APPENDIX 7: Marine and Estuarine (Aquatic) Biodiversity Specialist Assessment

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

SCOPING & ENVIRONMENTAL IMPACT ASSESSMENT (S&EIA) FOR THE PROPOSED 2 MEGALITRES PER DAY (MLD) SOLAR POWERED SEAWATER DESALINATION PLANT IN THE PORT OF EAST LONDON, BUFFALO CITY METROPOLITAN MUNICIPALITY, EASTERN CAPE PROVINCE, BY TRANSNET NATIONAL PORTS AUTHORITY

DFFE Pre-Application Reference Number: 2026-04-0038

July 2026

PART OF

MARINE AND ESTUARINE ECOLOGY IMPACT ASSESSMENT FOR A DESALINATION PLANT WITHIN THE PORT OF EAST LONDON, EASTERN CAPE

2026

Anchor Environmental Consultants Report No. 2176/12

Cover photo: Tahlia Henry

MARINE AND ESTUARINE ECOLOGY IMPACT ASSESSMENT FOR A DESALINATION PLANT WITHIN THE PORT OF EAST LONDON, EASTERN CAPE

2026

Report prepared for:

Transnet SOC Limited—Division Transnet National Ports Authority (TNPA))—East London Port

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EXECUTIVE SUMMARY

Introduction

Transnet SOC Limited (division Transnet National Ports Authority (TNPA)) has appointed contractors (Sunwater East London JV (Sunwater)) for the construction of a two megalitre per day solar-powered Reverse Osmosis desalination plant within the Port of East London, Buffalo City Metropolitan Municipality, East London. This proposed development requires an application for Environmental Authorisation, as well as a Coastal Waters Discharge Permit, and as a result a Marine Specialist Impact Assessment, including a numerical dispersion modelling study, is necessary.

Anchor Environmental Consultants (Pty) Ltd (Anchor) was appointed by Sunwater to undertake a Marine and Estuarine Ecology Impact Assessment for the proposed RO plant development and operation, to support the Environmental Impact Assessment process. This study presents results of the dispersion modelling assessment of the proposed reverse osmosis desalination plant discharge (plume behaviour, dispersion potential, etc.) as well as the marine and estuarine specialist impact assessment study for the proposed discharge and development, based on the results of this modelling.

The water required for the desalination process will be sourced from the lowest portion of the Buffalo River Estuary, within the Estuarine Functional Zone. Approximately 5 500 m^3 of saline water will be abstracted daily via a 290 m long intake pipeline (from the intake point to the RO Plant). This potable water will be used to support port operations and reduce dependence on municipal water supplies. The resulting brine effluent will be discharged via a pipeline to a marine outfall, and discharge volumes will increase as freshwater production scales up (up to approximately 3 260 m^3/day). The outfall pipeline will run along the southern section of the Port breakwater, positioned just above the rocks of the artificially constructed rocky beach, continuing through this area and terminating at the seaward edge of the rocks.

Affected Environment

The oceanography of East London is shaped by the strong southward-flowing Agulhas current and local processes. The interaction of warm Agulhas waters with cooler temperate waters creates a diverse marine ecosystem. Cool counter currents also flow inshore of the Agulhas current in an easterly direction, providing important opportunities for northward and eastward migration of certain species such as the sardine *Sardinops sagax*. Wind-driven water movement, especially strong easterly winds, causes localized upwelling, bringing nutrient-rich deep water to the surface. This supports phytoplankton blooms, which form the base of a food chain involving zooplankton, fish such as sardines, and larger predators.

The South African coastline experiences semi-diurnal tides, with high and low tides occurring every 12 hours and shifting approximately 25 minutes later each day due to the moon's 28-day cycle. Tides significantly influence the biological cycles of intertidal marine organisms and human activities along the coast. In East London, tides show slight diurnal inequality, with a range from 1.82 m at mean spring high tide to 0.23 m at mean spring low tide. Tidal activity also strongly affects current velocity in the Buffalo River Estuary.

Wave energy, determined by wind strength and fetch, plays a crucial role in shaping marine ecology and coastal activities. The Eastern Cape coast, characterized by high wave energy, experiences large ground swells during winter due to south-westerly winds and easterly wind swells in summer. Cyclone activity in the Mozambique Channel can also result in large easterly swells. Nearshore currents, driven by waves and tides, are dynamic and can shift rapidly, causing significant sediment movement and periodically smothering or exposing reefs.

Like much of the Eastern Cape, the East London coastal region consists predominately of sandy beaches, with rocky shore and wave cut platforms making up much of the remaining habitat. Wide dune fields with parabolic dunes occur between the high-water mark and inland vegetated coastal dunes, with sand movement influenced by easterly and westerly winds. The littoral active zone includes these dunes, intertidal, and sub-tidal areas, with extensive sand movement taking place between these habitats.

The shoreline in the vicinity of the proposed East London development is classified as Agulhas Exposed Rocky Shore, while the habitat further offshore is Agulhas Inner Shelf Mosaic. Agulhas Exposed Rocky Shore is defined as a “rocky shore type in the Agulhas ecoregion exposed to moderate wave intensity”, while Agulhas Inner Shelf Mosaic is a mixed sandy-bottom and rocky subtidal habitat that characterises the ‘inner shelf’ (to 40 m depth) in the Agulhas ecoregion. Both of these ecosystems are categorised as ‘Vulnerable’. While the coastal habitat in the vicinity of the proposed marine outfalls fort the East London desalination project is defined in the 2018 NBA as Agulhas Exposed Rocky Shore, the area lies to the south of the Port, and comprises mostly artificial dolosse, which create a heterogeneous environment supporting diverse marine communities that are similar to those present along similar habitats on the Easten Cape coastline.

A survey of the sediment quality and benthic macrofauna community in the vicinity of the brine outfall was undertaken on 23–24 July 2024 to collect baseline data with which to inform future monitoring of the brine discharge. Sediment and macrofauna samples collected from 14 sites, comprising 11 sites (A–K) around the proposed outfall, and three control sites further north (L–N). Sediment was collected using a stainless steel Van Veen grab, with subsamples collected for particle size distribution, total organic content and trace metal analyses. Trace metal concentrations were compared against the Effects Range Low thresholds established by the United States National Oceanic and Atmospheric Administration. The remaining sediment was washed through a 1 mm mesh bag, with all retained benthic macrofauna preserved in 10% formalin. In the laboratory, specimens were identified to the lowest taxonomic level possible, with the abundance and blotted wet biomass of each taxon recorded and standardized. Square root transformed macrofauna data underwent multivariate analyses and visualisation using PRIMER v6.1.11. A total of 23 macrofauna taxa were identified, ascribed to five phyla, three classes, 9 orders, 17 families, 14 genera and 11 species. The community was dominated by the phyla Arthropoda, Annelida and Mollusca, and is depauperate with low abundance and biomass values. This is likely due to the high-energy nature of the region, which is dominated by sand with low organic content, and consequently no elevated trace metal contamination. Therefore, there will likely be little to no impact of the potential operational phase and brine discharge on the soft subtidal habitat. The macrofauna communities were not significantly different between potential control and impact sites, with the former therefore sufficient to inform future monitoring of the brine discharge. Future monitoring should include the annual collection of sediment and macrofauna samples from the same sites, and at the same time of year, as the baseline survey to eliminate confounding variables.

Based on historic sightings or strandings records, as well as habitat projections of known species parameters, an estimated 21 species of cetaceans (whales and dolphins) are thought to occur (or are likely to occur) inshore of the shelf edge off the South Coast. Dolphins, specifically bottle nosed dolphins (*Tursiops* sp.) and humpback dolphins (*Sousa* sp.), have been reported near the Buffalo River Estuary mouth, and one resident species of coastal pinniped is present in the area, namely the Cape fur seal *Arctocephalus pusillus pusillus*.

The Buffalo River Estuary

Estuaries are highly productive ecosystems due to the combination of nutrient-rich river water and shallow, sheltered habitats. They serve as crucial nursery grounds for juvenile marine fish and invertebrates. However, estuaries face degradation from poor upstream management, including erosion, pollution, and water abstraction, as well as harbour development. This degradation threatens the biota and the ecosystem services estuaries provide.

The Buffalo River Estuary, categorized as a Warm Temperate, Predominantly Open system, extends 7.5 km from its mouth and includes the Port of East London, which falls within the lower 2 km of the system and is the only estuarine Port in the country. The estuary's mouth is regularly dredged to keep it open, but port infrastructure has eliminated natural estuarine banks, intertidal sand, mudflats, and salt marshes in the lower estuary. The local geomorphology, mean annual runoff, sediment movement, and water currents all influence the estuary's shape and nature.

The most recent National Biodiversity Assessment in 2018 rated the condition or Present Ecological State of the Buffalo River Estuary as a "D" or "Heavily Modified". The estuary is heavily impacted by changes to hydrology, habitat loss and modification, and poor water quality. Biotic elements of the estuary have been affected by changes to the physical components, with birds being the most affected aspect, followed by invertebrates, fish and microalgae. The Recommended Ecological Category of the estuary is a "D", meaning that, at a minimum, the current state of this system must be maintained, and human activities must be managed to prevent further degradation.

Human uses and influences

Several commercial marine activities take place within the broader region; these include shipping, marine ecotourism, and a range of commercial fisheries. The commercial fisheries in the vicinity of East London include the commercial (or traditional) line fishery, large pelagic longlining, and the South Coast rock lobster fishery. Small scale and recreational fishers also operate nearby.

- The commercial linefishery targets fish such as seabreams, geelbek, dusky kob, snoek, and yellowtail. The fishery employs 27% of all fishers but contributes only 6% of the total commercial marine fisheries' value. The Total Allowable Effort is set at 455 vessels, with 46 allocated to the zone in which East London falls. The fishery is highly active near the Port of East London.

- The pelagic longline fishery targets large, predatory, highly mobile fish including bigeye tuna, yellowfin tuna, southern bluefin tuna and swordfish. The fishery operates primarily along the continental shelf break and further offshore within South Africa's Exclusive Economic Zone, outside of the proposed development's area of influence.

- The South African longline trap fishery targets the endemic South Coast rock lobster *Palinurus gilchristi*. There is no perceived overlap between the proposed development area and South Coast rock lobster fishing effort, which is active further south.

- Small-scale fisheries are vital for income and food security for many people globally and in South Africa. Though the fishery contributes less than 1% to South Africa's GDP, it provides protein and employment to about 136 coastal communities along the 3 000 km coastline. The South Coast area in which the proposed development lies has many recognised small-scale fishing communities targeting various marine and estuarine species.

It was evident, across numerous site visits, that there is a significant and unacceptable litter problem within the Port system. While it is likely that much of this litter originates from further up the catchment area, this needs to be addressed by Port authority as a matter of urgency, given that these areas are not accessible to the public.

Spatial Constraints

The nearest Marine Protected Area to the Port of East London is the Amathole Marine Protected Area, of which the Gonubie section is 15 km from the Port. Ecologically or Biologically Significant Marine Areas (EBSAs) are defined by the Convention on Biological Diversity (CBD) as "geographically or oceanographically discrete areas that provide important services to one or more species/populations of an ecosystem or to the ecosystem as a whole, compared to other surrounding areas or areas of similar ecological characteristics, or otherwise meet the [EBSA] criteria". The Algoa to Amathole EBSA, including the Port of East London, spans the Eastern Cape shoreline and supports diverse marine features and key ecological processes, influenced by the Agulhas Current. This EBSA includes 36 ecosystem types, with 18 being threatened. The proposed development is situated within a section of EBSA zoned for 'Impact Management'.

A Critical Biodiversity Area (CBA) assessment provides a spatial plan to support sustainable development, using systematic biodiversity planning principles. CBA maps include Protected Areas, Critical Biodiversity Areas (CBAs; also called Biodiversity Conservation/Restoration Areas), and Ecological Support Areas (ESAs; also called Biodiversity Impact Management Zones), which are jointly important for the persistence of a viable representative sample of all ecosystem types and species, as well as the long-term ecological functioning and connectivity of the landscape or seascape as a whole. CBAs are categorized into 'CBA Natural' (maintaining natural conditions) and 'CBA Restore' (improving and restoring ecological conditions). ESAs cover portions of EBSAs not within MPAs or CBAs, plus a 5 km buffer around MPAs. ESAs aim to manage and minimize human impacts to maintain or improve ecological conditions. The marine components of the proposed development area lie entirely within an ESA.

Near Field Dispersion Modelling

Pollutant levels at the edge of the Recommended Mixing Zone (RMZ) are expected to comply with published Water Quality Guidelines (WQGs). A conservative 30 m RMZ was used for assessment of modelling outputs.

The calculated constituent concentrations after initial cross-shore dilution (dilution into the surf zone cell indicate that salinity WQG concentrations exceed the threshold at 60 m when the swell height is 1-1.5 m under extremely small surf zone widths (10 m) but were compliant across all other conditions. From available satellite imagery, it is exceedingly rare for the surf zone width to be > 10 m wide, and it is likely that this non-compliance will be temporary and limited to the immediate discharge area. Note that these calculations do not account for effluent volume directly, and there is no differentiation made between the Initial Phase and Full capacity discharge volumes.

