically possible. 								

Extent		Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
<ul style="list-style-type: none"> • Estuarine and riverine banks should be left intact if not included in a dredging operation, and should be suitably rehabilitated if avoiding disturbance is not possible. • Repeat maintenance dredging activities must only occur if deemed necessary through detailed bathymetric and ecological surveys, and with agreement from relevant authorities, with areas where minimal sediment deposition has occurred being left intact from dredging and other related disturbances. • Areas selected to be left intact during maintenance dredging activities must be left undisturbed by dredging equipment and machinery, and must be protected from smothering by silt curtains. 								
With mitigation	Local 	Low 	Medium term 	Very Low 3	Definite	VERY LOW	-ve	High

6.2.5 IMPACT 5: POTENTIAL TERRESTRIAL IMPACTS DUE TO THE DEWATERING OF SEDIMENT

2025 BULK DREDGING AND DEWATERING OPERATION

As discussed within the dredging plan, the proposed 2025 bulk dredging operation will require the removal of a very large amount of sediment from the estuary (up to 200 000 m³). Whilst this material will be removed from the estuary, and not a terrestrial environment, the required dewatering (drying out) of this sediment will occur within the terrestrial realm and require between 4–6 ha of open space. This, therefore, has the potential to impact upon the terrestrial environment both at the dewatering site, as well as the surrounding area if not managed appropriately.

However, this impact will be greatly mitigated by the proposed dewatering at the De Zandt site, according to the methodology presented in Section 5.5. Mitigation/ environmental suitability measures associated with the dewatering site are as follows:

- There is sufficient space available for all dewatering activities to occur at a single site.
- The site is not located on the estuarine bank/ immediate riparian areas, hence maintaining the integrity of any indigenous fringing vegetation, and reducing the likelihood of bank destabilisation.
- The site is located close enough to the estuarine channel, which reduces complexity associated with sediment transport and minimises impacts associated with depositing sediment and water into the terrestrial environment.
- The selected site, and surrounding area, are heavily disturbed by alien species infestation and illegal dumping—as confirmed by a specialist site visit by Anchor in November 2024—and are therefore of little ecological value.
- The site falls within an area slated for a large mixed-use development for which EA has been granted.
- The entirely freshwater nature of the estuary under current conditions, means that there is negligible risk of any saltwater introduction into the terrestrial environment by dewatering at this site.

FUTURE MAINTENANCE DREDGING OPERATION

Whilst the combination of the estuarine condition as of late 2024, the unique suitability of the proposed De Zandt dewatering site, etc. all contribute to minimize potential dewatering impacts during the initial 2025 bulk dredging operation, additional considerations need to be

made with respect to selecting sites for sediment dewatering linked to future maintenance dredging operations.

Prior to the commencement of future dredging operations, a suitable dewatering site must be identified, which must ideally follow the same principles determining the suitability of the De Zandt site. Ideally, the same dewatering site will still be available for future dewatering activities. However, it is likely that the continuation of the De Zandt Development will result in the site being developed into its proposed mixed-use form.

A future dewatering site should preferentially occur on the broader De Zandt Property, as this area is already slated for extensive alteration and development—which will avoid the need to disturb any additional habitat. However, should dewatering be proposed for any other areas, it is important that the site is in a degraded state and infested with aliens—and not of high value for indigenous vegetation. Should established stands of indigenous vegetation be identified during early screening, they will need to be demarcated and classified as “no-go” zones for dewatering. Additionally, the 32 m Riparian Buffer Area should ideally also be avoided for dewatering activities, to prevent disturbance and destabilization. However, the site should be in sufficient proximity of the estuary to minimize logistical challenges and undue terrestrial impacts associated with pumping/ transporting sediments over long distances for dewatering.

Furthermore, it is considered critically important that disturbed areas be rehabilitated to a suitable condition and revegetated with indigenous vegetation following the conclusion of a dredging operation.

Similarly to the proposed methodology for the 2025 bulk dredging and dewatering operation, the supernatant water drainage channel linking the dewatering area to the estuary will need to be lined with plastic to prevent undue erosion. Should the dewatering site be located at such a distance from the estuary that an exposed flow channel is not a viable option, then the supernatant water will need to be channelled into a pipeline, which must be directed into the estuary.

An additional consideration for future dredging activities will be the salinity of the estuarine environment preceding—and during—the dredge operation. Whilst this is not considered to be of concern during the proposed 2025 bulk dredge due to the perched, entirely fresh, nature of the estuary as of November 2024, coupled with the strategic dredging order and procedure stipulated within this MMP, this may not be the case in future. It is therefore very important that salinity testing be conducted in the estuary prior to the commencement of dredging activities and the selection of a dewatering site, to protect soils from salt contamination. If the estuarine salinity is high prior to maintenance dredging, dewatering should occur in the open areas surrounding the estuary where saline intrusion is expected. However, should this not be possible, the dewatering area should be suitably lined with plastic or another impervious layer to prevent salt from entering the ground.

This impact is rated to be of “Medium” negative significance without the implementation of essential mitigation, yet this is reduced to “Very Low” following the implementation of essential mitigation measures. The lowering in significance is principally due to a reduction in both the impact duration and the probability of the impact occurring.

Table 6.5. Impact 5: Potential terrestrial impacts due to the dewatering of sediment.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Medium 2	Long-term 3	Medium 6	Probable	MEDIUM	-ve	High
Essential mitigation measures applicable to the De Zandt dewatering site								
<ul style="list-style-type: none"> • There is sufficient space available for all dewatering activities to occur at a single site. • The site is not located on the estuarine bank/ immediate riparian areas, hence maintaining the integrity of any indigenous fringing vegetation, and reducing the likelihood of bank destabilisation • The site is located close enough to the estuarine channel, which reduces complexity associated with sediment transport and minimises impacts associated with depositing sediment and water into the terrestrial environment. • The selected site, and surrounding area, are heavily disturbed by alien species infestation and illegal dumping—as confirmed by a specialist site visit by Anchor in November 2024—and are therefore of little ecological value. • The site falls within an area slated for a large mixed-use development for which EA has been granted. • The entirely freshwater nature of the estuary under current conditions, means that there is negligible risk of any saltwater introduction into the terrestrial environment by dewatering at this site. • Sediment mounds must be secured with geotextile or shade cloth to prevent wind mobilisation and smothering of surrounding soils and vegetation. 								
Essential Mitigation applicable to future dewatering activities								
<ul style="list-style-type: none"> • If possible, future dewatering activities should occur on a portion of the De Zandt Property. • Dewatering should only occur in areas determined to be alien infested through satellite imagery analysis and ground truthing—intact stands of indigenous vegetation must be declared no-go zones. • The site should ideally have sufficient space to contain all dewatering activities. • If possible, the site should not be located on the estuarine bank/ immediate riparian areas, to maintain the integrity of any indigenous fringing vegetation, and reduce the likelihood of bank destabilisation. • The site should be located sufficiently close to the estuary to minimise the complexity associated with transporting sediment over long distances to the dewatering site and minimise associated impacts on the terrestrial environment. • Sediment mounds must be secured with geotextile or shade cloth to prevent wind mobilisation and smothering of surrounding soils and vegetation. • Supernatant water (water leached from the dewatering sediment) must be allowed to return to the estuary (the water resource) as rapidly as possible. This will assist in retaining sufficient water for estuarine function and for use in producing new dredge sediment slurry. • Supernatant water drainage channels into the estuary must be lined with plastic to prevent the formation of erosion channels and introduction of sediment into the estuary. • Should the dewatering site be located far enough from the estuary that a surface outflow channel is not viable, then the supernatant water must be channelled into a pipeline and returned to the estuary. • Salinity testing must occur in the estuary prior to the commencement of dredging. <ul style="list-style-type: none"> ○ Should the estuary have very low salinity, then the impact of salt water on the dewatering site will be negligible and the site can have a permeable base. ○ A salinity exceeding 10 PPT, then dewatering must either occur in the open areas immediately surrounding the estuarine channel or, should a terrestrial site be selected, then the dewatering area must be lined with plastic sheeting or another impermeable layer, to prevent saline intrusion into the sediment. 								
With Mitigation	Local 1	Medium 2	Medium-term 2	Low 5	Possible	VERY LOW	-ve	High

6.2.6 IMPACT 6: POTENTIAL DUST POLLUTION IMPACTS EMANATING FROM DREDGING AND DEWATERING ACTIVITIES.

Whilst the dredging of estuarine sediment is unlikely to mobilise much dust into the air (due to the high-water content in estuarine sediment), the proposed dewatering process may result in substantial dust mobilisation impacts. This is because, as sediment dries, the finer sized particles become more susceptible to mobilisation by wind. This can create dust clouds, and lead to respiratory problems for surrounding residents and fauna. Dust can also have a smothering effect, which can negatively affect photosynthesizing plants, alter soil chemistry, and can cause nuisance smothering of nearby properties. The issue of airborne dust pollution must be managed over the course of the dredging and dewatering activities.

Although problematic, this impact can be successfully mitigated in several ways, depending on the chosen dewatering methodology. The dewatering methodology typically best suited to dust containment is through the use of geotextile tubes (geotubes) which filter and contain all sediment during the dewatering process. Unfortunately, this methodology is quite costly, as the geotubes need to be custom built, are large in size, and tend to be single use—with the bag cut open after dewatering, and thereafter disposed of. Additionally, given the very large amount of sediment proposed to be dredged during the initial dredge operation, there will need to be extensive geotube procurement (and hence disposal). Furthermore, geotubes are often appropriate when sediment is contaminated, and hence the maximisation of the outflowing water quality is more important.

Given that the sediment deposits in the Onrus Estuary are, as of November 2024, predominantly composed of sand and peat eroded from the upstream Palmiet peat wetland, they are considered to be uncontaminated. Given the sediment quality, and the vast proposed dredging volumes, it is considered appropriate for alternative dust control measures to be employed. The proposed methodology will therefore be to cover and secure dewatering piles/ dried sediment mounds with an appropriate geotextile or shade cloth material both in the period during, and following the dewatering activities. This will act to prevent the mobilisation of windblown sediments; will be much cheaper and less wasteful than using geotubes; and the coverings will be reusable for the entire dewatering operation.

It is possible that the conditions may be different during subsequent maintenance dredging operations, in which case geotubes could be considered as the primary dewatering methodology—particularly if dewatering is to occur in spaces utilised by the public.

The deployment of either of the above methodologies will effectively mitigate this impact. Consequently, this impact is lowered from a significance of “Low” without mitigation to “Insignificant” with the employment of appropriate mitigation measures.

Table 6.6. Impact 6: Potential dust pollution impacts emanating from dredging and dewatering activities.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	High 3	Medium term 2	Medium 6	Probable	MEDIUM	-ve	High
Essential mitigation measures:								
<ul style="list-style-type: none"> The dewatering area and sediment storage mounds/ piles must be covered and using either a geotextile or shade cloth material, to prevent wind mobilisation. Water trucks may be required to spray the roads during sediment transit/ may be required to retain a small amount of surface moisture within dewatered sediment, to prevent wind mobilisation. 								

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
<ul style="list-style-type: none"> Under conditions where the above methodologies are inappropriate—such as if dewatering occurs in a highly utilised public spaces—the use of geotextile tubes should be considered. 								
With mitigation	Local 1	Medium 2	Medium term 2	Low 5	Possible	VERY LOW	-ve	High

6.2.7 IMPACT 7: NOISE IMPACTS DUE TO MAINTENANCE ACTIVITIES

Dredging operations and dewatering activities in the Onrus Estuary are anticipated to lead to the generation of near-continuous machinery noise. Such noise will be produced by the grabbing action of excavators, through excavator/ dredger movement, through the operation of the dredger’s generator, through the use of the trucks/ lorries required to transport sediment, etc.

Noise pollution has the potential to affect estuarine fauna in several ways. Birds, in particular, can experience direct physical impacts (damage to hearing), stress, fright-flight and avoidance responses. There are also potential behavioural impacts, including changes in foraging, reproductive success, communication and potential decreased response to audible alerts (from, for example, predators) (Ortega 2012). Cutts *et al.* (2013) suggests that noise below 55 dB reduces potential for a response (and therefore, potentially negative impacts) on birds in the immediate vicinity.

Since the estuary is fringed by residential properties, and a popular tourist town, there is also anticipated to be some level of noise disturbance to these groups over the course of the proposed maintenance activities.

However, despite being a near-continuous noise source, the actual sound intensity associated with the dredging activities is anticipated to be relatively low and is not expected to cause physical harm to surrounding bird species. Additionally, the highly impacted current state of the estuary (and the loss of their food sources) has led to the departure of most waterbirds—as confirmed by the November 2024 Estuarine Ecological Health Assessment—which further limits impact significance. Birds are also likely to habituate to ongoing noise and are likely to return to the area once the perceived threat from the equipment is reduced through exposure. As such, managing nuisance noise impacts on local residents is likely to be the most pressing concern—particularly since the initial bulk dredging operation could take approximately a year to reach completion.

Noise impacts on both residents/ tourists, and waterbirds can be effectively mitigated by restricting dredging operations to the period from one hour following dawn, to one hour before dusk. Since dawn and dusk are the peak feeding times for waterbirds, they will benefit from the relative silence during these periods. Additionally, by restricting maintenance activities to the daylight hours, this will minimise the disturbance to the sleep and rest of local residents and retain some of the “peaceful” character of the Onrus Area. should also be prohibited from occurring on Sundays and public holidays, as well as between 13:00 and 14:00 on Fridays—the time in which people of Muslim Faith typically take their Friday Prayers. Furthermore, additional strict restrictions should be enforced over the Christmas period. Finally, since the estuary borders upon the Habonim Conference Centre/ Campsite, loud maintenance activities must also not be allowed to occur on important Jewish holidays. Additionally, dredging activities are expected to move around the estuarine area depending on the dredging programme, with the net result being that dredging will not occur within a

specific area for a long period of time, hence distributing the nuisance impacts between the affected individuals.

SPECIFIC CONSIDERATION PERTAINING TO LONG-TERM MAINTENANCE ACTIVITIES

While the ecological impacts of noise during the 2025 bulk dredging and dewatering activities are greatly minimised due to the current absence of sensitive receptors—particularly birds—it is anticipated that there will be greater potential noise impacts should ecological recovery occur in the years following the bulk dredging operation. As such, maintenance dredging should ideally not occur during peak nesting season for waterbird species—i.e. between September and December. This is principally based off the concern that sudden noise may cause a fright-flight response, and cause nesting bird to abandon their clutches. Additionally, high levels of disturbance in the estuary may dissuade birds from nesting in the estuary and surrounding area.

IMPACT ASSESSMENT

Without mitigation, the extent is assessed as “Local”, and the intensity is assessed as “Medium”. Likewise, the duration is also assessed to be “Medium”, despite each dredging operation being anticipated to be completed within two years. This is to account for the time taken for the bird population to recover from a lost clutch due to flight/ fright, or the avoidance of the estuary as a nesting habitat due to ongoing noise and disturbance. When combined with the assessed impact probability of “Definite”, the pre-mitigation impact of noise is assessed to be of “Low” significance. However, with the implementation of suitable mitigation measures, such as reducing unnecessary noise, prohibiting dredging in the early morning, at dusk, and night, as well as implementing “soft starts”, the intensity of this impact is reduced to “Medium”, and therefore the significance rating is reduced to “Very Low” (Table 6.7).

Table 6.7. Impact 7: Noise impacts during dredging activities.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Medium 2	Medium term 2	Low 5	Definite	LOW	-ve	High
Essential mitigation measures: general								
<ul style="list-style-type: none"> • Efforts must be taken to reduce unnecessary noise or vibrations where possible. • Implementation of “soft starts” to ensure fauna leave the immediate area prior to the commencement of very loud activities. • Machinery should be subjected to noise testing throughout the project. • Inform all staff about sensitive estuarine habitats and species. • Restrict dredging activities to between the period from hour after dawn to one hour before dusk. • No dredging or can occur on public holidays, Sundays and between the hours of 13:00 and 14:00 on Fridays (during Muslim Prayers). • No dredging can occur during important holidays for the Jewish Faith, due to the proximity of the Habonim Jewish Campsite and Conference Centre. 								
Essential mitigation measures specific to follow-up maintenance dredging activities								
<ul style="list-style-type: none"> • Dredging activities should not occur during peak nesting season for waterbird species—between September and December. 								
With mitigation	Local 1	Medium 2	Short term 1	Very Low 4	Definite	VERY LOW	-ve	High

6.3 EXPECTED BENEFITS FROM THE PROPOSED MAINTENANCE ACTIVITIES IN THE ONRUS ESTUARY

In total, the maintenance dredging activities are anticipated to have five primary positive impacts (benefits) on the Onrus Estuary, as follows:

- Water quality improvements;
- Improved flood mitigation;
- Ecological health improvements due to dredging maintenance dredging;
- Flood mitigation benefits; and
- Creation of recreational opportunities.

6.3.1 BENEFIT 1: IMPROVEMENTS TO WATER QUALITY ASSOCIATED WITH INCREASED ESTUARINE CIRCULATION AND HYDRODYNAMIC FUNCTIONING

The water quality in the Onrus Estuary stands to benefit greatly from the increased circulation and hydrodynamic functioning relating to the proposed maintenance dredging. The estuary has been frequently affected by sewage spills and associated bacterial pollution, which directly places recreational users of the estuary and downstream Onrus Beach at risk of exposure to gastrointestinal illness. By dredging the estuary and allowing for the intrusion of a sizeable tidal prism of seawater, the tidal flushing of the estuary will improve, and the salinity will increase in turn. Increased tidal circulation will act to dilute bacterial concentrations, and facilitate the flushing of bacteria out to sea. Saline conditions are also hostile for the survival of human intestinal bacteria, which should further reduce the risk of illness. This improvement in water quality, and the transition to more saline conditions will have further benefits to organisms, such as fish, birds, and invertebrates, yet these are assessed separately in 6.3.3.

Furthermore, under current conditions, it is functionally impossible for the estuary to achieve its RQO guideline salinity concentration of 10–40 PPT. However, provided that maintenance dredging activities according as per this MMP, the significance of this impact rated as “High” (Table 6.8).

Table 6.8. Benefit 1: Improvements to water quality associated with increased estuarine circulation and hydrodynamic functioning.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
With enhancements	Local 1	High 3	Long term 3	High 7	Probable	HIGH	+ve	High
Essential enhancement measures								
<ul style="list-style-type: none"> • Ensure that a deep estuarine channel and basin are retained, particularly during periods of peak sewage inflows (summer). 								

6.3.2 BENEFIT 2: IMPROVEMENTS TO FLOOD MITIGATION ASSOCIATED WITH MAINTENANCE DREDGING OF THE ONRUS ESTUARY

Likely the most substantial benefit to be gained by dredging the Onrus Estuary in its current condition, is the reduction in flood risk to the surrounding town of Onrus and residential properties. At present, the absence of any flood attenuation provided by the estuary is placing the surrounding area at high risk of flooding during larger rainfall events.

By dredging the estuary to the depths prescribed within this plan, this flood risk will be substantially reduced, and the estuary will be able to capture a much greater volume of floodwater. Furthermore, this dredging will also greatly increase the capacity of the estuary to receive sediment during future flooding events, which is crucial as—under current conditions—floodwaters are likely to penetrate into the town and “drop” their sediment loads in the town itself.

The combined impact of the proposed bulk dredging operation and the subsequent maintenance dredging on reducing flood risk in the Onrus Estuary, is assessed to be of “High” positive significance. This is due to the high intensity, long-term duration (since maintenance dredging is expected to be required ad infinitum and will therefore continue this flood attenuation benefit going forwards) and its definite probability.

Table 6.9. Benefit 2: Improvements to flood mitigation associated with maintenance dredging of the Onrus Estuary.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
With enhancements	Local 1	High 3	Long term 3	High 7	Definite	HIGH	+ve	High
<ul style="list-style-type: none"> Bulk dredging activities to remove sediment from the estuary must occur, and ongoing maintenance dredging must continue, when required, 								

6.3.3 BENEFIT 3: ECOLOGICAL HEALTH IMPROVEMENTS ASSOCIATED WITH INCREASED OPEN WATER HABITAT, IMPROVED HYDRODYNAMIC FUNCTIONING, AND MORE SALINE CONDITIONS

Besides the anticipated flood attenuation benefits, the ecological benefits associated with the maintenance dredging—and the associated creation of a deepwater estuarine channel and basin and increase in estuarine salinity—are expected to be the most important. Since minimal estuarine function remains under current conditions, the reinstatement of an estuarine basin and tidal seawater exchange, will allow for the return of estuarine species of all trophic levels. Under historical conditions, the estuary supported population of the sandprawn *Kraussillichirus kraussi* in the lower estuarine reaches, which acted as a food source for wading bird species. However, the absence of saline intrusion has resulted in the complete collapse of the sandprawn population. Maintenance dredging therefore has the potential to facilitate the return of sandprawns and other estuarine invertebrates.