Numerical modelling was performed using the Cornell Mixing Zone expert system (CORMIX) to predict the geometry and dilution characteristics of the discharge and to determine the outfall design/effluent quality requirements to achieve compliance with these WQGs. All results at specific locations in the near field were determined according to the worst-case concentration of effluent exiting the pipe end. Dilutions were calculated through CORMIX and applied to the outlet concentration to find concentrations at the 30 m RMZ and the Zone of Initial Dilution (ZID). The model predicts that the plume will interact with the bank at 38.7 m and 57.3 m downstream from the outfall for the Initial Phase and Full Capacity phase respectively, which is well beyond the RMZ and ZID.

Compliance to WQG limits at the edge of the ZID is considered to be the gold standard — this is the most mathematically 'stable' result, leading to increased confidence in predicted compliance at the RMZ. Sufficient dilutions in the near-field (ZID) are likely to translate to similar, sufficient dilutions in the far-field (at the RMZ), with a higher degree of confidence in the result at the 30 m RMZ. The model results suggest that compliance at the ZID is achieved under both the Initial Phase and Full Capacity phases for salinity, TSS and NaOCl.

Impact Assessment

Potential impacts that may be experienced during effluent discharge before and after mitigation are summarised in Table. A total of ten impacts were identified and, after mitigation, none of the identified impacts were assessed as being above 'low' significance.

Table 1. Summary of potential impacts.

Phase	Impact identified	Significance	
		Without mitigation	With mitigation
Construction	Impact 1: Disturbance of intertidal and subtidal habitat	VERY LOW	INSIGNIFICANT
	Impact 2: Disturbance of pelagic open water habitat	INSIGNIFICANT	-
	Impact 3: Disturbance of estuarine habitat.	VERY LOW	INSIGNIFICANT
	Impact 4: Waste generation and disposal during construction	LOW	VERY LOW
	Impact 5: The effect of spillage of hazardous substances on marine biota	MEDIUM	LOW
	Impact 6: Disturbance and/or mortality of marine life due to the intake of seawater	LOW	VERY LOW
Operation	Impact 7: Increases in salinity	LOW	VERY LOW
	Impact 8: Reduced physiological functioning due to decreased dissolved oxygen.	LOW	VERY LOW
	Impact 9: Reduced physiological functioning due changes in water pH	LOW	INSIGNIFICANT
	Impact 10: The impacts of discharged co-pollutants on marine biota.	LOW	VERY LOW
All	Cumulative impacts	VERY LOW	INSIGNIFICANT

By definition, cumulative marine environmental impacts emanating from the proposed project are related to the overlap with various other sources of anthropogenic disturbance in the vicinity of the impact proposed project activities, under normal operating conditions. In this case, these impacts would include 1) disturbance of estuarine/marine habitat, 2) other systems of estuarine water intake and 3) cumulative effects of other brine discharges. Intertidal and subtidal impacts related to construction will not result in a net loss of habitat, and affect an already transformed communities that area already subject to high levels of disturbance (though wave energy), resulting in an impact of 'very low' significance before mitigation. In a similar way, impacts to estuarine habitat resulting from the proposed development are limited in scale, and are not expected to noticeably influence the ecology of the estuary. There are no other known developments in the area of impact that would result in any cumulative effects of greater significance. There may be cumulative impacts of waste generated (especially litter), should strict project controls to control the generation and management of such waste not be implemented. To reduce potential cumulative impacts, and cognisant of the significant amount of litter already on site, the active clean-up of the Port environment must be undertaken, with weekly beach clean ups undertaken by TNPA as a matter of urgency. Cumulative impacts related to intake and brine discharge are only relevant should similar operations exist within the impacted 'area of influence'. As no such developments exist, there are no anticipated cumulative effects of concern.

Construction phase mitigation measures include the following:

<u>Essential Mitigation:</u>

- Rehabilitate the disturbed area in the intertidal area immediately following construction by removing all artificial materials not related to the permanent fixture of the pipeline
- Limit duration of construction activities in the coastal zone.
- Constrain spatial extent of impacts to the minimum required.
- Rehabilitate the disturbed area in the estuarine area immediately following construction by removing all artificial materials not related to the permanent fixture of the pipeline
- Limit duration and spatial extent of construction activities in the EFZ to the minimum required.
- Ensure suitable stormwater management is in place to minimize run-off to the estuarine system.
- Suitable handling and disposal protocols must be clearly explained, and sign boarded.
- A "reduce, reuse, recycle" approach must be followed.
- Provide suitable containers for the disposal of all waste, including recycling.
- Regular litter sweeps should be carried out around the construction site.
- Intentional disposal of any litter into the environment is strictly prohibited, while accidental spillage must be prevented, contained and reported to the responsible Environmental Officer, Environmental Control Officer or other relevant party immediately.
- Inform and train all staff about sensitive estuarine species and the responsible disposal of construction waste. This training must be integrated into toolbox talks or onsite awareness sessions to ensure that waste management practices are understood and

followed diligently. Additionally, contractors must prepare a method statement outlining specific waste management procedures, which must be approved by the resident engineer before construction activities commence.

- Waste disposal at licensed landfill sites by qualified contractors is mandatory, with proof of disposal submitted to the appointed Environmental Officer. Waste management certification must be obtained, and detailed records of all stored and disposed waste, including quantity, nature, and fate, must be maintained for auditing purposes.
- Adequate sanitary facilities and ablutions must be provided for all personnel throughout the project area. Enforcement of facility usage and cleanliness is crucial.
- Implementation of a rigorous environmental management and control plan (including procedures for remediation).
- All fuel and oil is to be stored with adequate spill protection.
- No leaking vehicles are permitted on site.
- All hazardous substances must be accompanied by a permit, a hazard report sheet, and may only be handled by suitably trained operators.
- Implement leak detection and maintenance programmes for valves, flanges, fittings, seals, hydraulic systems, hoses, etc. All hydraulic systems should be adequately maintained, and hydraulic hoses should be frequently inspected. All process areas should be bunded to ensure drainage water flows into the closed drainage system. Drip trays should be used to collect run-off from equipment that is not contained within bunded areas and the contents routed to the closed drainage system.
- Low-toxicity biodegradable detergents should be used in the cleaning of all spillages.
- Intentional disposal of any substance into the environment is strictly prohibited, while accidental spillage must be prevented, contained and reported to the responsible Environmental Officer, Environmental Control Officer or other relevant party immediately.

Operational phase mitigation measures include the following:

<u>Essential Mitigation:</u>

- Intake velocities should be kept below 0.15 m/s to ensure that fish and other mobile organisms can escape the intake current.
- Intake structures should ensure the horizontal intake of water. This can be achieved through use of footer valves.
- Intake structures should be positioned away from sensitive environments or areas with high species diversity or abundance, like rocky reefs, and should not draw in water from the upper meter of the water column.
- Effluent discharged must meet modelled end of pipe concentrations.
- Monitoring of end of pipe concentrations must be conducted and dosing levels should be adjusted should adverse effects be detected by the monitoring program.

- Effluent discharged must meet end of pipe concentrations modelled here (Section 5.3.2).
- Aeration of the effluent prior to discharge must be undertaken if oxygen scavengers (such as sodium metabisulphite) are utilised.
- Aeration of the effluent prior to discharge must be undertaken if oxygen scavengers (such as sodium metabisulphite) are utilised.
- Neutralization of extremely alkaline or acidic solutions and treatment of additional cleaning agents is required prior to discharge.
- Corrosion resistant materials should be used.
- Strong acidic and alkaline solutions must be neutralised prior to discharge.
- There must be continual release of small volumes of chemicals used during the Clean-in-Place (CIP) process with the brine discharge to allow for maximum dilution before release into the environment.

DECLARATION OF INDEPENDENCE

Anchor Environmental Consultants (Pty) Ltd is an independent consultancy 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 renumeration 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

The study was undertaken by Ms Lily Bovim, Ms Amy Wright, Ms Tahlia Henry, Mr Michael Armitage and Dr Ken Hutchings.

Dr Ken Hutchings has more than 25 years of research and consulting experience in the fields of fisheries management, mariculture, estuarine research and management, marine and estuarine spatial planning, marine impact assessment, research and conservation strategy development, fishery socio-economic surveys and analyses, biological sampling and life-history analyses of fish (age and growth, reproduction, mortality, migration, diet, ecology), taxonomic methodology, population genetics, fisheries modelling, marine ecotoxicity trials, trace metal pollution and physico-chemical, ecological and biodiversity surveys of marine, estuarine and freshwater habitats. Dr Hutchings is experienced in developing estuarine and coastal management plans and in conducting public participation processes. Dr Hutchings is a research associate of the University of Cape Town's Marine Research Institute. He has excellent verbal and writing communication skills, is competent with software packages used in scientific research and consulting projects. He has published 20 scientific papers and compiled more than 100 consulting reports. Dr Hutchings is comfortable working as part of a team in both a leadership and mentoring position or as a team member. Dr Hutchings has participated in international collaborative studies in Angola, Mozambique, Tanzania, Namibia, Sierra Leone, Republic of Congo, Somalia and Mauritius. He has practical and research experience of most commercial fishing methods (hand, line, spear, pole, gill net, trammel, net, beach seine net, trap, longline, trawl and purse-seine). He has personally collected scientific data for the demersal trawl and longline hake fisheries, designed, implemented and managed multi-year fishery observer programmes for line, longline, lobster trap and demersal trawl fisheries in South Africa. He has project managed several long-term fishery and mariculture research and monitoring projects for the South African Department of Forestry, Fisheries and the Environment and numerous other consulting projects for state, NGO and private sector clients.

Amy Wright has an MSc degree in Biological Sciences and BSc. Hons. degrees in Marine Biology and Applied Biology from the University of Cape Town. She is a Senior Associate for Marine Ecosystems & Resources at Anchor Environmental and a professionally registered Natural Scientist (SACNASP 131256). She is a marine ecologist with environmental research, impact assessment, permitting, dispersion modelling and environmental auditing experience in systems across South Africa, Namibia, Mozambique, Mauritius, Nigeria, Kenya, Angola, Tanzania and Madagascar. Her areas of expertise include maritime and estuarine engineering; reverse osmosis/desalination operations; industrial and small-scale intake, discharge and cooling systems (including gas to power, green hydrogen and fisheries processing); offshore oil and gas operations; land- and sea-based mariculture, dredging and offshore mining operations, and shipping (ballast, antifoulants). She has direct experience in the undertaking and application of two- and three-dimensional hydrodynamic modelling of marine and estuarine systems to inform impact assessments and regulatory compliance, as well as monitoring program design and implementation. She has experience in a range of numerical model systems, including the Delft3D modelling suite and CorMIX. She is the author of four scientific publications in Class A scientific journals and over 100 technical reports.

Lily Bovim is a marine ecologist with a strong academic foundation and diverse field experience across Southern Africa and beyond. She holds an MSc in Marine Biological Resources Management (magna cum laude), awarded jointly by Ghent University, the University of the Algarve, and the Galway-Mayo Institute of Technology. She also holds a BSc Honours degree in Biological Sciences and a BSc in Marine Biology and Ocean & Atmosphere Sciences (Oceanography) from the University of Cape Town. She is a registered Professional Natural Scientist (SACNASP 172158). As a Consultant in Anchor's Marine Ecosystems & Resources team, Lily contributes to a wide range of marine and estuarine projects through impact assessments, environmental audits, baseline surveys, monitoring programme design, and specialist studies. Her fieldwork experience includes rocky intertidal and ichthyofauna surveys, benthic sampling, and water and effluent quality sampling. She has in-country scientific experience across South Africa and in Guinea, Mozambique, Portugal, and Germany. Lily is a medically fit Class V Scientific Commercial Diver, certified Marine Mammal Observer, and has offshore experience in oceanographic and deep-sea sampling. Her technical skills include data analysis (R, PRIMER), GIS mapping, and basic graphic design.

Tahlia Henry is a physical oceanographer with a background in operational oceanography and hydrographic survey. She completed her BTech in 2015 at Cape Peninsula University of Technology, where her work and studies focused on the physical oceanographic dynamics of the Prince Edward Island region and investigating connectivity between Sub-Antarctic islands using Lagrangian modelling techniques. She completed a taught MSc in Hydrography, University of Plymouth (2021) in which her dissertation focused on sediment and current dynamics in estuarine regions to best monitor and salvage sunken wrecks using hydrographic survey techniques. These postgraduate studies have given Tahlia skills in remotely sensed and oceanographic data collection, data analysis, coding and research report writing and presenting. Tahlia has worked as an oceanographic technician serving onboard marine research vessels overseeing operation, maintenance and validation of oceanographic instruments. As part of her offshore work experience, she has had the opportunity to build skills in the fields of operational/physical oceanography and hydrography. Tahlia is currently an environmental consultant at Anchor Environmental Consultants. Her responsibilities include data collection (scientific diving), GIS mapping, data processing, report writing and assisting within the benthic monitoring team.

Michael Armitage holds MSc and BSc (Hons) degrees in Environmental and Geographical Science (EGS), as well as a BSc in EGS and Archaeology, all from the University of Cape Town. His expertise lies in integrated environmental and water resources management—with a focus on coastal, estuarine, and freshwater systems, as well as nature-based management solutions. He thrives on unpacking the complexities of dynamic systems to develop integrated, practical, and effective management solutions. Michael works as an Environmental Assessment Practitioner (EAP) and Environmental Management Specialist, undertaking Environmental Impact Assessments (EIAs) and preparing a range of environmental management plans. He also has experience in estuarine studies, sediment quality assessment, and GIS mapping. He is a registered Candidate EAP (EAPASA: 2024/7978) and a member of the International Association for Impact Assessment South Africa (IAIAsa: 7619).

SIGNATURES OF LEAD SPECIALIST

I, Amy Wright, declare that:

- I act as the independent specialist in this application;
- I 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;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I 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;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my 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 myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature

Date: June 2026

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GLOSSARY

Benthic: Pertaining to the environment inhabited by organisms living on or in the ocean/estuary bottom.

Biogeography: the patterns and processes that have influenced the distribution of species and ecosystems over space and time.

Bioregion: A region defined by characteristics of the natural environment rather than by man-made divisions.

Chart datum: Chart Datum is level on the shore corresponding with the Lowest Astronomical Tide (LAT) as from 1 January 2003.

Construction phase: The stage of project development comprising site preparation as well as all construction activities associated with the development.

Critical Biodiversity Area: An area in a natural condition that is required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure. The management objectives for these areas require that they are to remain in a natural or near-natural state, with no further loss of natural habitat.

Cumulative impacts: Direct and indirect impacts that act together with current or future potential impacts of other activities or proposed activities in the area/region that affect the same resources and/or receptors.

Desalination: The process of removing salts or other minerals and contaminants from seawater, brackish water, and wastewater effluent and it is an increasingly common solution to obtain fresh water for human consumption and for domestic/industrial utilization.

Diversity: The number of different species that are represented in a given community.

Ecological Support Area: An area that is not essential for meeting biodiversity targets but does play an important role in supporting the functioning of Protected Areas or CBAs and are often vital for delivering ecosystem services.

Ecologically or Biologically Significant Marine Areas (EBSAs): Defined by the Convention on Biological Diversity (CBD) as "geographically or oceanographically discrete areas that provide important services to one or more species/populations of an ecosystem or to the ecosystem as a whole, compared to other surrounding areas or areas of similar ecological characteristics, or otherwise meet the [EBSA] criteria".

Ecosystem Threat Status: Developed by SANBI (2018) is an indicator of how threatened ecosystems are, specifically the degree to which ecosystems are still intact or alternatively losing vital aspects of their structure, function, or composition (Harris *et al*. 2018).

Ecozone: The 2011 National Biodiversity Assessment used the terms 'ecoregions' and 'ecozones' to replace the similar, but revised 'bioregions' and 'biozones' used previously and to avoid confusion between the different map layers from previous assessments

Effects Range Low (ERL): The concentration at which toxicity may begin to affect sensitive species. Thresholds established by the United States National Oceanic and Atmospheric Administration (NOAA).

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: Delineated by a 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.''

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.

Intertidal zone: The section of the marine environment that lies exposed at low tide and submerged at high tide.

Invertebrate: Animals that do not have a backbone. Invertebrates either have an exoskeleton (e.g. crabs) or no skeleton at all (worms).

Macrobenthos/macrofauna: Those animals retained by a 1.0-mm-mesh sieve. Macrobenthic invertebrates are defined as organisms that live on or inside the deposit at the bottom of a water body.

Mixing zone: An administrative construct which defines a limited area or volume of the receiving water where the initial dilution of a discharge is allowed to occur, until the water quality standards are met. In practice, it may occur within the near field or far field of a hydrodynamic mixing process and therefore depends on source, ambient, and regulatory constraints.

Near-field: The region of a receiving water where the initial jet characteristic of momentum flux, buoyancy flux and outfall geometry influence the jet trajectory and mixing of an effluent discharge.

PSU: Ocean salinity is generally defined as the salt concentration in sea water. It is measured in unit of PSU (Practical Salinity Unit), which is a unit based on the properties of sea water conductivity. It is equivalent to per thousand or (o/00) or to g/kg.

Recommended Mixing Zone (RMZ): An administrative construct which defines a limited area or volume of the receiving water where the initial dilution of a discharge is allowed to occur, until the water quality standards are met. In practice, it may occur within the near field or far field of a hydrodynamic mixing process and therefore depends on source, ambient, and regulatory constraints. The following recommendations have been tabled for South Africa (Anchor Environmental Consultants 2015): 300 m in an offshore environment, 100 m in a nearshore open coast environment, 30 m in sheltered coastal environments and special management areas, 0 m for outfalls in estuaries.

Sediment: Mud, sand, silt, clay, shell debris, and other particles that settle on the bottom of rivers, lakes, estuaries, and oceans.

Turbidity: measure of the cloudiness or haziness of a liquid caused by the presence of suspended particles, which are typically invisible to the naked eye.

Water Quality Guidelines (WQGs): Target values for a range of contaminants that must be met in the receiving environment.

ABBREVIATIONS AND ACRONYMS

ADCP	Acoustic Doppler Current Profiler
Anchor	Anchor Environmental Consultants
CBA	Critical Biodiversity Area
CBD	Convention on Biological Diversity
CD	Chart Datum
CIP	Cleaning-in-place
CorMix	Cornell Mixing Zone software
CSIR	Council for Scientific and Industrial Research
CWDP	Coastal Waters Discharge Permit
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DO	Dissolved Oxygen
DWAF	Department of Water Affairs and Forestry
EA	Environmental Authorisation
EBSA	Ecologically or Biologically Significant Marine Area
EFZ	Estuarine Functional Zone
ERL	Effects Range Low
ESA	Ecological Support Area
ICMA	National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008)
MLD	Megalitre per day
MLRA	Marine Living Resources Act 18 of 1998 (as amended)
MPA	Marine Protected Area
MSP	Marine Spatial Planning
NBA	National Biodiversity Assessment
NEM:BA	National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
NEM:PAA	National Environmental Management: Protected Areas Act (Act No. 57 of 2003)
NEMA	National Environmental Management Act No. 107 of 1998 (as amended)
nMDS	Non-metric multidimensional scaling plot
NOAA	National Oceanic and Atmospheric Administration
NTU	Nephelometric Turbidity Unit
Ppt	Parts per thousand
PSD	Particle Size Distribution
PSU	Practical Salinity Unit
REC	Recommended Ecological Category
RMZ	Recommended Mixing Zone
RO	Reverse Osmosis
SANBI	South African National Biodiversity Institute
SCRL	South Coast Rock Lobster
TAC	Total Allowable Catch
TAE	Total Allowable Effort
TNPA	Transnet National Ports Authority
TOC	Total Organic Content
WQG	Water Quality Guidelines
ZID	Zone of Initial Dilution

1 INTRODUCTION

1.1 BACKGROUND

Transnet SOC Limited (through its division Transnet National Ports Authority (TNPA)) proposes to construct and operate a reverse osmosis (RO) desalination plant powered by a hybrid system of solar (sun) energy and backup municipal grid electricity, with the purpose of producing fresh potable water from saltwater abstracted from the estuarine/ marine environment. The plant will have a daily production capacity of 2 MLD and will be located within the Port of East London, in the Buffalo City Metropolitan Municipality, Eastern Cape Province (Figure 1.1). TNPA has appointed Sunwater East London Joint Venture (Pty) Ltd (Sunwater) to undertake the engineering feasibility, construction, and operation of the development. Anchor Environmental Consultants (Pty) Ltd (Anchor) was subcontracted to carry out the S&EIA process and other associated environmental permitting activities prior to construction and commissioning.

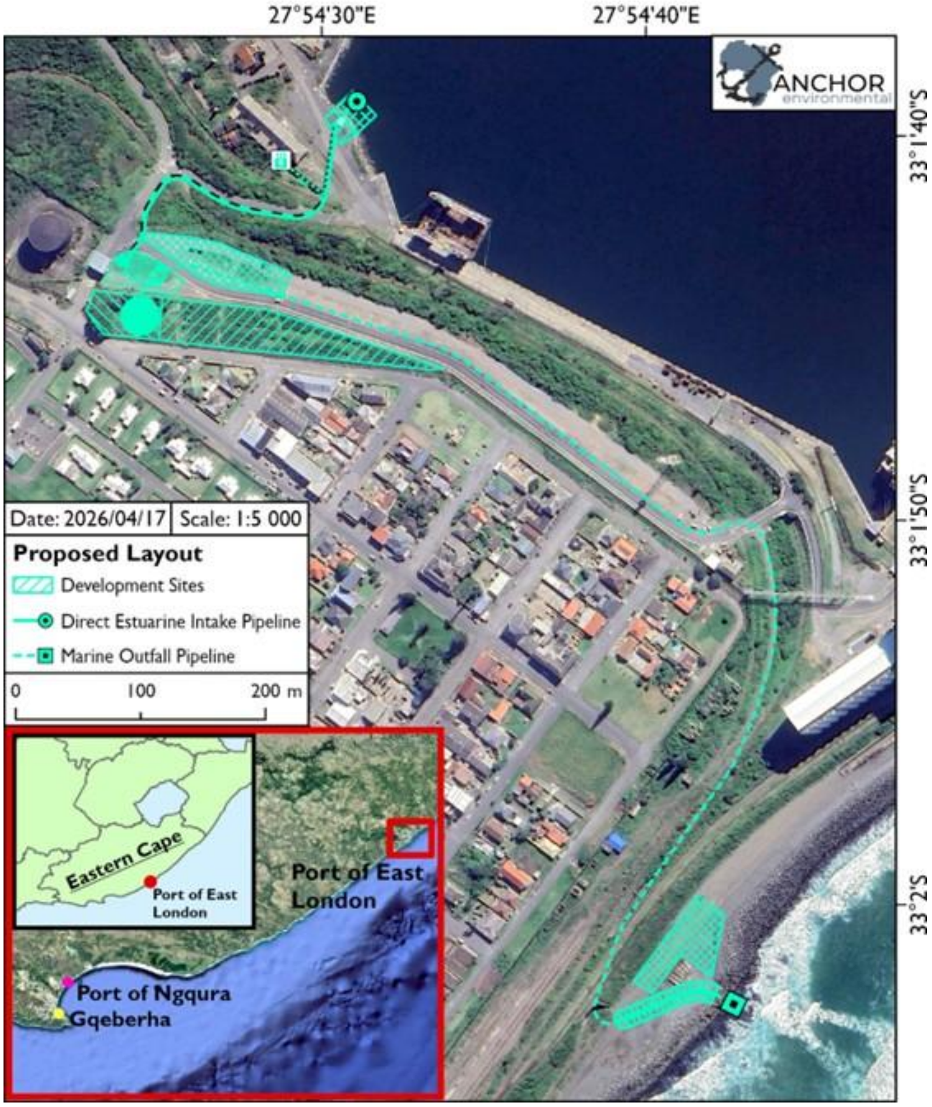

Figure 1.1. Location of the proposed development within the Port of East London, Eastern Cape Coastline, South Africa.

The installation and operation of such a plant requires an application for Environmental Authorisation in terms of the National Environmental Management Act (NEMA). The disposal of a land derived effluent (brine produced as a result of desalination) to the marine environment also requires a Coastal Waters Discharge Permit (CWDP) in terms of the NEMA: Integrated Coastal Management Act (2009). A CWDP application requires a Marine Specialist Impact Assessment to assess the likely impacts of effluent discharge on the marine environment. In addition, the CWDP application also requires that a numerical dispersion modelling study be undertaken to assess the dilution and dispersion of the effluent/brine to be discharged.

To this end, Anchor Environmental Consultants (Pty) Ltd (Anchor) was appointed by Sunwater to undertake a Marine and Estuarine Ecology Impact Assessment for the proposed RO plant development and operation. This study presents results of the dispersion modelling assessment of the proposed discharge (plume behaviour, dispersion potential etc.) as well as the marine and estuarine specialist impact assessment study for the proposed discharge and development, based on the results of this modelling. This study will support the Environmental Impact Assessment (EIA) process.

This specialist impact assessment takes into account published literature, field survey data and the details of the proposed project activities, provided by the client, to inform an impact assessment of anticipated impacts related to the project. A description of the affected environment, legislative context, and the spatial constraints relevant to this project are also provided.

1.2 PROJECT DETAILS

Approximately 5 500 m^3 (5.5 Megalitres (ML)) of saline water will be abstracted daily from the Buffalo River Estuary and desalinated at the RO plant to produce potable water (Figure 1.1, and Figure 1.2). This potable water will be used to support port operations and reduce dependence on municipal water supplies. The resulting brine effluent will be discharged via a pipeline to a marine outfall at the breakwater (the outer edge of the dolosse)(Figure 1.1). The outfall pipeline will have an outlet diameter of 150 mm. Discharge volumes will increase as freshwater production scales up:

- In the initial phase (±500 m^3/day freshwater production), brine discharge will be approximately 815 m^3/day.
- At full capacity (2 000 m^3/day freshwater production), brine discharge will increase to approximately 3 260 m^3/day.

The proposed development will span multiple erven, all owned by the applicant (Figure 1.3). The entire development is located within the urban edge, except for the section of the outfall pipeline that extends onto the dolosse (Figure 2). Note that the area is not situated within a delineated Coastal Public Property (CPP) as no CPP boundary exists within ports as confirmed by the Department of Forestry, Fisheries and the Environment (DFFE): Oceans and Coasts. A site camp will be constructed close to the marine outfall next to the port breakwater.

The intake pipeline from the estuary to the RO Plant will be approximately 290 m long (Figure 1.1), with a diameter of 315 mm. The intake point will be located approximately

13-18 m from the edge of the existing wharf. This distance is based on the requirement that the intake be positioned 0.5 m below the lowest water level (LAT), approximately roughly -2 m MSL, allowing for some tolerances. Survey data indicate that the -2 m MSL contour lies 13–18 m from the wharf edge at this site. The intake will be installed to avoid drawing water from the upper or lower 1 m of the water column and will draw in water horizontally. Intake velocities will be kept below 0.15 m/s, and a strainer barrier will be fitted onto the intake head to minimise debris entrainment and marine life impingement (to ensure that fish and other mobile organisms can escape the intake current), in line with international best practice and the marine specialist study recommendations (Fedorenko 1991). The intake pipeline will be attached to a floating pontoon extending ~19 m into the estuary from the existing concrete wharf (Figure 1.2).