Substantial improvements are also anticipated for the fish community. Under current conditions, there is minimal available habitat for estuarine fish, owing both to the very low salinities, and lack of water depth. This is reflected in the near complete absence of any fish seen in the estuary in the October 2024 survey, besides a very small population observed directly upstream of the mouth channel. By dredging a deep outflow channel and central estuarine basin, the total habitat for estuarine fish will increase by many orders of magnitude. This is due to both the anticipated increase in the size of the tidal prism able to penetrate the estuary (increasing salinities), and the available deepwater habitat for fish—which has the additional benefit of providing protection from piscivorous waterbirds. This will allow for much greater utilisation of the estuary by estuarine and marine fish. Furthermore, it should facilitate the estuaries’ function as a nursery habitat for marine fish species. Such nursery habits are extremely limited along coastline in the Western Cape Province and support major

commercial and recreational fisheries species such as Southern mullet *Chelon Richardsonii*, elf Pomatomus saltatrix, leervis *Lichia amia*, White stumpnose *Rhabdosargus globiceps*, White steenbras *Lithognathus lithognathus*, etc.

The current absence of a stable fish community in the estuary is also having a direct impact on the observed waterbird community. The largest absence has been seen in the piscivorous (fish eating) bird species, with no herons, egrets, or cormorants sighted during the October 2024 survey. These birds tend to migrate regionally and will move between estuaries depending on the availability of food sources. The proposed dredging activities, and the associated recover of the estuarine fish community therefore has the potential to restore the food sources for these waterbirds and reestablish the estuary as a suitable habitat. Beyond restoration of the piscivorous species, the restoration of the estuarine invertebrate population is likely to provide an additional food source for wading bird species. This is of particularly high value as wader populations have been declining both locally and globally owing largely to human encroachment into estuarine and wetland areas, coupled with rising sea levels.

The impact of maintenance dredging is assessed to be of “Very High” positive ecological significance, due to its regional extent (owing to the potential nursery function provided to regionally significant marine fish species) as well as the value that the restoration of habitat for piscivorous and wading bird species will have on their regional population stability. Intensity is rated as high due to both the current state of ecological collapse, as well as the potential for the dredging to create suitable habitat for a wide variety of species.

Table 6.10 Benefit 3: Ecological Health Improvements associated with increased open water habitat, improved hydrodynamic functioning, and more saline conditions.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional 2	High 3	Long term 3	Very High 8	Probable	VERY HIGH	+ve	High
Essential mitigation/ enhancement measures:								
<ul style="list-style-type: none"> All essential mitigation measures listed with respect to noise impacts, dust pollution, and direct destruction of benthic and riparian habitat must be implemented during both the initial bulk dredging operation, as well as follow-up maintenance dredging and dewatering activities. 								

6.3.4 BENEFIT 4: RECREATIONAL OPPORTUNITIES EMANATING FROM THE CREATION OF AN OPEN ESTUARINE CHANNEL AND BASIN.

Due to unprecedented sedimentation associated with the 2023 Heritage Day Floods, as well as sediment resettling during the 2024 winter rainfall season, the potential for recreational activities in the Onrus Estuary is now very low. This is principally due to the lack of a deep-water body, either in the form of an estuarine channel or basin—with the deepest areas in the estuary now being 20 cm in depth at the mouth. In fact, most of the estuary is now characterised by perched mudflats which have no surface water coverage, with the remaining area consisting of deltaic channels of 5 cm in depth or less. Besides the above-mentioned impacts this has had on the resident estuarine ecology, this has essentially halted recreational activities. The estuary has, historically, been utilised extensively by canoeists and swimmers, with both activities now being functionally impossible due to the extremely shallow conditions.

The proposed dredging activities, and the creation (and maintenance) of a deepwater channel and basin therefore has the potential to restore the Onrus Estuary to its prior condition as a

waterbody suitable for swimming, canoeing, and other recreational activities. Whilst this is predominantly due to the proposed creation of suitable water depths, this will also be aided by the anticipated improvements in estuarine functioning, flushing, and increased salinities, and the associated improvements in estuarine water quality (as assessed in 6.3.1). Improved water quality, and reduced counts of harmful bacteria, will likely facilitate both full contact and partial contact recreational activities, and aid in reducing the frequency of closure due to high bacterial counts.

Furthermore, the maintenance activities may facilitate several additional forms of non-contact recreation, including birding—should bird species abundance and diversity due to an increase in available food sources and suitable nesting habitat.

The impact of the proposed maintenance activities on recreation within the Onrus Estuary is assessed to of “High” positive significance should bulk dredging operations and subsequent maintenance dredging occur.

Table 6.11. Benefit 5: Recreational opportunities emanating from the creation of an open estuarine channel and basin.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	High 3	Long term 3	High 7	Probable	HIGH	+ve	High
Essential mitigation/ enhancement measures:								
<ul style="list-style-type: none"> Ensure that a deep estuarine channel and basin are retained, particularly during periods of peak sewage inflows (summer). 								

6.4 CUMULATIVE IMPACTS

Anthropogenic activities can result in numerous and complex effects on the natural environment. While many of these are direct and immediate, the environmental effects of individual activities or projects can interact with each other in time and space to cause incremental or aggregate effects. Impacts from unrelated activities may accumulate or interact to cause additional effects that may not be apparent when assessing the activities individually. Cumulative effects are defined as the total impact that a series of developments, either present, past or future, will have on the environment within a specific region over a particular period of time (DEAT IEM Guideline 7, Cumulative effects assessment 2004).

Cumulative estuarine impacts emanating from the proposed project are overwhelmingly positive. The proposed maintenance dredging, dewatering, and the proposed use of this material for upstream wetland rehabilitation, is anticipated to have substantial ecological and social benefits. Furthermore, the placement of this MMP within the broader Onrus Catchment-to-Coast (C2C) Project—which aims to restore and protect the Onrus System at a catchment scale—will ideally to an improvement in the efficacy and ease of maintaining the Onrus Estuary, due to reductions in sediment inflow volumes and ideally increased inflowing water volumes. Additionally, given that it is proposed to utilise much of the dredged material from the Estuary for upstream wetland rehabilitation, the proposed estuarine maintenance activities have the potential to directly facilitate upstream ecological restoration. Furthermore, the peatlands within the Onrus Main Wetland are considered to be the most ecologically

important peatlands in South Africa, which indicates both the importance of their rapid stabilisation and restoration from their current devastating state of “run-away” soil erosion, as well as the critical role that utilising peat and sediment from the Onrus Estuary can have on this restoration.

The Onrus Catchment-to-Coast Project is not limited to the Estuary and upstream wetland, but is envisaged to include large scale stabilisation and restoration activities throughout the Onrus Catchment. An integrated project of this scale is both highly ambitious and, should it be implemented successfully, will act as an important case study in integrated catchment management and restoration. However, given the highly ambitious nature of a project at this scale and the considerable number of stakeholders, government entities, and legislative requirements necessary to get reach its full potential, the assessed Cumulative Impact probability has been rated as possible. Conversely, the anticipated consequence rating has been assessed as “Very High”. The anticipated duration of these Cumulative Impacts are considered to be “Long Term”, and should persist well beyond 15 years, assuming a satisfactory degree of implementation.

All told, the Cumulative Impacts emanating from projects like this, and other similar projects, within in the Onrus Catchment, are assessed to be of “High” positive significance.

Table 6.12. Cumulative impacts (benefits) resulting from similar restorative and management projects in the Onrus Catchment and surrounding areas.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
With appropriate mitigation and implementation	Regional 2	High 3	Long term 3	Very High 8	Possible	HIGH	+ve	Medium

6.5 ASSESSMENT OF THE NO-GO ALTERNATIVE

The implications of not going ahead with the maintenance dredging and dewatering operations are as follows:

Lost benefits

- The intense flood risk in Onrus will persist, and may worsen with time due to continued sedimentation. If high intensity flooding occur under such conditions, there is a high likelihood of both property damage and threat to human health and lives.
- Hydrodynamic functioning will remain compromised and will likely worsen with time, and no water quality improvements will occur as a result of improved tidal flushing, saltwater penetration, and their influence in reducing bacterial counts.
- The ecological health of the estuary will remain compromised, with the estuary remaining of minimal value for estuarine invertebrates, fish, waterbirds, etc. This is also likely to worsen with time and will be exacerbated by the anticipated rapid encroachment of *Phragmites australis* onto the exposed mudflat areas.
- The estuary will remain largely unusable for recreational activities, with swimming and canoeing being impossible due to lack of water depth. Additionally, the compromised

nature of the estuary will remain unsuitable for lower-contact activities such as fishing and bird watching. Furthermore, the absence of water quality improvements linked to improved hydrodynamic functioning and saline penetration will result in no reductions in bacterial counts being observed. Subsequently, no reduction in the frequency of beach/ estuary closure due to poor water quality will be observed.

- No peat or sediment will be available for stabilisation and rehabilitation of the upstream Onrus Main Wetlands, which is already under serious threat of desiccation and disastrous levels of ecological degradation.
- The proposed maintenance activities will not result in any beneficial Cumulative Impacts related to the broader C2C project, and the opportunity to create a case study for integrated catchment management will be lost.

Avoided Impacts

Seven potential negative estuarine impacts will be avoided by not commencing with the proposed maintenance activities, most of which pertain to impacts occurring during the maintenance activities themselves (dredging and dewatering). However, the significance of all these impacts is considered minor should they be appropriately mitigated, with six of the seven being rates to be of “Very Low” negative significance, and one impact rated as “Insignificant”

Summary Impacts

The situation in the estuary is considered critical, with little long-term stability in its current state. It is therefore anticipated that conditions will worsen with time, with sedimentation likely persisting, and potentially increasing in rate as reedbed encroachment accelerates upon the exposed mudflat areas. The resultant effect will likely be further deterioration in ecological health and a continued—and potential intensification—of threats relating to flooding and water quality.

Therefore, the No-Go Alternative is assessed to be of “Medium” negative significance relative to the current—already heavily compromised—state of the estuary

Table 6.13. Assessment of the No-Go Alternative

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without maintenance activities	Local 1	Medium 2	Long term 3	Medium 6	Probable	MEDIUM	-ve	Medium

6.6 SUMMARY OF POTENTIAL IMPACTS AND BENEFITS

Potential impacts or benefits that may be experienced due to the proposed maintenance activities in Onrus Estuary, both before and after mitigation, are summarised in (Table 6.14).

Table 6.14. Summary of potential impacts associated with maintenance activities included within this MMP. Impacts were rated in terms of their consequences (Very high/High/Med/Low/Very low/Insignificant), probability of occurrence (Very low/Low/Medium/Nigh/Very high), status (+ve or -ve) and the level of confidence we had in the assessment (Very low/Low/Med/High/Very high).

	Impact Identified	Consequence	Probability	Significance	Status	Confidence
Negative Impacts	Impact 1: Waste generation and disposal from maintenance operations.	Medium	Probable	MEDIUM	-ve	High
	With mitigation	Low	Possible	VERY LOW	-ve	High
	Impact 2: Hazardous substance spills during maintenance operations.	Low	Probable	LOW	-ve	High
	With mitigation	Very Low	Possible	INSIGNIFICANT	-ve	High
	Impact 3: Generation of turbidity plumes.	Low	Definite	LOW	-ve	High
	With mitigation	Ver Low	Probable	VERY LOW	-ve	High
	Impact 4: Direct destruction of benthic and riparian habitat.	Low	Definite	LOW	-ve	High
	With mitigation	Very Low	Definite	VERY LOW	-ve	High
	Impact 5: Potential terrestrial impacts due to the dewatering of sediment.	Medium	Probable	MEDIUM	-ve	High
	With mitigation	Low	Possible	VERY LOW	-ve	High
	Impact 6: Potential dust pollution impacts emanating from dredging and dewatering activities.	Medium	Probable	MEDIUM	-ve	High
	With mitigation	Low	Possible	VERY LOW	-ve	High
	Impact 7: Noise impacts during dredging activities.	Low	Definite	LOW	-ve	High
	With mitigation	Very Low	Definite	VERY LOW	-ve	High
Potential Benefits	Benefit 1: Improvements to water quality associated with increased estuarine circulation and hydrodynamic functioning.	High	Probable	HIGH	+ve	High
	With mitigation					
	Benefit 2: Improvements to flood mitigation associated with maintenance dredging of the Onrus Estuary	High	Definite	HIGH	+ve	High
	With mitigation					
Benefit 3: Ecological Health Improvements associated with increased open water habitat, improved hydrodynamic functioning, and more saline conditions	Very High	Probable	VERY HIGH	+ve	High	
With mitigation						
Benefit 4: Recreational opportunities emanating from the creation of an open estuarine channel and basin.	High	Probable	HIGH	+ve	High	
With mitigation						
Cumulative Impacts (Benefits)	Cumulative Impacts (benefits) resulting from similar restorative and management projects in the Onrus Catchment and surrounding areas With appropriate mitigation and implementation	Very High	Possible	HIGH	+ve	Medium

No-Go Alternative	Assessment of the No-Go Alternative	Medium	Probable	MEDIUM	-ve	Medium
	Without maintenance activities					

6.7 SUMMARY OF PROPOSED MITIGATION MEASURES

This section contains all proposed essential mitigation measures included in the impact assessment section. **Note:** this list does not include the full list of protocols, monitoring requirements or necessary scientific reporting contained within Section 7 below, yet does contain the general mitigation measures which inform the specifications within Section 7.

6.7.1 ESSENTIAL MITIGATION MEASURES FOR ANTICIPATED NEGATIVE IMPACTS

IMPACT 1: WASTE GENERATION AND DISPOSAL AND HAZARDOUS SUBSTANCE SPILLS DURING MAINTENANCE OPERATIONS

- Inform all staff about sensitive estuarine species and the responsible disposal of waste.
- Suitable handling and disposal protocols must be clearly explained, and sign boarded.
- Reduce, reuse, recycle.

IMPACT 2: HAZARDOUS SUBSTANCE SPILLS DURING MAINTENANCE OPERATIONS

- Intentional disposal of any substance into the environment is strictly prohibited, while accidental spillage must be prevented, contained and reported immediately.
- A rigorous environmental management and control plan (including procedures for remediation) must be developed and implemented.
- All fuel and oil must be stored with adequate spill protection.
- No leaking equipment or vehicles are permitted on site.
- All hazardous substances must be accompanied by a permit, a hazard report sheet, and a first aid treatment protocol and may only be handled by suitably trained operators.
- Spill kits must be available on site at all times, and staff must be trained in their proposed use.

IMPACT 3: GENERATION OF TURBIDITY PLUMES.

- Dewatered soil piles must be either be secured with geotextile or shade cloth material to prevent wind mobilisation into the estuary.
- Silt curtains should be utilised once a large open water body is established to restrict the extent of turbidity plumes. Furthermore, silt curtains must be used to protect areas planned for exclusion from future maintenance dredging activities, to protect benthic habitat.
- A filtration mechanism must be utilised on the downslope end of the dewatering site to prevent suspended fine (silty) sediments from flowing back into the estuary and causing localised turbidity plumes.

IMPACT 4: DIRECT DESTRUCTION OF BENTHIC AND RIPARIAN HABITAT.

- Dredging should only be conducted when necessary, and according to prescribed triggers

- Vehicle movement should be constrained to dredge areas, and areas proposed for dredging, wherever practically possible.
- Estuarine and riverine banks should be left intact if not included in a dredging operation and should be suitably rehabilitated if avoiding disturbance is not possible.
- Repeat maintenance dredging activities must only occur if deemed necessary through detailed bathymetric and ecological surveys, and with agreement from relevant authorities, with areas where minimal sediment deposition has occurred being left intact from dredging and other related disturbances.
- Areas selected to be left intact during maintenance dredging activities must be left undisturbed by dredging equipment and machinery and must be protected from smothering by silt curtains.

IMPACT 5: POTENTIAL TERRESTRIAL IMPACTS DUE TO THE DEWATERING OF SEDIMENT.

Essential mitigation measures applicable to the De Zandt dewatering site

- There is sufficient space available for all dewatering activities to occur at a single site.
- The site is not located on the estuarine bank/ immediate riparian areas, hence maintaining the integrity of any indigenous fringing vegetation, and reducing the likelihood of bank destabilisation
- The site is located close enough to the estuarine channel, which reduces complexity associated with sediment transport and minimises impacts associated with depositing sediment and water into the terrestrial environment.
- The selected site, and surrounding area, are heavily disturbed by alien species infestation and illegal dumping—as confirmed by a specialist site visit by Anchor in November 2024—and are therefore of little ecological value.
- The site falls within an area slated for a large mixed-use development for which EA has been granted.
- The entirely freshwater nature of the estuary under current conditions, means that there is negligible risk of any saltwater introduction into the terrestrial environment by dewatering at this site.
- Sediment mounds must be secured with geotextile or shade cloth to prevent wind mobilisation and smothering of surrounding soils and vegetation.

Essential mitigation applicable to future dewatering activities

- If possible, future dewatering activities should occur on a portion of the De Zandt Property.
- Dewatering should only occur in areas determined to be alien infested through satellite imagery analysis and ground truthing—intact stands of indigenous vegetation must be declared no-go zones.
- The site should ideally have sufficient space to contain all dewatering activities.
- If possible, the site should not be located on the estuarine bank/ immediate riparian areas, to maintain the integrity of any indigenous fringing vegetation, and reduce the likelihood of bank destabilisation.
- The site should be located sufficiently close to the estuary to minimise the complexity associated with transporting sediment over long distances to the dewatering site and minimise associated impacts on the terrestrial environment.
- Sediment mounds must be secured with geotextile or shade cloth to prevent wind mobilisation and smothering of surrounding soils and vegetation.

- Supernatant water (water leached from the dewatering sediment) must be allowed to return to the estuary (the water resource) as rapidly as possible. This will assist in retaining sufficient water for estuarine function and for use in producing new dredge sediment slurry.
- Supernatant water drainage channels into the estuary must be lined with plastic to prevent the formation of erosion channels and introduction of sediment into the estuary.
- Should the dewatering site be located far enough from the estuary that a surface outflow channel is not viable, then the supernatant water must be channelled into a pipeline and returned to the estuary.
- Salinity testing must occur in the estuary prior to the commencement of dredging. Should the estuary have
 - a) Very low salinity, then the impact of salt water on the dewatering site will be negligible and the site can have a permeable base.
 - b) A salinity exceeding 10 PPT, then dewatering must either occur in the open areas immediately surrounding the estuarine channel or, should a terrestrial site be selected, then the dewatering area must be lined with plastic sheeting or another impermeable layer, to prevent saline intrusion into the sediment.

IMPACT 6: POTENTIAL DUST POLLUTION IMPACTS EMANATING FROM DREDGING AND DEWATERING ACTIVITIES.

- The dewatering area and sediment storage mounds/ piles must be covered and using either a geotextile or shade cloth material, to prevent wind mobilisation.
- Water trucks may be required to spray the roads during sediment transit or it may be required to retain a small amount of surface moisture within dewatered sediment, to prevent wind mobilisation.
- Under conditions where the above methodologies are inappropriate—such as if dewatering occurs in a highly utilised public spaces—the use of geotextile tubes should be considered.

IMPACT 7: NOISE IMPACTS DURING MAINTENANCE ACTIVITIES.

Essential mitigation measures: general

- Efforts must be taken to reduce unnecessary noise or vibrations where possible.
- Implementation of “soft starts” to ensure fauna leave the immediate area prior to the commencement of very loud activities
- Machinery should be subjected to noise testing throughout the project.
- Inform all staff about sensitive estuarine habitats and species.
- Restrict dredging activities to between the period from hour after dawn to one hour before dusk
- No dredging activities can occur on public holidays, Sundays and between the hours of 13:00 and 14:00 on Fridays (during Muslim Prayers).
- No dredging can occur during important holidays for the Jewish Faith, due to the proximity of the Habonim Jewish Campsite and Conference Centre.

Essential mitigation measures specific to follow-up maintenance dredging

- Dredging and activities should not occur during peak nesting season for waterbird species—between September and December.

7 IMPLEMENTATION, MONITORING, AND AUDITING RESPONSIBILITIES

7.1 PREAMBLE

As discussed throughout this document, implementation of the proposed maintenance activities will need to occur in several phases over varying time periods, with responsibility for the implementation of these activities varying likewise. To aid with the smooth adoption of this plan, an intensive environmental monitoring and auditing programme has been drafted to ensure that implementation of the MMP occurs to a sufficient standard, and complies with all stipulated environmental requirements.