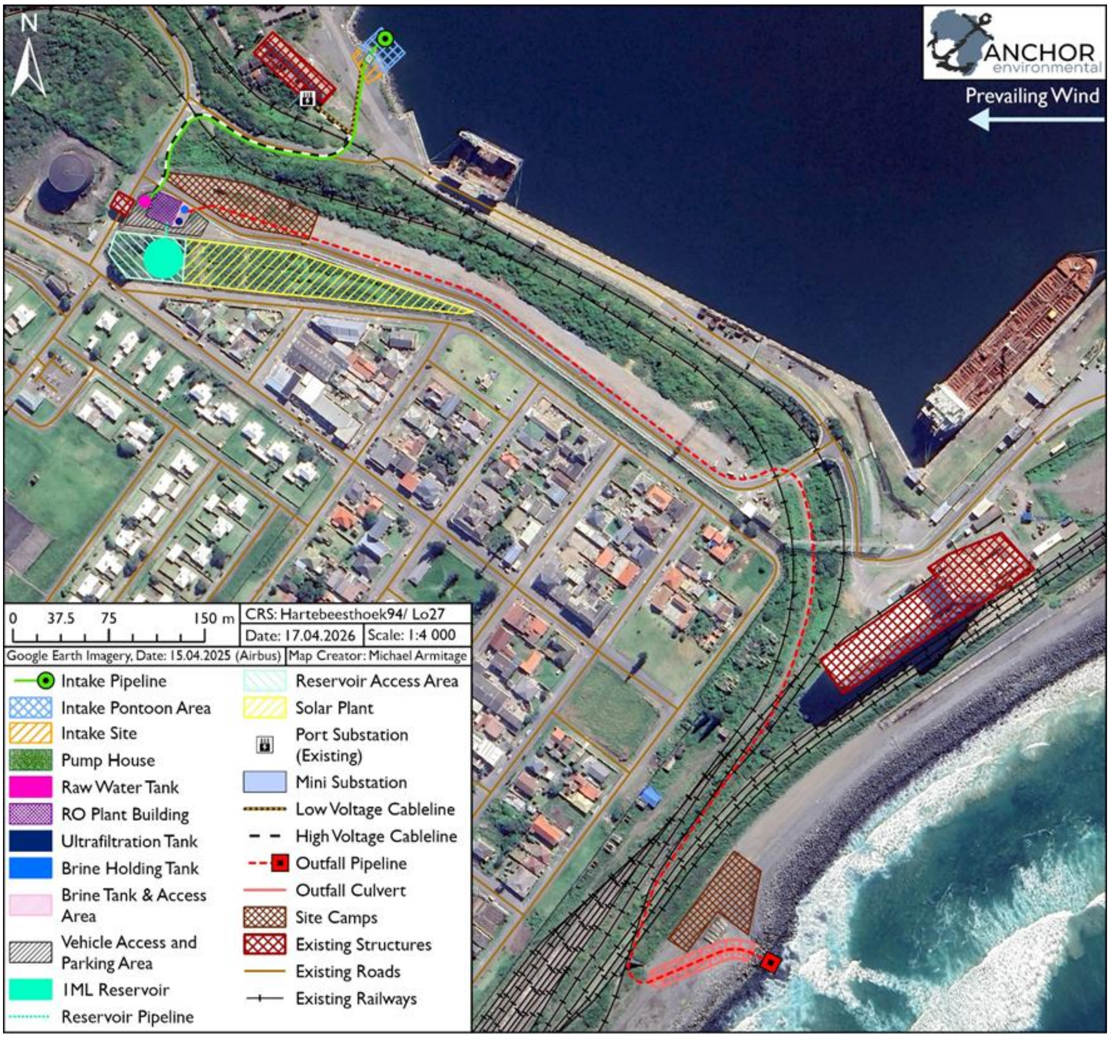

Figure 1.2. Preferred development layout for the Solar & RO Desalination Plant and Intake and Outfall Pipelines and associated Infrastructure/ Structures.

Figure 1.3. The development falls within Erven 63584, 38530 and 63586 on the South Bank of the Port of East London. Also shown is the Buffalo City Urban Development Edge.

1.3 Terms of Reference

The Terms of Reference for this study include the following:

- Near field dispersion modelling to assess rates of initial dilution of cooling water effluent in the receiving environment in relation to identified sensitive/significant features for a range of different discharge scenarios.
- An Estuarine and Marine Impact Assessment, informed by the outputs from the model and available information on the nature of the marine environment at the discharge site, which will include:
  - A description and assessment of all potential impacts associated with the intake of water from and discharge of brine to the marine environment adjacent to the Port of East London, and significance thereof on surrounding ecological resources/sites. Direct, indirect and cumulative impacts will be assessed.
  - Recommendations on the protection and management of any significant ecological sites that occur within the study site and for any ongoing monitoring that may be necessary for all phases of the project life cycle.
  - Identification of practicable mitigation measures to reduce negative impacts on ecological resources and indicate how such measures can be implemented for the various phases of the project life cycle.
  - Recommendations on minimum monitoring requirements based on the assessed impacts of the discharge on the marine environment.

1.4 Data sources

Project-specific information was gathered through consultation with Sunwater, project members from TNPA, as well as from other consultants who will be involved with various aspects of this project, from feasibility to operation.

An in-situ survey was conducted on 23–25 July 2024. This survey included:

- The deployment of an Acoustic Doppler Current Profiler (ADCP) to measure current speed and direction in the receiving environment. This instrument captured 37 days of data.
- The deployment of an Aqua Troll CTD to the harbour wall near the proposed desalination plant intake pipeline to collect data on salinity, temperature and water level. This instrument captured 100 days of data.
- The collection and assessment of:
    - Water quality, including temperature (°C), conductivity (mS/cm), salinity (PSU), dissolved oxygen (mg/L and % saturation), turbidity (NTU), fluorescence, pH, Total Suspended Solids, Chlorophyll-a;
    - Sediment, including trace heavy metal content, Total Organic Content (TOC), Particle Size Distribution (PSD) and the concentrations of trace metals; and,
    - Benthic macrofaunal communities.

The potential effects of the discharge of brine to the marine environment was assessed using a Cornell Mixing Zone expert system (CorMIX) modelling study. Model set up was informed by existing literature as well as in situ data collected during the field survey.

Considerable work has been undertaken in assessing and protecting South Africa's marine, coastal and estuarine systems. Marine Spatial Planning (MSP) is prioritized as an initiative to enhance South Africa's Economy and many of the reports and data produced to support MSP around South Africa's coast have contributed to this assessment. They include:

- The National Framework on Marine Spatial Planning in South Africa provides guidance on MSP on the national level. It specifies the objectives of MSP and outlines the process.
- The Marine Spatial Planning Act, 2018 (Act No. 16 of 2018) provides the legal basis for MSP in South Africa.
- The National Biodiversity Assessment (NBA) is the primary tool for monitoring and reporting on the state of biodiversity in South Africa. It is used to inform policies, strategies, and actions for managing and conserving biodiversity more effectively.
- SANBI's Biodiversity GIS (BGIS) online portal is an easy-to-use mapping platform that allows users to visualise and download important biodiversity features, reports, and spatial datasets.

- Marine Living Resources Act 18 of 1998 (as amended) (MLRA), the National Environmental Management: Protected Areas Act (Act No. 57 of 2003) (NEM:PAA), and the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEM:BA). All of these acts provide explicit protection for living and non-living resources below the high-water mark only (viz. the MLRA) or above the high-water mark only (the rest).
- National Environmental Management: Protected Areas Act 2003.

1.5 Assumptions and limitations

The study is based on details provided by the client as they pertain to planned infrastructures design, proposed activities and sites etc.

- The accuracy and confidence of this study is dependent on the data available for the estuarine and coastal environments of the area itself.
- The study is based on details provided by the client (construction and operations plans and designs).
- The assessment of the significance of impacts of the Project on the affected environment is based on the assumption that the activities are limited to those described in Section 1.2. If any substantial changes are made to the project description, impacts may need to be reassessed.

2 LEGISLATIVE CONTEXT

2.1 THE MARINE LIVING RESOURCES ACT 18 OF 1998

The objectives and principles of the Marine Living Resources Act (No. 18 of 1998) (as amended) deals with the management of marine living resources, the need to protect whole ecosystems, preserve marine biodiversity and minimize marine pollution, as well as to comply with international law and agreements.

2.2 NATIONAL ENVIRONMENTAL MANAGEMENT: INTEGRATED COASTAL MANAGEMENT ACT 24 OF 2008

2.2.1 COASTAL WATERS DISCHARGE PERMITS

The National Environmental Management: Integrated Coastal Management Act 24 of 2008 (ICMA) is the primary environmental legislation responsible for the integration and coordination of various coastal and marine management efforts. This integrated coastal management addresses the governance of human activities affecting the sustainable use of goods and services generated by coastal and marine ecosystems.

Chapter 8 of ICMA controls marine and coastal pollution. In terms of Section 69 of ICMA, no person is permitted to discharge effluent originating from a source on land into coastal waters except in terms of a General Discharge Authorisation or a Coastal Waters Discharge Permit (CWDP). New operators wishing to discharge effluent to coastal waters are required to apply for a CWDP before commencing and are also required to comply with the applicable WQGs. Applications for CWDP are expected to include data on contaminant levels in the effluent to be discharged, as well as results of dilution and dispersion model studies. These models are required to simulate the worst-case scenario and indicate maximum expected levels for the same contaminants at the edge of the Recommended Mixing Zone (RMZ). These levels are expected to comply with published guideline levels as defined by other existing, or potential, beneficial uses of the receiving environment.

When considering an application for a CWDP, the Minister must take into consideration the likely impact and cumulative effects of the discharge on the coastal environment. Any discharges of effluent must be compliant with waste standards or water management practices prescribed under ICMA and section 29 of the National Water Act of 1998 (as amended). Moreover section 58(1) of ICMA places the duty of care requirement, as prescribed in section 28 of the National Environmental Management Act (No. 107 of 1998) as amended, explicitly on any person who produced or discharged a substance which caused, is causing or is likely to cause, an adverse effect on the coastal environment.

In 2019, Coastal Waters Discharge Permit Regulations were published to provide an administrative framework to implement Section 69(3) of the ICMA and stipulate timeframes, renewal application processes, applicable fees and information to be submitted as part of an application for a CWDP.

2.2.2 Water Quality Guidelines

The 1995 Water Quality Guidelines for Coastal Marine Waters contain narrative statements and guideline values along with relevant background information (e.g. description, source, fate in the environment, occurrence in South African marine waters etc.) for 29 properties (temperature, salinity, dissolved oxygen, etc.) and constituents (nutrients, toxic substances, pathogens) (DWAF 1995) (Table 2.1). In 2018, the Department of Environmental Affairs (DEA) released updated Water Quality Guidelines for Coastal Marine Waters: Natural Environment and Mariculture (DEA 2018) (Table 2.1), which were again updated in following international review (DFFE 2022).

The 2018 and 2022 guidelines sought to improve South Africa's guidelines for physico-chemical properties with regards to (1) the level of protection awarded to the designated uses (previous WQG regulations lacked a definition for the term 'ambient conditions') and (2) the practicality for implementation. These regulations specifically adopt a site-specific, "reference system" approach, defining 'ambient condition' "*as the natural range of conditions at a particular site (seasonal and/or event driven)*" (DFFE 2022) (Table 2.1).

Table 2.1. Water quality guidelines for physico-chemical properties of seawater as contained in the 1995, 2018 and 2022 South African Water Quality Guidelines for Coastal Marine Waters (DWAF 1995, DEA 2018, DFFE 2022).