At a high level, responsibility for implementing the proposed maintenance activities falls to the applicant, the Overstrand Local Municipality (OLM). OLM is therefore responsible for the delegation of responsibilities to other entities and contractors who will, in turn, be responsible for their respective components and/ or subcomponents. **Note:** a high level of detail has been provided in the following sections with respect to the responsibilities regarding implementation, monitoring, funding, etc. for the initial three-year period following adoption of this MMP. However, it is not possible to assign a similar level of detail for subsequent years, as these have yet to be confirmed. This does not represent a responsibility void, as the ultimate responsibility for complying with the MMP will fall to the OLM as the applicant and prospective right holder.

The following section therefore tabulates all currently acceptable information regarding responsibility, monitoring requirements, and triggers/ thresholds for future maintenance activities. Whilst it being critical that the core principles of this MMP are upheld during the years of its operation, it is expected that changes to methodologies and monitoring refinements will occur over its lifetime.

7.2 RESPONSIBILITY ASSIGNED TO VARIOUS PROJECT ASPECTS

Table 7.1. Responsibilities associated with the proposed maintenance activities

<p>Authorities</p>	<p>Principal decision-making Competent Authority (CA):</p> <ul style="list-style-type: none"> • Western Cape Department of Environmental Affairs and Development Planning (DEA&DP), Directorate: Development Management (Region 2). <p>Supplemental decision-making authorities</p> <ul style="list-style-type: none"> • Breede-Olifants Catchment Management Agency (BOCMA)—the responsible Authority (RA) under the National Water Act. • Department of Water Affairs and Sanitation (DWS). • CapeNature: Marine and Coasts Department.
<p>Overall Project Responsibility</p>	<ul style="list-style-type: none"> • Overstrand Local Municipality (OLM): • Holder of the MMP. • Responsible for implementation of the MMP, and answerable to the Competent Authority and Responsible Authority.
<p>Initial bulk dredging operation (years 0–1)</p>	<p>Overall responsibility</p> <ul style="list-style-type: none"> • Overstrand Local Municipality.

	<p>Dredging and dewatering activities (including equipment procurement and sediment/ peat transportation)</p> <ul style="list-style-type: none"> • Overstrand Local Municipality. <p>Environmental monitoring, Environmental Control Officer (ECO) auditing, and reporting</p> <ul style="list-style-type: none"> • OLM. • Anchor Environmental Consultants (Pty) Ltd.
Maintenance Dredging Operations, Years 1-3	<p>Overall responsibility</p> <ul style="list-style-type: none"> • OLM. <p>Dredging and dewatering activities (including equipment procurement and sediment/ peat transportation)</p> <ul style="list-style-type: none"> • OLM. <p>Environmental monitoring, Environmental Control Officer (ECO) auditing, and reporting</p> <ul style="list-style-type: none"> • Anchor Environmental Consultants (Pty) Ltd
Maintenance Dredging Operations, Years 4-onwards	<p>Overall responsibility</p> <ul style="list-style-type: none"> • OLM <p>Dredging and dewatering activities (including equipment procurement and sediment/ peat transportation)</p> <ul style="list-style-type: none"> • OLM to procure service provider. <p>Funding</p> <ul style="list-style-type: none"> • OLM to procure funding from relevant sources. <p>Environmental monitoring, Environmental Control Officer (ECO) auditing, and reporting</p> <ul style="list-style-type: none"> • OLM to procure ECO/ auditing/ monitoring services for future work.

7.3 ENVIRONMENTAL AUDITING AND MONITORING REQUIREMENTS

Environmental auditing and monitoring will be required throughout the course of any maintenance activities to ensure that activities are conducted in a manner which comply with the methodologies prescribed within this MMP, and avoid unnecessary harm to the environment. The frequency and requirements of said activities will vary based on the maintenance activity being conducted, its locality, duration, etc. The monitoring requirements prescribed below may need to be amended over the MMPs lifespan, to refine and optimise the process through experience/ trial-and-error.

Furthermore, the following auditing and monitoring requirements are predominantly required from the period prior to a proposed maintenance activity to the period following the activity (i.e. close-out). For the sake of practicality and minimising undue costs, the intensity of these requirements are much reduced when maintenance activities are not required.

7.3.1 ECO SITE VISITS, REPORTING, AND AUDITING REQUIREMENTS

As indicated in Table 7.1 above, an Environmental Control Officer (ECO) will be required for components of all maintenance activities. The responsibilities of the ECO will vary based on the maintenance activities being undertaken. Responsibilities for the ECO and auditing work for the initial three-year period will fall jointly to Anchor and the Overstrand Local Municipality (OLM). However, the drafting of ECO reports and audit reports for submission to the CA (DEA&DP) and RA (BOCMA) will be completed by Anchor. ECO site visits can be conducted either by the environmental consultant team—which is proposed to be Anchor for the initial

three-year period—or by an official from OLM, acting under the banner of the C2C project. The ECO will have five principal responsibilities, including conducting site visits, obtaining photographic evidence and documentation of the maintenance activities, preparing ECO reports for submission to the Competent Authority (CA, DEA&DP) and Responsible Authority (RA, BOCMA), and conducting internal audits at set intervals (Table 7.2 and Table 7.3). The final responsibility ECO—and one not given its own heading in the tables below as it is a necessary component of the other headings—will be that of assisting the Operators with remaining compliant with the MMP and the requirements of relevant legislation and identifying and halting maintenance activities should dangerous environmental pollution/ destruction/ non-compliance be identified.

ECO MONITORING, REPORTING, AND AUDITING REQUIREMENTS RELATED TO MAINTENANCE DREDGING AND DEWATERING ACTIVITIES.

Table 7.2. ECO monitoring, reporting, and auditing requirements related to the 2025 bulk dredging and dewatering operation (Years 0–1).

ECO requirements (Years 0–1)
<p>Site visits</p> <p>The first ECO site visit should be conducted in the week preceding the commencement of dredging activities, at which time the current state of the estuary must be photographed and documented, and the ECO must be shown all the proposed equipment and talked-through the plan by operators to ensure all is compliant with the MMP.</p> <p>Once dredging commences, site visits from the Anchor ECO and OLM Representative must occur once every two weeks, with the designated Anchor ECO alternating with the OLM representative, resulting in a total of two visits per month. Each site visit should include detailed photographing of the dredging operation and observations as to the compliance with the MMP. Should non-compliances be noted on site, these should be made aware of to the site operators, with guidance given as to how to make the work compliant. Should environmentally damaging activities be observed during these site visits—such as a continued oil leak—dredging operations should be halted until this is remedied. These site visits should occur, as indicated, for the entire duration of the maintenance activities, as well as the month (four weeks) following completion.</p>
<p>Site photographs</p> <p>Must be taken weekly, starting one week before dredging commences, weekly during dredging operations, and weekly for four weeks following conclusion of dredging operations.</p> <ul style="list-style-type: none"> • The Anchor ECO and OLM representative must keep a detailed photographic record during each fortnightly site visit. • The dredging operator must additionally take detailed photographs of both the dredging and dewatering on a weekly basis, with it being preferential for this to occur on the same day every week. These photographs must be sent to the Anchor ECO weekly, for inclusion in the ECO reports. • All site photographs (including those from the Anchor ECO, OLM Representative, and the dredging operator) must be dated and timestamped, and kept for use in ECO and auditing reports. The photographs must also be provided to the Competent Authority (CA) or Responsible Authority (RA) (DEA&DP/ BOCMA) on request.
<p>Water quality testing</p> <p>As per the requirements of GN4167 of the NWA, it is necessary for water quality (WQ) testing to be conducted weekly throughout the course of the maintenance activities. Under typical circumstances this would also warrant weekly testing for an entire month prior to the commencement of maintenance activities to establish the baseline water quality. However, given that the initial maintenance dredging/ dewatering is proposed to occur under the Emergency Protocol—in conjunction with the need for rapid commencement of dredging operations and the detailed baseline EHS study conducted to inform this MMP—it is considered appropriate that water quality testing only commence from one week prior to the commencement of dredging. This will then need to continue weekly for the entire dredging and dewatering operation, as well as for the entire month following conclusion of the dredging/ dewatering activities, in order to compare the water quality recovery with the baseline data. Specific requirements are as follows:</p> <ul style="list-style-type: none"> • Sampling must occur at a total of three sites, with sites located both a short distance upstream and downstream of the dewatering inlet channel, and the third site located in the lower estuary downstream of all maintenance dredging activities.

- Photographs must be taken of each during each sampling event, with images including the sampling point, the immediate environmental context, and the colouration of both the river water and water within the sampling bottles.
- Sampling can be conducted by either the ECO, OLM, or the contractor/ operator, yet should most-likely be conducted by the operator given their continued presence on site. However, ensuring that sampling and analysis occurs to the standard of the MMP will fall under the responsibility of the ECO.
- After collection/ in-field analysis, the samples should be delivered to a suitable laboratory for Total Suspended Solids (TSS) analysis.

Specific WQ parameters to be analysed are as follows:

- pH
- Electrical Conductivity (EC)/ Salinity
- Total Suspended Solids (TSS)
- Turbidity
- Temperature
- Dissolved Oxygen

Besides TSS, all of the above parameters can be analysed in-field using handheld instrumentation, such as a Hach HQ40d, hence the prescribed testing will be both quick, and relatively easy/ inexpensive to conduct. Furthermore, TSS can also be tested using an inexpensive and minimally time-intensive laboratory process.

ECO reports

ECO reports must be prepared monthly by the Anchor ECO, from the commencement of maintenance activities until completion of the activities, and must be submitted to DEA&DP/ BOCMA for comment. The ECO Reports must include:

- A description of the maintenance progress to-date, and how much progress was made during the month window.
- A detailed description of the activities undertaken, with photographic imagery to support the claims.

Should non-compliances be identified during the month, these should be described and documented, with photographic evidence provided to substantiate these claims. Additionally, a description of the process undertaken following the identification of the non-compliance must be provided. It is also necessary to include how this issue was resolved, how the responsible parties were informed of the issues, and what measures were taken to educate individuals. Measures taken to avoid similar issues from occurring in future must also be highlighted. Furthermore, it is considered critical that the process aids in assisting maintenance teams with being compliant with the MMP and protecting the environment, rather than the focus being to accuse/ incriminate.

The final ECO Report for the proposed dredging must be completed in the month following the completion of the activities and must take the form of a “Close-Out” report, in which a summary of the dredging and dewatering activities is provided. This report must include commentary on the efficacy of the maintenance activities and provide recommendations as to how the maintenance activities (and the associated) ECO/ monitoring/ reporting work can be refined for future maintenance activities.

Environmental auditing requirements

As per the requirements of GN 4167 of the NWA and environmental best practice, environmental auditing must be conducted in addition to the ECO site visits and reporting prescribed above. However, since the ECO reporting will largely fulfil the purpose of environmental auditing, it is only considered necessary to complete two audits pertaining to these activities, with each having discrete objectives. Furthermore, it is considered unnecessary for these audits to be conducted externally, with both audits being conducted internally by Anchor’s ECO and Specialist Team.

- **The first audit (Audit 1)** should be completed approximately halfway through the maintenance activities—approximately 6 months following commencement of the maintenance activities. This audit should integrate all available information from the activities to that date, and should consider the progress of the work, environmental concerns and issues identified during the ECO site visits and monthly reports. This audit should assess the efficacy of both the dredging methodology itself, the essential mitigation measures proposed within this MMP, as well as the environmental monitoring and ECO work. This analysis should consider both the retrospective efficacy of the above-mentioned criteria for mitigating against negative environmental impacts, and the effectiveness of the implementation of the plan and mitigation measures. By completing the audit at the midpoint of the maintenance operation, this may allow for refinement for both the second half of the maintenance operations, as well as feeding into future maintenance operations.
- **The second audit (Audit 2)** should be completed within 3–6 months following the completion of the maintenance dredging activities, as per the requirements of this GN4167 of the NWA. Similarly, this should contain a detailed analysis of the efficacy of the maintenance dredging and dewatering activities, and the efficacy of the employed environmental management protocols. This retrospective analysis should be used to better inform any future maintenance dredging processes. Furthermore, unlike Audit 1, a key component of Audit 2 will be an assessment of the stability of the estuary and river system following the completion of maintenance activities. To this end, a site visit should be conducted by the ECO and specialist team to document the systems

condition throughout the entire maintenance dredging area, dewatering site, etc. This should include detailed photographic documentation. This site visit/ audit will prove to be a valuable tool for assessing and optimising the efficacy of the maintenance activities going forwards.

Table 7.3. ECO monitoring, reporting, and auditing requirements related to future dredging and dewatering activities.

ECO requirements (Year onwards)
<p>Preface</p> <p>Should the need for repeat dredging and dewatering operation be established according to the stipulated requirements in Section 5.6, then the ECO requirements should proceed in alignment with those prescribed for the 2025 dredging operation. However, for proposed maintenance following the initial 3–year period, the main difference will be the potential replacement of an ECO from Anchor, with one from another consultancy.</p>
<p>Site visits</p> <ul style="list-style-type: none"> • The first ECO site visit should be conducted in the week preceding the commencement of dredging activities, at which time the current state of the estuary must be photographed and documented, and the ECO must be shown all the proposed equipment and talked-through the plan by operators to ensure all is compliant with the MMP. • Once dredging commences, site visits from the ECO and OLM Representative must occur once every two weeks, with the designated ECO alternating with the OLM representative, resulting in a total of two visits per month. Each site visit should include detailed photographing of the dredging operation and observations as to the compliance with the MMP. Should non-compliances be noted on site, these should be made aware of to the site operators, with guidance given as to how to make the work compliant. Should environmentally damaging activities be observed during these site visits—such as a continued oil leak—dredging operations should be halted until this is remedied. These site visits should occur, as indicated, for the entire duration of the maintenance activities, as well as the month (four weeks) following completion.
<p>Site photographs</p> <p>Must be taken weekly, beginning one week before dredging commences, weekly during dredging operations, and weekly for four weeks following conclusion of dredging operations.</p> <ul style="list-style-type: none"> • The ECO and OLM representative must keep a detailed photographic record during each fortnightly site visit. • The dredging operator must additionally take detailed photographs of both the dredging and dewatering on a weekly basis, with it being preferential for this to occur on the same day every week. These photographs must be sent to the ECO weekly, for inclusion in the ECO reports. • All site photographs (including those from the ECO, OLM Representative, and the dredging operator) must be dated and timestamped, and kept for use in ECO and auditing reports. These photographs must also be provided to the Competent Authority (CA) or Responsible Authority (RA) (DEA&DP/ BOCMA) on request.
<p>Water quality testing</p> <p>As with the initial bulk dredging/ dewatering operation, weekly water quality testing must occur as per GN4167 of the NWA. However, since future maintenance will likely occur at a time when conditions are no longer classified as an emergency, the initiation of WQ testing should occur one month (four weeks) prior to the commencement of dredging activities, as per GN4167. WQ testing will thereafter follow the methodology presented in Table 7.2, as follows:</p> <p>Once WQ testing commences, it will need to continue weekly for the entire dredging and dewatering operation, as well as for the entire month following conclusion of the dredging/ dewatering activities, to compare the water quality recovery with the baseline data. Specific requirements are as follows:</p> <ul style="list-style-type: none"> • Sampling must occur at a total of three sites, with sites located both a short distance upstream and downstream of the dewatering inlet channel, and the third site located in the lower estuary downstream of all maintenance dredging activities. • Photographs must be taken during each sampling event, with images including the sampling point, the immediate environmental context, and the colouration of both the river water and water within the sampling bottles. • Sampling can be conducted by either the ECO, OLM, or the contractor/ operator, yet should most-likely be conducted by the operator given their continued presence on site. However, ensuring that sampling and analysis occurs to the standard of the MMP will fall under the responsibility of the ECO. • After collection/ in-field analysis, the samples should be delivered to a suitable laboratory for TSS analysis. <p>Specific WQ Parameters to be analysed are as follows:</p> <ul style="list-style-type: none"> • pH

- Electrical Conductivity (EC)/ Salinity
- Total Suspended Solids (TSS)
- Turbidity
- Temperature
- Dissolve Oxygen

Besides TSS, all of the above parameters can be analysed in-field using handheld instrumentation, such as a Hach HQ40d, hence the prescribed testing will be both quick, and relatively easy/ inexpensive to conduct. Furthermore, TSS can also be tested using an inexpensive and minimally time-intensive laboratory process.

ECO reports

Must be prepared monthly by the ECO, from the commencement of maintenance activities till once month following the completion of the activities and must submitted to DEA&DP/ BOCMA for comment. The ECO Reports must include:

- A description of the maintenance progress to-date, and how much progress was made during the month window.
- A detailed description of the activities undertaken, with photographic imagery to support the claims.
- Should non-compliances be identified during the month, these should be described and documented, with photographic evidence provided to substantiate these claims. Additionally, a description of the process undertaken following the identification of the non-compliance must be provided. It is also necessary to include how this issue was resolved, how the responsible parties were informed of the issues, and what measures were taken to educate individuals. Measures taken to avoid similar issues from occurring in future must also be highlighted. Furthermore, it is considered critical that the process aids in assisting maintenance teams with being compliant with the MMP and protecting the environment, rather than the focus being to accuse/ incriminate.
- The final ECO Report for the proposed dredging must be completed in the month following the completion of the activities and must take the form of a “Close-Out” report, in which a summary of the dredging and dewatering activities is provided. This report must include commentary on the efficacy of the maintenance activities and provide recommendations as to how the maintenance activities (and the associated) ECO/ monitoring/ reporting work can be refined for future maintenance activities.

Environmental auditing requirements

Like the initial dredging and dewatering operation, it will be necessary to conduct environmental auditing in conjunction with the required ECO reporting activities. However, the exact auditing requirements will vary based on the extent of the required dredging operation., as follows:

- Should maintenance activities be completed within a six month period, then it will only be necessary to conduct a single retrospective audit of the maintenance activities in the 3–6 month period following the activities (in accordance with “Audit 2”) from Table 7.2.
- Should maintenance activities run over a period longer than six months, then two internal audits will be required, including a mid-operation audit (Audit 1), and a retrospective audit (Audit 2) both detailed in Table 7.2.

7.3.2 REQUIREMENTS FOR FUTURE DREDGE OPERATIONS

Below follows a list of thresholds and requirements associated with future dredging of the Onrus Estuary, which is designed to ensure that dredging is necessary and well informed and reduces unnecessary impacts on the estuarine system. **Note:** all the below criteria must be considered; all dredging thresholds exceeded; and all relevant studies completed/ reported on prior to future maintenance dredging to occur.

However, in the event of an emergency, there is potential for maintenance dredging to occur prior to the completion of all prerequisite studies, assuming that the current situation is posing imminent threat to human life and/ or estuarine functioning. In such circumstance, approval must be given by the relevant management authorities (DEA&DP) and reporting completed retrospectively. Under such circumstances—at minimum—site visits must still be conducted by relevant specialists, and baseline photographs taken to give an indication of estuarine condition.

Table 7.4. Thresholds and scientific requirements associated with repeat proposed future maintenance dredging of the Onrus Estuary.

Topographic/ bathymetry survey	
Basic threshold/ details	Specific thresholds/ details
<p>Topographical/ bathymetric survey Should maintenance dredging be proposed, a detailed topographical/ bathymetric survey must be conducted for the entire management area—from the mouth to the R43 Road Bridge.</p> <p>Basic dredging threshold Dredging is permissible if Average estuarine bed level >1 m above target depths.</p>	<p>Detailed dredging threshold</p> <ul style="list-style-type: none"> • Even if the basic threshold is met, and dredging in the estuary is considered permissible, a given area must have an average sediment accumulation of >0.5 m above target depths for dredging to be permissible within the area.
Baseline ecological field survey and report	
Basic threshold/ details	Specific thresholds/ details
<p>Basic overview Prior to approval of a maintenance dredging operation, a baseline ecological field survey must be conducted by a suitably qualified estuarine specialist team. This survey team must prepare a survey report and provide a recommendation as to whether maintenance dredging should occur.</p>	<p>The ecological field survey must be conducted for the entire maintenance area up till the R43 road bridge, and must include:</p> <ul style="list-style-type: none"> • A seine net fish survey at sites spaced throughout the estuary and channel. • Waterbird counts, with the area divided into segments • An aquatic and fringing vegetation survey • Sampling for benthic macrofauna (invertebrate) identification, quantification, and spatial distribution, at sites spaced throughout the maintenance area. • Sediment sampling for soil particle size, Total Organic Content (TOC), and trace metals, at site spaced throughout the maintenance area. • Water quality sampling and testing at sites spaced throughout the maintenance area, at a detection limit appropriate to the gazetted RQO values for the Onrus River and Estuary. Parameters include: <ul style="list-style-type: none"> ○ Total Suspended Solids (TSS), ○ Chlorophyll-a (Chl-a) ○ pH ○ Electrical Conductivity (EC)/ Salinity ○ Turbidity ○ Temperature ○ Dissolved Oxygen <p>and the following nutrient species:</p> <ul style="list-style-type: none"> ○ Total Ammonia Nitrogen (TAN) ○ Nitrate (NO3) ○ Nitrite (NO2) ○ Dissolved Inorganic Nitrogen ○ Orthophosphate (PO4) <ul style="list-style-type: none"> • Extensive photographic documentation of the current estuarine condition. • Visual survey of estuarine conditions and sediment deposits, to be used to discern between peat-containing areas and sand/ silt. <p>The ecological survey report must include:</p> <ul style="list-style-type: none"> • A current description of the species abundance, diversity, and spatial distributions of the fish, bird, vegetation and invertebrate populations recorded in the entire maintenance area. • Analysis and descriptions of sediment quality, composition, etc. • Detailed site photographs of the current estuarine condition.