<table>
<tr><th>Parameter</th><th>WQGs (1995)</th><th>WQGs (2018)</th><th>WQGs (2022)</th></tr>
<tr><td>Temperature</td><td>The maximum acceptable variation in ambient temperature is + or - 1°C.</td><td colspan="2">Derived from a reference system (data set) for locality; range defined by the 20th and 80th percentiles of the seasonal and/or event-driven distributions for the receiving system. Test data: median value.</td></tr>
<tr><td>Salinity</td><td>The target range for the South African coastal zone is 33-36 ppt.</td><td colspan="2">Derived from a reference system (data set) for locality; range defined by the 20th and 80th percentiles of the seasonal and/or event-driven distributions for the receiving system, depending upon whether low salinity or high salinity effects are being considered. Test data: median concentration.</td></tr>
<tr><td>pH</td><td>The target range for the South African coastal zone is 7.3-8.2</td><td colspan="2">Derived from a reference system (data set) for locality; range defined by the 20th and 80th percentiles of the seasonal and/or event-driven distributions for the receiving system.
pH changes of more than 0.5 pH units from the seasonal maximum or minimum defined by the reference systems should be fully investigated. Test data: median concentration for the period.</td></tr>
<tr><td>Suspended solids</td><td>The concentration of suspended solids should not be increased by more than 10% of the ambient concentration.</td><td colspan="2">Derived from a reference system (data set) for locality; should not exceed the 80th percentile of the seasonal and/or event-driven distributions for the receiving system. Test data: median concentration.
Additionally, the natural euphotic depth (Z) should not be permitted to change by more than 10%.</td></tr>
<tr><td>Colour/Turbidity/Clarity</td><td>Turbidity and colour acting singly or in combination should not reduce the depth of the euphotic zone by more than 10 % of background levels</td><td colspan="2">Derived from a reference system (data set) for locality; should not exceed the 80th percentile of the seasonal and/or event-driven distributions for the receiving system. Test data: median concentration.
Additionally, the natural euphotic depth (Z) should not be permitted to change by more than 10%.</td></tr>
</table>

Parameter	WQGs (1995)	WQGs (2018)	WQGs (2022)
	measured at a comparable control site. The colour (substances in solution) of water should not exceed background levels by more than 35 Hazen units.		
Dissolved oxygen	For the south and east coasts, the dissolved oxygen should not fall below 5 mg/L (99% of the time) and below 6 mg/L (95% of the time). For the west coast, the dissolved oxygen should not fall below 10% of the established natural variation.	Derived from a reference system (data set) for discharge locality; and should not drop below the 20th%ile of the seasonal and/or event-driven distributions in question. Where possible, values should be obtained during low flow and high temperature periods when DO concentrations are likely to be lowest. Test data: Median DO concentration for the period, calculated using the lowest diurnal DO concentrations.	Derived from a reference system (data set) for discharge locality and time of day (separate diurnal and nocturnal oxygen ranges should be determined); should not drop below the 20th%ile of the seasonal and/or event-driven distributions in question. Where possible, values should be obtained during low flow and high temperature periods when DO concentrations are likely to be lowest. Test data: median concentration.
Dissolved nutrients (mg/L): Phosphates (PO4-P), Nitrogen (NO2-, NO3 and NH3)	Should not cause excessive algal growth and the loads should not exceed the levels which are introduced by natural processes such as upwelling.	Should not result in chlorophyll a, turbidity and/or dissolved oxygen levels that are outside the recommended WQG range. Alternatively, derived from a reference system (data set) for locality; should not exceed the 80th percentile of reference. Where insufficient/no reference data exists, single guideline values derived from available data based on professional judgement, as an interim measure.	
Ammonium (NH_3) and ammonia ($NH_3 + NH_4^+$)	0.02 mg N as NH_3 0.60 mg N as $NH_3 + NH_4^+$	Should not result in chlorophyll a, turbidity and/or dissolved oxygen levels that are outside the recommended WQG range. Alternatively, derived from a reference system (data set) for locality; should not exceed the 80th percentile of reference. Where insufficient/no reference data exists, single guideline values derived from available data based on professional judgement, as an interim measure.	
Toxic inorganics (µg/L)	As total recoverable x (µg/L) (Chronic): Arsenic (As) 12 Cadmium (Cd) 4 Chromium (Cr) 8 5 12	As total recoverable x (µg/L) (Chronic): Arsenic (As) 8 Cadmium (Cd) 0.12 Chromium (Cr) 2 Copper (Cu) 3 2	As total recoverable x (µg/L) (Chronic): Arsenic (As) 8 Cadmium (Cd) 0.12 Chromium (Cr) 2 (Cr^{6+}) 3 2

Parameter	WQGs (1995)		WQGs (2018)		WQGs (2022)	
	Copper (Cu) Lead (Pb) Mercury (Hg) Nickel (Ni) Zinc (Zn)	0.30 25 25	Lead (Pb) Mercury (Hg) Nickel (Ni) Zinc (Zn)	0.016 5 20	Copper (Cu) Lead (Pb) Mercury (Hg) Nickel (Ni) Zinc (Zn)	0.016 5 20
Toxic organics (µg/L)	As total recoverable x (µg/L) (Chronic):		As total recoverable x (µg/L) (Chronic):		As total recoverable x (µg/L) (Chronic):	
	Ammonia	600 µg/L as NH_3 + NH_4^+	Ammonia	600 µg/L as total ammonia nitrogen (Chronic)	Ammonia	600 µg/L as total ammonia nitrogen (Chronic)

2.3 SIZE OF THE RECOMMENDED MIXING ZONE

The radius of the RMZ was determined according to the "Assessment Framework for Effluent Discharged from Land Based Sources" (Anchor 2015). An RMZ of 30 m was used for a discharge in the surf zone.

3 AFFECTED ENVIRONMENT

3.1 OCEANOGRAPHY

Given that the physical oceanography of an area, particularly water temperature, nutrient and oxygen levels, are the principal driving forces that shape the marine communities, it is worth considering the broader oceanography of the region. The oceanography of East London is influenced by both the strong-flowing Agulhas current that moves down the east coast of South Africa as well as by localised oceanographic processes (Figure 3.1).

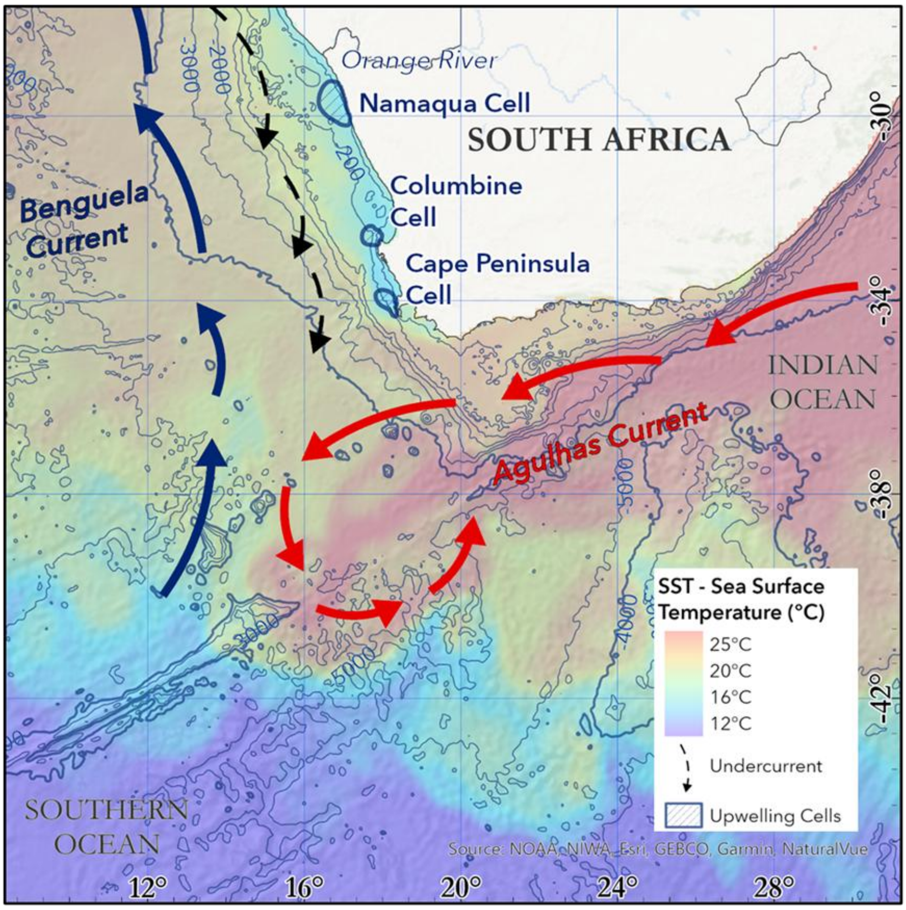

Figure 3.1. Major current streams around South Africa. The warm Agulhas Current flows down the east coast, and cold upwelling plumes can be observed along the west coast

It is the interaction of the warm Agulhas current with cooler temperate waters that is the principal reason for the diverse range of coastal and marine flora and fauna for which South Africa is famous. The water carried by the Agulhas current cools as it moves southwards and supports a changing array of species. Cool counter currents also flow inshore of the Agulhas current in an easterly direction, providing important opportunities for northward and eastward migration of certain species such as the sardine *Sardinops sagax*.

Water movement close to the East London coast is for the most part wind driven. Strong easterly winds, during spring and summer, blow parallel to the coast and cause localized upwelling events (Hanekom et al. 2009). Cooler, deep water rises up to replace the deflected surface water, and this water usually contains elevated nutrient concentrations (nitrates and phosphates). Phytoplankton bloom when the nutrients reach the surface waters where plenty of light is available for photosynthesis, and the phytoplankton is then preyed upon by zooplankton, which is in turn eaten by filter feeding fish such as anchovy or sardine which in turn are fed upon by large fish and piscivorous mammals and birds.

3.2 TIDES, WAVES AND CURRENTS

The South African coastline experiences semi-diurnal tides, with each successive high (and low) tide separated by 12 hours. Each high tide occurs approximately 25 minutes later every day, which is due to the 28-day rotational cycle of the moon around the earth. Spring tides occur once a fortnight during full and new moons. Tidal activity greatly influences the biological cycles (feeding, breeding and movement) of intertidal marine organisms, and influences when people visit the coastline to partake in various activities (e.g. relax, bathe, harvest marine resources).

The tides in the East London area exhibit slight diurnal inequality (Schumann et al. 1996, CSIR 2022). Tides range from 1.82 m Chart Datum (CD) at mean spring high tide and 0.23 m CD at mean spring low tide, and the highest Astronomical Tide of 2.08 m CD (CSIR 2022). There is a strong tidal influence on current velocity in the adjacent Buffalo River Estuary (mean velocity of 5 cm/s, with a range of 1-19 cm/s), and a lag time in tides between the estuary and the ocean (CSIR 2022).

Another factor that greatly influences marine ecology and human activities along the coastline is wave energy. Wave size is determined by wind strength and fetch (or distance over which it blows) and determines the degree to which breaking waves at the shore will shift sand and erode rock. Long south-westerly fetch zones associated with low pressure systems in the south Atlantic and Indian Oceans typically result in consistently large ground swells along the Eastern Cape Coast during the winter months. Conversely, during the summer months high pressure systems result in predominant easterly wind swells, whilst cyclone activity in the Mozambique Channel occasionally result in very large easterly swells hitting the Eastern Cape coast. The Eastern Cape coast is generally described as a high wave energy coastline and the absence of protected bays along the study area results in consistently high wave energy along the shore.

Surf zones typically exhibit onshore wave driven water movement over shallow sand banks or reefs, longshore drift in the direction of the prevailing wind and strong rip currents running perpendicular to the shoreline that dissipate behind the wave back line (Branch & Branch 1981). These near shore currents are highly dynamic and may shift in a matter of hours with changes in wind, wave and tidal conditions often associated with large scale movement of sediments within the surf zone that may periodically smother or expose low profile reefs.

3.3 BIOGEOGRAPHY

Most studies recognised three South African coastal regions; a cool temperate west coast, a warm temperate south coast and a subtropical east coast region (Bustamante & Branch 1996, Branch et al. 2017). East London falls within the warm temperate Agulhas

Ecoregion (and specifically, the Agulhas inshore ecoregion), which is characterised by high levels of endemism (species with distributions restricted to the bioregion), and is a breeding area for many species (Figure 3.2) (Sink et al. 2012). The more recent NBA that was released in 2019 does not reclassify these biogeographic regions. Communities within this marine habitat are largely ubiquitous throughout the southern African South Coast region, being particular only to substrate type or depth zone.

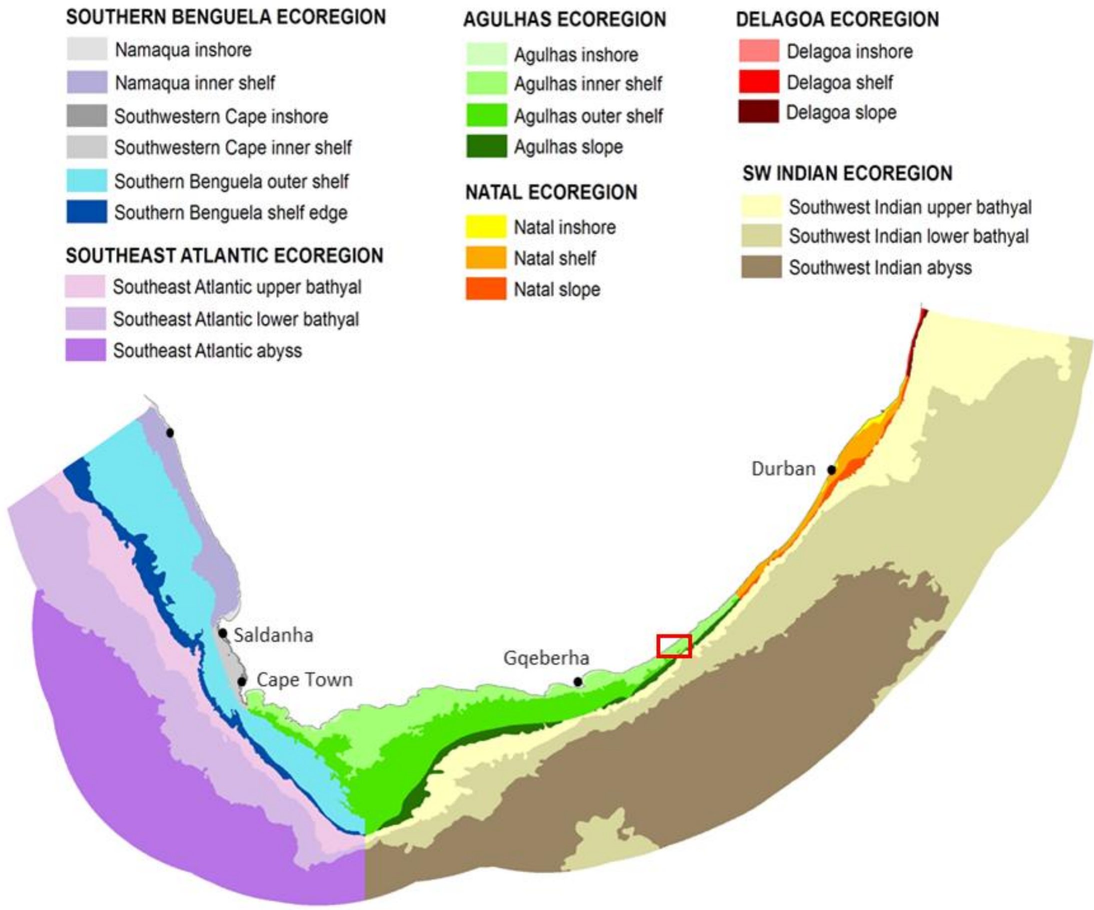

Figure 3.2. Inshore and offshore Ecoregions in South Africa (Whitehead et al. 2019). The area of interest falls within the red polygon.

3.4 Ecology and Habitats

3.4.1 Overview

The shoreline in the vicinity of the East London project is classified by the 2018 NBA as Agulhas Exposed Rocky Shore, while the habitat further offshore is Agulhas Inner Shelf Mosaic (Figure 3.3) (Sink et al. 2019b, Whitehead et al. 2019). The threat status of these ecosystem types is discussed in Section 4.2. Agulhas Exposed Rocky Shore is defined as a "*rocky shore type in the Agulhas ecoregion exposed to moderate wave intensit*y", while Agulhas Inner Shelf Mosaic is a mixed sandy-bottom and rocky subtidal habitat that characterises the 'inner shelf' (to 40 m depth) in the Agulhas ecoregion (Sink et al. 2019b).

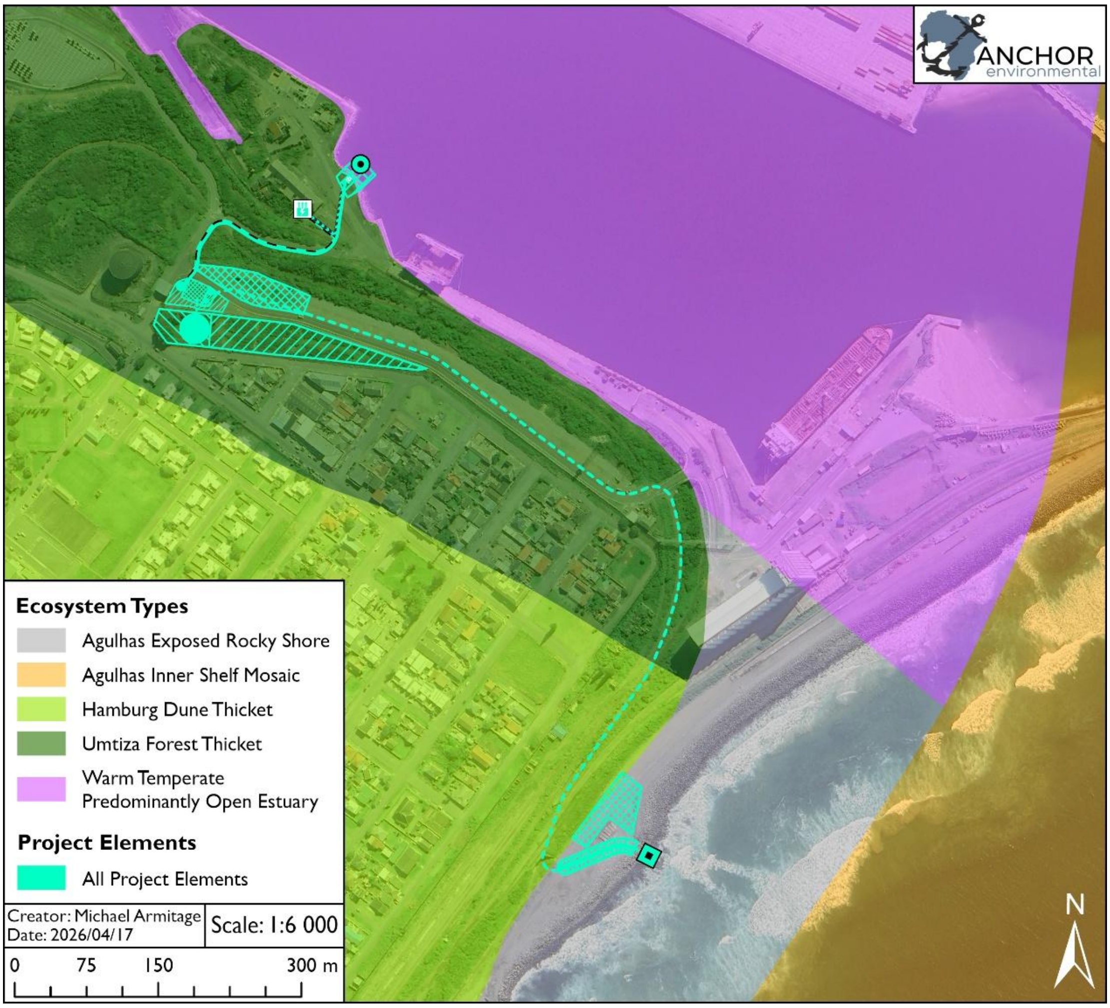

Figure 3.3. Ecosystem Types in the vicinity of the proposed development, as per the 2018 National Biodiversity Assessment (Van Niekerk et al. 2019b, Sink et al. 2019b).

3.4.2 Rocky shores

Like much of the Eastern Cape, the East London coastal region consists predominately of sandy beaches, with rocky shore and wave cut platforms making up much of the remaining habitat (Lubke 1998). Along much of the shore, between the high-water mark and the inland vegetated coastal dunes, wide dune fields comprising parabolic dunes occur (Lubke 1998). The direction of sand movement within these dunes reverses frequently as the predominant easterly or westerly winds blow parallel to the coast. The littoral active zone includes these dune fields, the intertidal and sub-tidal areas, with extensive sand movement taking place between these habitats. The rocky shore comprises mostly outcrops, boulders or low rocky platforms of aeoleonite dunerock (sandstone) exposed at low tide that are eroded by the sea, forming sand filled gullies and rock pools (Marker 1988, Rust 1998, Bornman & Klages 2004).

While the coastal habitat in the vicinity of the proposed marine outfalls fort the East London desalination project is defined in the 2018 NBA as Agulhas Exposed Rocky Shore (Figure 3.3), the area lies to the south of the Port, and comprises mostly artificial dolosse habitat (Figure 3.4). Dolosse are concrete blocks of complex geometric shape weighing up to 20 tonnes and used together to protect harbour walls from the erosive force of ocean waves (indeed, they were invented to protect the Port of East London in 1963, see (Zwamborn 1989)).

Figure 3.4. The beach to the south of the Port of East London entrance is comprised almost entirely of artificial dolosse habitat.

While environmental conditions prevented an assessment of the communities inhabiting these dolosse, previous work has shown that dolosse can create a highly heterogeneous habitat (e.g., (Wright et al. 2018)). Environmental heterogeneity is an important factor in determining community structure, and there is the widespread evidence showing a positive relationship between richness and environmental heterogeneity (Yang et al. 2015) i.e., the more complex a habitat, the more diverse the community. It is likely therefore that these dolosse provide a heterogenous intertidal rocky shore habitat, and it is likely that the associated communities are very similar to those present in similar habitats along the Eastern Cape coastline.

Therefore, a description of common species inhabiting the different rocky shore zones based largely on generic Eastern Cape rocky shore descriptions follows below (from (Branch & Branch 1981), (Beckley 1988) and (Wooldridge & Coetzee 1998)). Also provided are details on ecological interactions between macro algae and grazers (Whittington-Jones 1997, Díaz et al. 2011), spatial heterogeneity of biota within mussel beds (Erlandsson et al. 2011), competitive interaction between indigenous and alien mussel species (Rius & McQuaid 2006) and human exploitation of intertidal resources (Rius et al. 2006, Proudfoot et al. 2006).

Zonation patterns on rocky shores results from the variation in environmental variables across the shore (e.g. the amount of time each zone is exposed to the air), which in turn influences the organisms which inhabit each section of the shore (Branch & Branch 1981, Beckley 1988). Species that are more tolerant to desiccation (drying out) are found near the high-water mark, while those that cannot stand long periods of water recession are found near the low-water mark. Five distinct zones are typically found on rocky shores South Africa's coast, most of which are present on the Eastern Cape Coastline. These zones (moving in a landward direction) are named the Infratidal zone, the Cochlear zone, the Lower Balanoid zone, the Upper Balanoid zone and the Littorina zone (Figure 3.5).

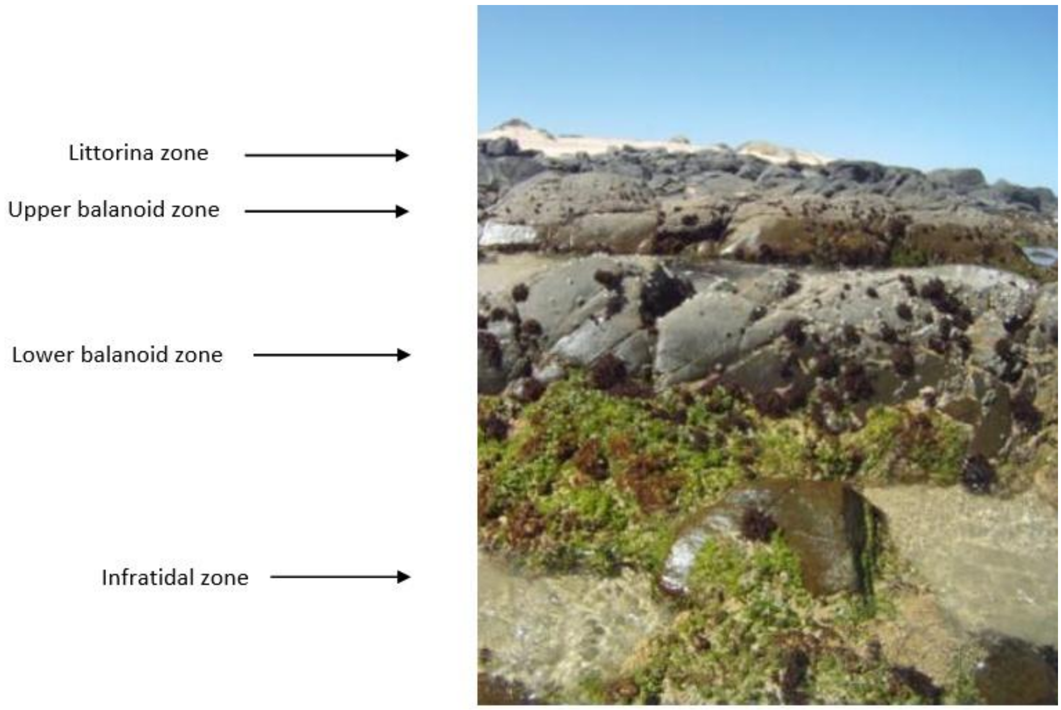

Figure 3.5. Typical pattern of zonation evident on rocky shores in the Eastern Cape.

The Infratidal zone is inhabited by species that cannot withstand long periods of exposure and include algal beds, red bait (*Pyura*), corals, coralline algae and sea urchins (*Parechinus*). The upper and lower Balanoid zones are named due to the abundance of barnacles *Cthamalus dentatus*, *Tertaclita serrata* and *Octomeris angulosa*. Dominant seaweed species in the Infratidal and Lower Balanoid include foliose alage (*Ulva* spp, *Chaetomorpha* spp and *Enteromorpha* spp.); red turfs (*Ceramium* spp., *Aristothammion* spp. and *Centroceras* spp.), corticated algae *Gelidium pristoides* and *Hypnea spicifera*; encrusting coralline (*Leptophytum* spp and *Spongites* yendoi) erect articulated coralline

(*Corralina* spp, *Cheilosporum* spp, *Arthrocardia* spp) and encrusting corraline (*Ralfsia verruscosa*). Although a few *Scutellastra cochlear* are found on the low shore, it does not typically form the dense monospecific bands that it does on rocky shores further west along the South African coast, and may be absent entirely (Clark & Hutchings 2019). Other grazers found on the low shore (infratidal and lower balanoid) include several other *Scutellastra* species (*S. tabularis*, *S. barbara*, and *S. longicosta*); the sea urchin *Parechinus angulosus* and the cushion star *Patriella exigua*.

Filter feeding mussels *Perna perna* and *Mytilis* spp., predatory welks *Burnupena* species and sessile carnivorous anemones *Pseudoactina flagellifera*, *Actina mandelae*, *Aullactinia reynaudi* and *Anthopleura michaelseni* also occur from the Balanoid zone seawards. The midshore (upper balanoid) is dominated by animals, in particular limpets (*Cymbula oculus, Siphonaria capensis*, *S. serrata*, *S. concinna*), the winkles *Oxystele tigrina* and *O. tabularis*, and barnacles. Little seaweed occurs within this zone; however, some sea lettuce *Ulva*, red algae *G. pristoides* and encrusting non-corraline algae, *Hildenbrandia rubra* may be present. The harshest of all is the Littorina zone, which is dominated by the snails *Afrolittorina africana* and A. *knysnaensis*. The shore crab *Cyclograpsus punctatus* and the flat-bladed algae *Porphyra* also occur in this zone (Branch & Branch 1981). Starfish *Marthasterias africana*, octopus *Octopus vulgaris*, and various species of fish, including clinids, gobies, juvenile sparids and mullet utilize the intertidal rock pools and prey on invertebrates found on the rocky shore.