- A comparison to a variety of historical reference conditions (both pre and post dredging events) to provide detail as to the health of the estuarine system. **Note:** a full, intensive, Ecological Health Assessment (EHS) for the estuary is **not** a requirement for such a report.
- Recommendations as to the ecological suitability of a maintenance dredging operation, including indications of suitable areas to be dredged, as well as identified “no-go”. No-go areas to be identified based on ecological sensitivities identified during the field survey and analysis.

Dredging method statement

Basic threshold/ details

OLM/ dredge contractor/ Environmental Consultant must prepare a detailed method statement detailing all proposed elements of a dredging/ dewatering operation, which must be supplied to DEA&DP/ BOCMA for approval. This method statement must be in alignment with the core principles of this MMP.

Specific thresholds/ details

Specific details to include in the method statement include:

- Equipment to be utilised;
- Personnel requirements;
- Sediment removal methodology, including how the material will be transported to the dewatering site;
- Details of the proposed dewatering site and dewatering methodology, including signed approvals of landowners if required;
- Confirmation of the proposed reuse/ disposal site of the dredged material following dewatering, or a signed letter indicating that the material can be stored on the proposed dewatering site until such time as approval for re-use can be acquired.
- Indicative strategy for medium-to-long term storage of dredged material on the dewatering site, and how this will be managed in a way which minimises potential environmental/ human health impacts.
- Detailed Operational Health and Safety (H&S) plan to minimise risk to workers.
- Plan to minimise undue impacts on the sensitive estuarine environment during dredging and dewatering activities—to align with mitigation measures stipulated within this MMP;
- Confirmation from an Environmental Consultant/ Competent Authority (CA) that the proposed activities will not trigger any additional NEMA listed activities not covered within this MMP, or any additional water uses stipulated in the NWA, or similar, in other legislation.

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 PREAMBLE

This Maintenance Management Plane (MMP) and the supporting Ecological Health Assessment Report have both clearly indicated that the condition in the lower Onrus River and Estuary have been critically compromised through intense sediment deposition. This sediment, which is predominantly derived from disastrous levels of erosion within the upstream Onrus Main Wetland, washed into the estuary during the September 2023 “Heritage Day” floods, and was subsequently redistributed downstream following heavy rainfall events in 2024—leading to a complete covering infilling of the estuarine channel upstream of the mouth. Consequently, almost all proper estuarine functioning has ceased, with no seawater able to enter the main estuarine body due to the system being “perched” above the height of the tides. The system has therefore functionally shifted from an estuary to a freshwater riverine outlet.

The sedimentation, combined with the intense floods, has resulted in a near-total collapse in the ecological health of the estuary due to dramatic losses in available habitat, and related degradation of the small amount of habitat that remains. In fact, the estuarine fish, bird, invertebrate, amphibian, and aquatic vegetation populations were almost completely non-existent as of the 2024 survey, with the being estuary downgraded from a rating of “D” (Heavily Modified) in 2018 to “E” (Severely Modified) in 2024. The only category worse than “E”, is “F” (Critically Modified) which is reserved for systems that are considered to be so degraded that effective rehabilitation is almost impossible.

Additionally, the estuary and surrounding areas are almost completely infested with alien invasive plants (AIPs) which are further stressing ecological health restricting the available habitat for remnant indigenous plant and animal species. Concerningly, both the coverage of alien infestation and the density/ completeness of the infestation, appears to be increasing in recent years, which indicates that this pressure will continue to worsen with time.

Beyond the ecological concerns, the sedimentation has also dramatically increased the risk of flooding of Onrus village itself, due to the loss of the energy-dampening and flood attenuation effects of the estuary, placing residents, landowners, and visitors at risk of both personal harm and damage to property should heavy rain/ a flood occur in the future.

8.2 THE PROPOSED MMP

The proposed MMP aims to address the above concerns, with the primarily strategies being to conduct a bulk dredging (sediment removal) operation as soon as possible, to clear the estuary of the accumulated material. The plan also provides provision for future dredging should it be required, and contains a stringent list of requirements which must be met before any future dredging can commence—thereby preventing unnecessary impacts.

8.2.1 DREDGING AND DEWATERING

It is proposed that sediments be removed from the estuary using a combination of a dedicated suction dredger, and support from numerous other vehicles, including excavators and bulldozers. The sediment will be removed in two primary ways, with the being to dislodge the sandy sediments and use the amphibious suction dredger to pump the material as a semi-

liquid slurry, via a series of flexible and inflexible pipelines to the proposed dewatering site (located to the east of the estuary). Sediments identified to be predominantly composed of organic peat, are instead proposed to be utilised for rehabilitation of the Upstream Onrus Main Wetland (described below) and will instead be removed using excavators and transported by trucks.

Dewatering (drying out) of the sandy sediments will take place in a series of sedimentation ponds on the De Zandt dewatering site, with several options for the reuse of the dry sediment being briefly described below.

8.2.2 PROPOSED SEDIMENT REUSE

Given the high sand content and low trace metal content of the estuarine sediments, the proposed dredge material is suitable for numerous forms of reuse, with the most ideal proposal being to reuse it for wetland rehabilitation in the upstream Onrus Main Wetland. This wetland has been heavily impacted by intensive erosive action—which is predominantly driven by upstream interception of its required freshwater inflows due to the presence of the De Bos Dam. The resultant desiccation is resulting in the erosion of a large ravine, which is further speeding up the rate of both erosion and desiccation. The Palmiet Peat Wetland type (which characterises the wetland) requires constant sediment saturation to remain functional, thus the desiccation is leading to intense degradation. This has the potential to have dire consequences, as this wetland system is considered to be the most important of its type in South Africa. The dredged peat, and some portion of the sandy sediments, are therefore proposed to be used for both erosion prevention measures and for direct rehabilitation measures within the wetland. Importantly, the proposed activities in the wetland do not fall under the ambit of this MMP, yet still fall under the auspices of the Onrus Catchment-to-Coast project, with the proposed tool facilitating the wetland activities being the Department of Agriculture’s Landcare EMPr.

Beyond reuse in the Onrus Main Wetland, interest in using the sediment for construction and land-grading activities has also been expressed by the owners of the proposed dewatering site, De Zandt, who are also the holders of the Environmental Authorisation (EA) for the large mixed-use development which has commenced to the east of the Onrus Estuary—with the dewatering site falling within their development area.

The above two methodologies provide suitable reuse options for the dredged sediment and should limit concerns regarding post-dredge disposal.

8.3 IMPACT ASSESSMENT

Identified potential impacts of the proposed maintenance activities on the Onrus Estuary were assessed as part of this study. Impacts have been separated into the negative and positive impacts (benefits) expected to be associated with the maintenance activities. Mitigation and/or enhancement measures have also been provided to minimise the significance of negative benefits and maximise the significance of the assessed benefits.

A total of seven potential negative impacts have been identified for the proposed maintenance activities, with a further five positive impacts (benefits) being identified (Table 8.1). Furthermore, an assessment of the No-Go Alternative—impacts associated with not conducting the proposed maintenance—as well as an assessment of the Cumulative Impacts

(the combined impacts associated with conducting this, and similar works, within the broader Onrus Area) was also conducted.

The assessment found that all negative impacts could be heavily mitigated with the implementation of suitable mitigation measures coupled with rigorous scientific monitoring and assessments prior to commencement of future maintenance activities. With the implementation of these measures, the assessed impact significance was lowered to ‘Very Low’ for all impacts besides the risk of hazardous substance spills, which was lowered to ‘Insignificant’.

Conversely, the assessment found that all identified benefits were overwhelmingly positive for factors such as ecological health, estuarine function, flood risk, human health and safety, and the recreational viability of the estuary. In fact, all but two benefits were rated as ‘High’ positive significance with the implementation of appropriate mitigation/ enhancement.

The most significant benefit identified from the proposed maintenance activities pertains to the predicted improvements to ecological health and functioning, both within the Onrus System and surrounding areas. This benefit was rated to be of ‘Very High’ positive significance with appropriate mitigation and enhancements. This is principally because the maintenance activities are predicted to facilitate the creation of functional estuarine habitat, where almost all habitat was destroyed due to flooding and sedimentation in 2023 and 2024. Furthermore, the maintenance activities may create habitat for species which are of ecological significance at larger scales—including regionally significant estuarine-dependent marine fisheries species, as well as globally threatened wading bird species.

When the proposed maintenance activities were considered within the broader setting of the Onrus Catchment-to-Coast project and other similar rehabilitation initiatives, the cumulative impacts of this project were assessed to be of ‘High’ positive significance. The only factor detracting from this rating was the probability of these benefits occurring, which was assessed as ‘Possible’, due to the complex requirements for the implementation of all the proposed enhancement measures. Potential complexities include permissions—such as Environmental Authorisations, Water Use Licenses, landowner consent—as well as potential funding and manpower constraints.

Finally, impacts associated with the No-Go Alternative were found to be of ‘Medium’ negative significance. This is predominantly because the estuary has crossed numerous “tipping points”, with its compromised state being predicted to cause further ecological decline, as well as increasing flooding/ human health risks with time. Consequently, whilst (by definition) the No-Go Alternative will not introduce any new threats to the estuary, the consequences of this inaction are unquestionably negative.

Table 8.1. Summary of potential impacts associated with maintenance activities included within this MMP. Impacts were rated in terms of their consequences (Very high/High/Med/Low/Very low/Insignificant), probability of occurrence (Very low/Low/Medium/Nigh/Very high), status (+ve or -ve) and the level of confidence we had in the assessment (Very low/Low/Med/High/Very high).

	Impact identified	Consequence	Probability	Significance	Status	Confidence
Negative Impacts	Impact 1: Waste generation and disposal from maintenance operations	Medium	Probable	MEDIUM	-ve	High
	With mitigation	Low	Possible	VERY LOW	-ve	High
	Impact 2: Hazardous substance spills during maintenance operations	Low	Probable	LOW	-ve	High
	With mitigation	Very Low	Possible	INSIGNIFICANT	-ve	High
	Impact 3: Generation of turbidity plumes	Low	Definite	LOW	-ve	High
	With mitigation	Ver Low	Probable	VERY LOW	-ve	High
	Impact 4: Direct destruction of benthic and riparian habitat	Low	Definite	LOW	-ve	High
	With mitigation	Very Low	Definite	VERY LOW	-ve	High
	Impact 5: Potential terrestrial impacts due to the dewatering of sediment	Medium	Probable	MEDIUM	-ve	High
	With mitigation	Low	Possible	VERY LOW	-ve	High
	Impact 6: Potential dust pollution impacts emanating from dredging and dewatering activities	Medium	Probable	MEDIUM	-ve	High
	With mitigation	Low	Possible	VERY LOW	-ve	High
	Impact 7: Noise impacts during dredging activities	Low	Definite	LOW	-ve	High
	With mitigation	Very Low	Definite	VERY LOW	-ve	High
Potential Benefits	Benefit 1: Improvements to water quality associated with increased estuarine circulation and hydrodynamic functioning	High	Probable	HIGH	+ve	High
	With mitigation					
	Benefit 2: Improvements to flood mitigation associated with maintenance dredging of the Onrus Estuary	High	Definite	HIGH	+ve	High
	With mitigation					
Cumulative Impacts (Benefits)	Benefit 3: Ecological Health Improvements associated with increased open water habitat, improved hydrodynamic functioning, and more saline conditions	Very High	Probable	VERY HIGH	+ve	High
	With mitigation					
Cumulative Impacts (Benefits)	Benefit 4: Recreational opportunities emanating from the creation of an open estuarine channel and basin	High	Probable	HIGH	+ve	High
	With mitigation					
Cumulative Impacts (Benefits)	Cumulative impacts (benefits) resulting from similar restorative and management projects in the Onrus Catchment and surrounding areas	Very High	Possible	HIGH	+ve	Medium
	With appropriate mitigation and implementation					

	Impact identified	Consequence	Probability	Significance	Status	Confidence
No-Go Alternative	Assessment of the No-Go alternative Without maintenance activities	Medium	Probable	MEDIUM	-ve	Medium

8.4 REASONED OPINION AND RECOMMENDATION

The precautionary approach, given in the National Environmental Management Act, 1998 (NEMA) (Act no. 107 of 1998), requires that, if there is a strong suspicion that a certain activity may have environmentally harmful consequences, it is better to control that activity now rather than to wait for incontrovertible scientific evidence. The same principle can likewise be applied to situations wherein environmental harm/ risks to human health and safety are already present, and rapid remediation is required to prevent further degradation/ risk.

This document therefore presents a middle-ground between scientific and legislative best practice required to prevent the occurrence of activities that have the potential to cause adverse harm to environmental and human receptors. The preparation of the Ecological Health Assessment, as well as this detailed MMP and Impact Assessment, presents a strong, scientifically rigorous case and supporting methodology for the commencement of maintenance activities in the Onrus Estuary and lower Onrus river. The predicted benefits of these maintenance activities are overwhelmingly positive when compared to the relatively minor negative impacts assessed to co-occur with these benefits. Likewise, the consequences of inactivity/ slow or ineffectual responses to the threats to the Onrus System, are much more significant than any potential negatives associated with the proposed maintenance activities.

However, the severity of the situation does not imply that appropriate processes/ legislation need not be complied with but rather stresses the need to utilise all available legal tools to enable swift implementation—without compromising on established requirements.

It is therefore recommended that this MMP be the primary tool required to facilitate initiation of the maintenance activities, with the necessary parallel Water Use License Application (WULA), falling under the auspices of the Emergency Protocol described within GN 4167 of 2023. This protocol does not absolve the applicant from the need to acquire a Water Use Authorisation, yet does allow for the completion of the application retrospectively—following commencement of the maintenance activities. Likewise, it is proposed that the proposed Main Onrus Wetland stabilisation/ rehabilitation measures be conducted under a Landcare EMPr.

In conclusion, it is our scientific opinion that the maintenance activities proposed for the Onrus Estuary and Lower River commence with all possible haste, with this document being used as the primary instrument and methodology enabling these activities to occur in a manner which minimises undue environmental and social impacts, while maximising benefits.

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10 APPENDIX I

The significance of all potential impacts that would result from the proposed project is determined in order to assist decision-makers. The significance of an impact is defined as a combination of the consequence of the impact occurring and the probability that the impact will occur. The significance of each identified impact was thus rated according to the methodology set out below:

Step I – Determine the consequence rating for the impact by determining the score for each of the three criteria (A-C) listed below and then adding them. The rationale for assigning a specific rating, and comments on the degree to which the impact may cause irreplaceable loss of resources and be irreversible, must be included in the narrative accompanying the impact rating:

Rating	Definition of Rating	Score
A. Extent – the area over which the impact will be experienced.		
Local	Confined to project or study area or part thereof (e.g. limits of the concession area)	1
Regional	The region (e.g. the whole of Namaqualand coast)	2
(Inter) national	Significantly beyond Saldanha Bay and adjacent land areas	3
B. Intensity – the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources.		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. Duration – the time frame for which the impact will be experienced and its reversibility.		
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2
Long-term	More than 15 years (state whether impact is irreversible)	3

The combined score of these three criteria corresponds to a Consequence Rating, as follows:

Combined Score (A+B+C)	3 – 4	5	6	7	8 – 9
Consequence Rating	Very low	Low	Medium	High	Very high

Example I:

Extent	Intensity	Duration	Consequence
Regional 2	Medium 2	Long-term 3	High 7

Step 2 – Assess the probability of the impact occurring according to the following definitions:

Probability – the likelihood of the impact occurring	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

Example 2:

Extent	Intensity	Duration	Consequence	Probability
Regional 2	Medium 2	Long-term 3	High 7	Probable

Step 3 – Determine the overall significance of the impact as a combination of the consequence and probability ratings, as set out below:

		PROBABILITY			
		Improbable	Possible	Probable	Definite
CONSEQUENCE	Very Low	INSIGNIFICANT	INSIGNIFICANT	VERY LOW	VERY LOW
	Low	VERY LOW	VERY LOW	LOW	LOW
	Medium	LOW	LOW	MEDIUM	MEDIUM
	High	MEDIUM	MEDIUM	HIGH	HIGH
	Very High	HIGH	HIGH	VERY HIGH	VERY HIGH

Example 3:

Extent	Intensity	Duration	Consequence	Probability	Significance
Regional 2	Medium 2	Long-term 3	High 7	Probable	HIGH

Step 4 – Note the status of the impact (i.e. will the effect of the impact be negative or positive?)

Example 4:

Extent	Intensity	Duration	Consequence	Probability	Significance	Status
Regional 2	Medium 2	Long-term 3	High 7	Probable	HIGH	-ve

Step 5 – State the level of confidence in the assessment of the impact (high, medium or low).

Impacts are also considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The prescribed system for considering impacts status and confidence (in assessment) is laid out in the table below. Depending on the data available, a higher level of confidence may be attached to the assessment of some impacts than others. For example, if the assessment is based on extrapolated data, this may reduce the confidence level to low, noting that further ground-truthing is required to improve this.

Confidence rating	
Status of impact	+ ve (beneficial) or – ve (cost)
Confidence of assessment	Low, Medium or High

Example 5:

Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Regional 2	Medium 2	Long-term 3	High 7	Probable	HIGH	-'ve	High

The significance rating of impacts is considered by decision-makers, as shown below. Note, this method does not apply to minor impacts which can be logically grouped into a single assessment.

- **INSIGNIFICANT:** the potential impact is negligible and will not have an influence on the decision regarding the proposed activity.
- **VERY LOW:** the potential impact is very small and should not have any meaningful influence on the decision regarding the proposed activity.
- **LOW:** the potential impact may not have any meaningful influence on the decision regarding the proposed activity.
- **MEDIUM:** the potential impact should influence the decision regarding the proposed activity.
- **HIGH:** the potential impact will affect a decision regarding the proposed activity.
- **VERY HIGH:** The proposed activity should only be approved under special circumstances.

Step 6 – Identify and describe practical mitigation and optimisation measures that can be implemented effectively to reduce or enhance the significance of the impact. Mitigation and optimisation measures must be described as either:

1. Essential: must be implemented and are non-negotiable; and
2. Best Practice: must be shown to have been considered and sound reasons provided by the proponent if not implemented.

Essential mitigation and optimisation measures must be inserted into the completed impact assessment table. The impact should be re-assessed with mitigation, by following Steps 1-5 again to demonstrate how the extent, intensity, duration and/or probability change after implementation of the proposed mitigation measures.

Example 6:

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional 2	Medium 2	Long-term 3	High 7	Probable	HIGH	-ve	High
Essential mitigation measures								
<ul style="list-style-type: none"> • Xxxx • Xxxxx 								
With mitigation	Local 1	Low 1	Long-term 3	Low 5	Improbable	VERY LOW	- ve	High

Step 7 – Prepare a summary table of all impact significance ratings as follows:

Phase	Impact identified	Severity	Probability	Significance	Status	Confidence
XXXXXX	Impact 1: xxx	Medium	Improbable	LOW	-ve	High
	With mitigation	Low	Improbable	VERY LOW		High
	Impact 1: xxx	Very Low	Definite	VERY LOW	-ve	Medium
	With mitigation	Very Low	Improbable	INSIGNIFICANT	-ve	Medium

Indicate whether the proposed development alternatives are environmentally suitable or unsuitable in terms of the respective impacts assessed by the relevant specialist and the environmentally preferred alternative.