Figure 3.6. Numerous fish including gobies, juvenile mullet and sparids utilize intertidal rock pool habitats along the Eastern Cape Coast (Clark & Hutchings 2019).

3.4.3 HARD SUBTIDAL HABITATS

Subtidal habitats are likely to comprise of a mixture of patchy reef and sand, very similar to the intertidal, with exposed rock becoming less common with distance offshore. There appears to be no published surveys of the near-shore sub tidal, mixed rock and sand habitats at the discharge sites. These sites were surveyed opportunistically by divers during deployment of instrumentation (see Section 5.3.1). The subtidal habitat comprises high profile reef, interspersed with pebbles and larger boulders, and some hard consolidated sandy patches (Henry, T. p*ers. obs*.). Unfortunately, the highly turbulent conditions and very low visibility did not allow for a quantitative assessment of the biota inhabiting the subtidal patchy reefs and sand gullies. However, what could be seen appeared dominated by algae, similar to those found in the infratidal region.

The shallow subtidal rocky shore is likely to host a range of seaweed species, including the commercially important *Gelidium* (Weerts & Taljaard 2019). Sessile filter feeders include brown mussel *Perna perna*, rock oysters *Striostrea margaritacea, Saccostrea cucullata*, ascidians including red bait *Pyura stolonifera* and organisms such as octopus, abalone *Haliotis midae* and other haliotid species, and spiny rock lobster *Panulirus homarus* (Weerts & Taljaard 2019).

Subtidal reefs support a wide variety of longer-lived large finfish species. Indeed, the mixed sand and rock surf zone habitat is an important feeding area for many fish species — surf zone habitats are, in fact, widely recognised as important nursery areas for fish, and is even thought to rival that of estuaries in some areas (Lenanton et al. 1982, Bennett 1989, Potter et al. 1990, Clark et al. 1996). Fish species occurring within the mixed rock and sand surf zone in the Eastern Cape include several species of mullet and klipfish, black tail, silver and black sea catfish, banded galjoen, poenskop, evil eye puffer fish, bronze bream, stone bream, bellman, wildeperd, musselcracker, dusky kob, elf, leervis, white stumpnose, spotted grunter, Cape stumpnose, Natal stumpnose, Cape knifejaw, sand steenbras, moonys, streepies, steentjies, Sand soldiers, cat sharks, dogfish, spotted gully sharks, smooth hound sharks and sand sharks (Smale & Buxton 1998, Branch et al. 2017).

Furthermore, rocky reef community structure is known to influence macrobenthic distribution and abundance in the adjacent soft bottom habitats, as many of the reef associated fish and crustaceans not only forage directly on the reef, but also on the adjacent sandy bottom areas (Barros et al. 2001).

3.4.4 Soft subtidal habitats

Soft subtidal habitats comprise unconsolidated sediments (e.g. gravel, sand, mud) that are shaped by hydrodynamic activities, and play a role in structuring benthic macrofauna communities (Pan & Pratolongo 2022). These communities consist largely of invertebrates residing within (infauna) or upon (epifauna) the sediment (Snelgrove 1999), with species composition and distribution controlled by a combination of factors including sediment granulometry, dissolved oxygen, organic matter content, trophic interactions, disturbance and anthropogenic pollution (Pan & Pratolongo 2022).

There are no published surveys detailing this habitat type at the potential sites where brine will be discharged from the desalination plant into the marine environment adjacent to the Port of East London. Therefore, a survey of the sediment quality, and benthic macrofauna community at this location was undertaken on 23–24 July 2024 to assess the potential operational phase and effluent discharge impacts. This baseline data will also be used to inform future monitoring of the brine discharge.

Sediment and macrofauna samples were collected from 14 sites, comprising 11 sites (A–K) around the proposed outfall, and three control sites further north (L–N) (Figure 3.7). Sediment was collected using a stainless steel Van Veen grab, which sampled an area of 0.055 m^2 and depth of 30 cm, deployed from a small vessel. Subsequently, subsamples were collected for PSD (particle size distribution), TOC (total organic content) and trace metal analyses. Trace metal concentrations were compared against the Effects Range Low (ERL) thresholds established by the United States National Oceanic and Atmospheric Administration (NOAA). The ERL represents the concentration at which toxicity may begin to affect sensitive species (Buchman 2008). The remaining sediment was washed through a 1 mm mesh bag, with all retained benthic macrofauna preserved in 10% formalin. In the laboratory, specimens were identified to the lowest taxonomic level possible, with the abundance and blotted wet biomass of each taxon recorded and standardized to individuals per square meter (ind./m^2) and grams per square meter (g/m^2). Square root transformed macrofauna data were converted into a similarity matrix using the Bray-Curtis similarity coefficient and analysed using PRIMER v6.1.11 (Clarke & Gorley 2006). Finally, the spatial variability in macrofaunal community structure (based on abundance data) was visually assessed using a non-metric multidimensional scaling (nMDS) plot to detect any natural groupings amongst sites and determine control site efficacy. Findings from this baseline survey are detailed and discussed below.

Figure 3.7. Sediment and macrofauna sites sampled during the environmental baseline survey conducted from 23–24 July 2024 in East London.

SEDIMENT QUALITY

Marine sediments undergo complex interactions driven by weathering, biological, and marine processes, alongside hydrodynamic and geomorphological forces. These interactions result in spatial and temporal variations in sediment composition and distribution, with significant ecological and physico-chemical implications. In areas of low hydrodynamic disturbance, fine sediments tend to accumulate, while high-energy regions with prevalent currents, tides, and waves typically retain coarse sediments. Understanding these sedimentary characteristics offers valuable insights into the diversity and distribution patterns of benthic macrofaunal communities, as well as the potential for accumulation of trace metals and other pollutants.

Sediment samples collected from the 14 sites were predominantly composed of sand, with very little mud (<3%) (Figure 3.8), and consequently had very little organic matter (Figure 3.9). In addition, no trace metals exceeded the ERL thresholds (Table 3.1). This correspondence between TOC, mud content, and trace metal contamination is expected given that organic matter and contaminants like metals and organic toxic pollutants are mainly found in depositional zones and are therefore linked with fine sediment particles, such as mud and silt. This association arises because both organic matter and fine-grained particles tend to gather in depositional areas, and fine sediments offer a larger surface area for the absorption and binding of pollutants. Consequently, a higher presence of mud, compared to sand or gravel, can result in elevated organic loading and trace metal contamination levels (Horowitz & Elrick 1987, Martinčić et al. 1990). As such, the sand-dominated samples with low organic content, and no elevated trace metal contamination, indicate a high-energy region characterised by large waves and strong currents. Indeed, highly turbulent conditions were experienced by Anchor scientific divers when deploying water quality instrumentation during the same time period (see Section 5.3.1).

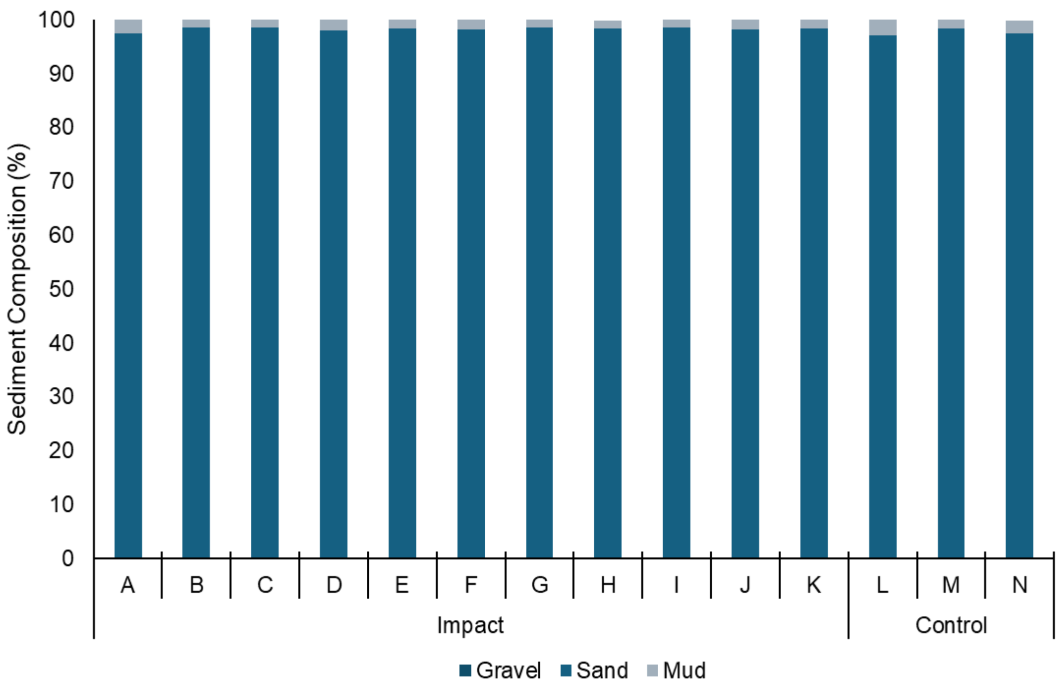

Figure 3.8. Percentage composition of gravel, sand and mud in sediment samples collected during the environmental baseline survey conducted from 23–24 July 2024 in East London.

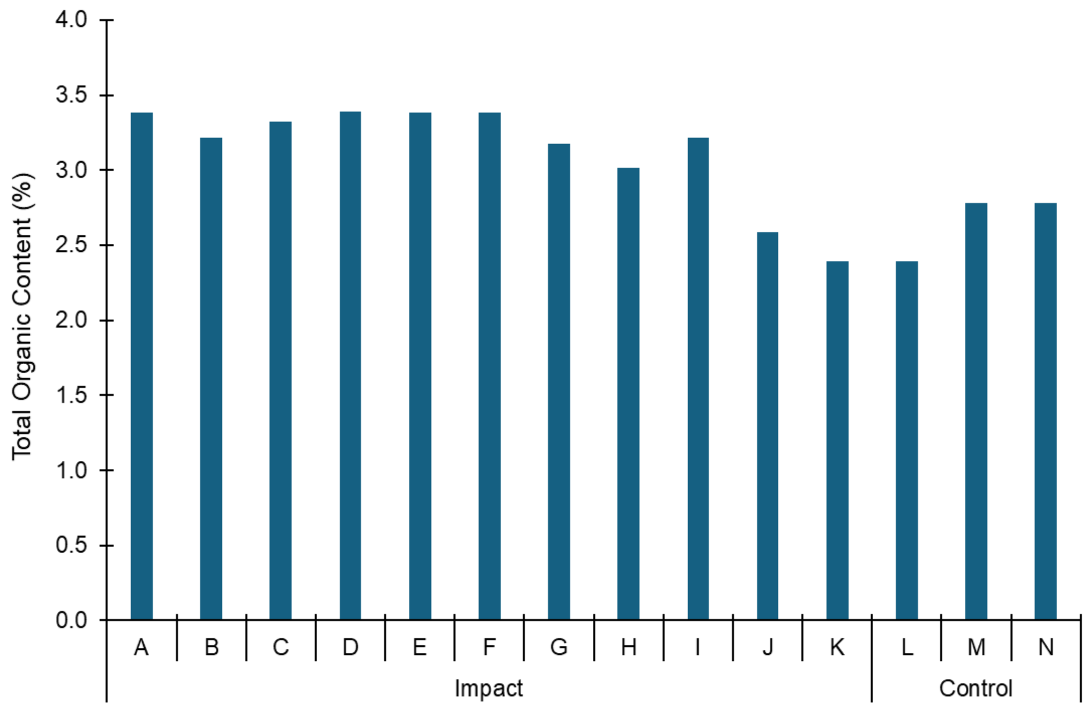

Figure 3.9. Total Organic Content (TOC) in sediment samples collected during the environmental baseline survey conducted from 23–24 July 2024 in East London.

Table 3.1. Trace metal concentrations in sediment samples collected during the environmental baseline survey conducted from 23–24 July 2024 in East London, alongside the NOAA Effects Range Low (ERL) threshold for each metal (Buchman 2008). No value exceeded the ERL limit.

Metal	Units	Mean	Standard Deviation	ERL
Impact sites (A–K)				
Aluminium (Al)	%	0.3	0.0	
Iron (Fe)	%	0.3	0.0	
Arsenic (As)	ppm	4.5	0.2	8.2
Barium (Ba)	ppm	12.9	1.2	
Beryllium (Be)	ppm	<1.0	N/A	
Cadmium (Cd)	ppm	<1.0	N/A	1.2
Chromium (Cr)	ppm	9.0	0.6	81
Cobalt (Co)	ppm	1.6	0.1	
Copper (Cu)	ppm	<1.0	N/A	34
Lead (Pb)	ppm	2.3	1.0	46.7
Manganese (Mn)	ppm	59.0	4.9	
Nickel (Ni)	ppm	2.0	0.2	20.9
Vanadium (V)	ppm	6.3	0.4	
Zinc (Zn)	ppm	7.4	0.6	150
Control sites (L–N)				
Aluminium (Al)	%	0.2	0.0	
Iron (Fe)	%	0.3	0.0	
Arsenic (As)	ppm	4.0	0.4	8.2
Barium (Ba)	ppm	10.1	0.9	

Metal	Units	Mean	Standard Deviation	ERL
Beryllium (Be)	ppm	<1.0	N/A	
Cadmium (Cd)	ppm	<1.0	N/A	1.2
Chromium (Cr)	ppm	8.4	0.3	81
Cobalt (Co)	ppm	1.4	0.1	
Copper (Cu)	ppm	<1.0	N/A	34
Lead (Pb)	ppm	2.8	N/A	46.7
Manganese (Mn)	ppm	56.0	1.4	
Nickel (Ni)	ppm	1.8	0.3	20.9
Vanadium (V)	ppm	6.4	0.5	
Zinc (Zn)	ppm	7.1	0.5	150

BENTHIC MACROFAUNA

Benthic macrofauna function as highly responsive indicators of environmental health due to their intimate association with sedimentary habitats. They dwell within or upon the sediment, directly exposing them to variations in sediment quality, including changes in composition, texture, and organic matter content (Sinu 2022). They also have the capacity to accumulate pollutants from the sediment via ingestion or absorption, thereby facilitating bioaccumulation and biomagnification within the food chain (Jędruch et al. 2019). Consequently, alterations in the abundance, diversity, or community structure of benthic macrofauna can serve as reliable indicators of shifts in sediment quality, pollution levels, or habitat conditions arising from anthropogenic impacts (Warwick 1988, Nehring 2000, Mosbahi et al. 2019, Sinu 2022).

A total of 23 macrofauna taxa were identified in sediment samples collected during the environmental baseline survey (Figure 3.10, Table 3.2). These taxa were ascribed to five phyla, three classes, 9 orders, 17 families, 14 genera and 11 species. Two taxa, *Ogyrides saldanhae* and *Gastrosaccus* spp., are considered pelagic and were removed from subsequent analyses.

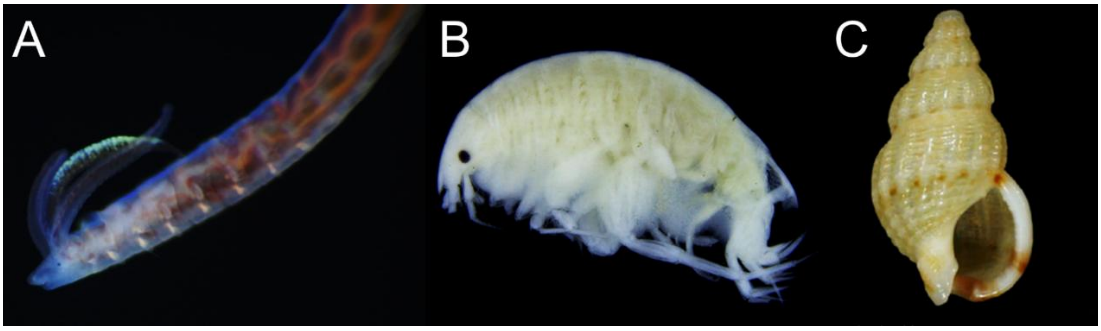

Figure 3.10. Selection of species identified from sediment samples collected during the East London environmental baseline survey (July 2024). (A) polychaete *Pygospio elegans*, (B) amphipod *Paraphoxus oculatus*, (C) gastropod *Nassarius kochianus*. (Photo credits: A: Chris Isaacs, B: AHS Tandberg, C: Joop Trausel & Frans Slieker).

Table 3.2. Taxa identified from sediment samples collected during the environmental baseline survey (July 2024). Pelagic taxa are denoted with an asterisk.

Phylum	Class	Order	Family	Genus	Taxon
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera*	*Glycera papillosa*
		Spionida	Spionidae	*Pygospio*	*Pygospio elegans*
					Spionidae sp.
		Terebellida	Cirratulidae		Cirratulidae sp.
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca*	*Ampelisca spinimana*
			Eusiridae		Eusiridae spp.
			Lysianassidae	*Socarnes*	*Socarnes septimus*
			Oedicerotidae	*Perioculodes*	*Perioculodes longimanus*
			Phoxocephalidae	*Heterophoxus*	*Heterophoxus opus*
				Paraphoxus	*Paraphoxus oculatus*
				Pseudharpinia	*Pseudharpinia excavata*
					Phoxocephalidae sp.
			Synopiidae	*Glandulotiron*	*Glandulotiron australis*
		Cumacea	Bodotriidae		Bodotriidae sp.
		Decapoda	Ogyrididae	*Ogyrides*	*Ogyrides saldanhae**
		Isopoda	Holidoteidae	*Austroarcturus*	*Austroarcturus* spp.
			Sphaeromatidae	*Exosphaeroma*	*Exosphaeroma* sp.
		Mysida	Mysidae	*Gastrosaccus*	*Gastrosaccus* spp.*
Mollusca	Gastropoda	Neogastropoda	Buccinidae		Buccinidae sp.
			Mitridae		Mitridae sp.
			Nassariidae	*Nassarius*	*Nassarius kochianus*
Nemertea					Nemertea sp.
Sipunculida					Sipuncula sp.

The benthic macrofaunal community was dominated by the phyla Arthropoda (12 taxa), Annelida (4) and Mollusca (3). The community is depauperate (i.e. has few taxa) and is characterised by low abundance and biomass values (Table 3.3). This is likely due to the high-energy region dominated by sand with low organic content. Therefore, there will likely be little to no impact of the potential operational phase and brine discharge on the soft subtidal habitat.

Although the control sites had slightly higher abundance and biomass values compared to potential future impact sites, the communities were not significantly different

(PRIMER, ANOSIM, R = -0.035, p = 0.629) (Figure 3.11). Consequently, the control sites are sufficient to inform future monitoring of the brine discharge. Future monitoring should include the annual collection of sediment and macrofauna samples from the same sites, and at the same time of year, as the baseline survey to eliminate confounding variables.

Table 3.3. Benthic macrofauna community descriptor comparison across sediment sites sampled during the environmental baseline survey (July 2024). All values are per m^2.

Site	Total Taxa	Total Individuals	Total Biomass
Impact sites (A–K)			
A	2	36	0.44
B	3	109	1.42
C	1	36	0.16
D	1	18	0.18
E	5	145	1.42
F	1	18	0.35
G	1	18	0.18
H	2	55	0.69
I	3	55	0.56
J	1	18	0.34
K	0	0	0.00
Average	**2**	**46**	**0.52**
Control sites (L–N)			
L	6	255	2.14
M	2	36	0.65
N	1	18	0.24
Average	**3**	**103**	**1.01**

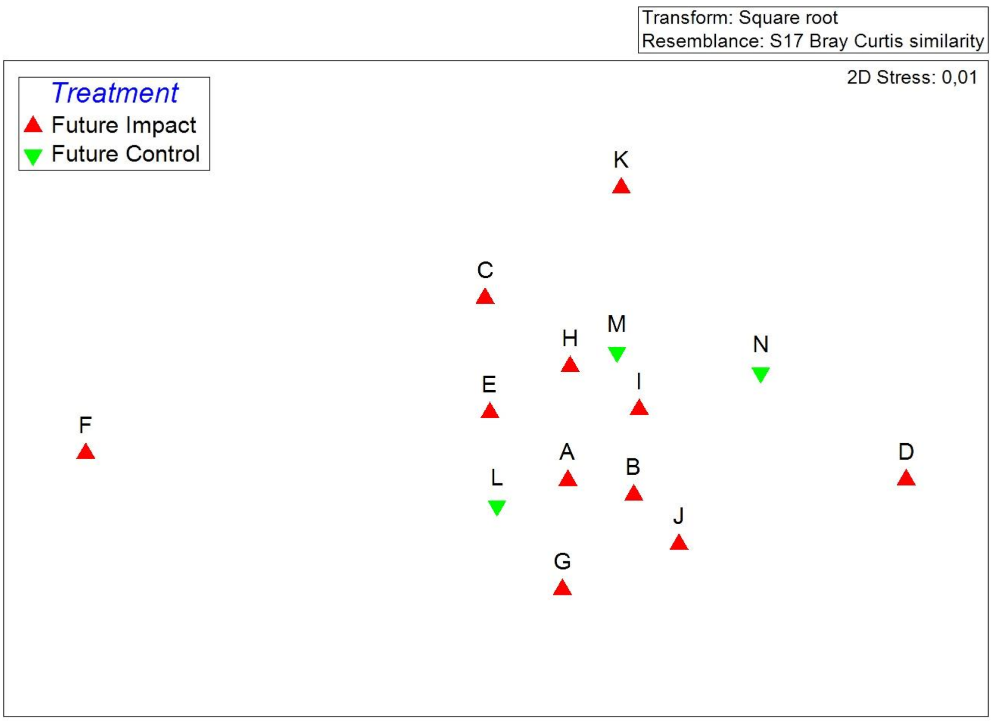

Figure 3.11. Non-metric multidimensional scaling (nMDS) plot of benthic macrofauna abundance data (number of individuals per m^2) from sediment samples collected during the environmental baseline survey (July 2024).

3.4.5 Species of Conservation Concern

The DFFE Environmental Screening Tool (DFFE 2024) found one Species of Conservation Concern (SCC) that may occur within the project area: the rocky kurper fish *Sandelia bainsii*, which is listed as Endangered on the IUCN Red List (IUCN 2025). However, this species only occurs in freshwater habitats (Mayekiso 1986, Skelton 2001), and as such is highly unlikely to be present in the estuarine or marine habitats within which the project area falls.

3.4.6 Pelagic Habitat

Based on historic sightings or strandings records, as well as habitat projections of known species parameters, an estimated 21 species of cetaceans (whales and dolphins) are thought to occur (or are likely to occur) inshore of the shelf edge off the South Coast (Findlay et al. 1992, Best 2007, Weir 2011) (Table 3.4). Dolphins have been reported near the estuary mouth (CSIR 2022), and one resident species of coastal pinniped is present in the area, namely the Cape fur seal *Arctocephalus pusillus pusillus* (David 1989).

The draft Buffalo River Estuarine Management Plan (2016) notes that the "transformed nature of the estuary mouth provides a sheltered habitat for mammals such as the resident bottle nosed dolphins (*Tursiops* sp.) and humpback dolphins (*Sousa* sp.)".

Table 3.4. Cetacean occurrence off in the nearshore off the South Coast of South Africa, their seasonality, and IUCN Red List conservation status (IUCN 2023), *(Penry et al. 2016), **(Barendse & Carvalho 2016).

Common name	Species name	Distribution	Seasonality (presence in the area)	Global IUCN (2023) Conservation Status
Delphinids (Odontocetes)				
Dusky dolphin	*Lagenorhynchus obscurus*	Inshore	Year round	Least Concern
Heaviside's dolphin	*Cephalorhynchus heavisidii*	Inshore	Year round	Near Threatened
Common bottlenose dolphin	*Tursiops truncatus*	Inshore	Year round	Least Concern
Common dolphin	*Delphinus delphis*	Inshore	Year round	Least Concern
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	Inshore	Year round	Near Threatened
Southern right whale dolphin	*Lissodelphis peronii*	Inshore	Year round	Least Concern
Indian Ocean humpback dolphin	*Sousa plumbea*	Inshore	Year round	Endangered
Short-finned pilot whale	*Globicephala macrorhynchus*	Data deficient		Least Concern
Rough-toothed dolphin	*Steno bredanensis*	Data deficient		Least Concern
Killer whale	*Orcinus orca*	Occasional	Year round	Data deficient
False killer whale	*Pseudorca crassidens*	Occasional	Year round	Near Threatened
Pygmy killer whale	*Feresa attenuata*	Data deficient		Least Concern
Baleen whales (Mysticetes)				

Common name	Species name	Distribution	Seasonality (presence in the area)	Global IUCN (2023) Conservation Status
Antarctic minke whale	*Balaenoptera bonaerensis*	Inshore	>Winter	Near Threatened
Common minke whale	*Balaenoptera acutorostrata*	Inshore	Year round	Least Concern
Fin whale	*Balaenoptera physalus*	Inshore	MJJ & ON	Vulnerable
Sei whale	*Balaenoptera borealis*	Inshore	MJ & ASO	Endangered
Bryde's whale (inshore subspp.)	*Balaenoptera brydei* (previously *B. edeni*)	Inshore	Year round	Vulnerable*
Pygmy right whale	*Caperea marginata*	Data deficient	Year round	Least Concern
Humpback sp.	*Megaptera novaeangliae*	Inshore	Year round, SONDJF	Least Concern
Humpback B2 population	*Megaptera novaeangliae*	Inshore	Summer peak ONDJF	Vulnerable**
Southern right whale	*Eubalaena australis*	Inshore	Year round, SONDJF	Least Concern

3.4.7 Estuaries

OVERVIEW

An "estuary" or "estuarine system" is defined in terms of the ICM Act as "a body of surface water that (a) 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.'' In South Africa, a revised classification system has recently been introduced which categorises coastal outlets into nine different estuary types and three micro-system types. Based on this classification system, South Africa has 290 functional estuaries and 202 micro-systems (Van Niekerk et al. 2019c). The NBA defines the Estuarine Functional Zone (EFZ) as "the area that not only encapsulates the estuary waterbody, but also the supporting physical and biological processes and habitats necessary for estuarine function and health. It includes all dynamic areas influenced by long-term estuarine sedimentary processes, i.e., sediment stored or eroded during floods, changes in channel configuration, aeolian transport processes, and changes due to coastal storms. It also encompasses all the multiple ecotones of floodplain and estuarine vegetation that contribute detritus (food source) and provide refuge from strong currents during high flow events". In other words, the EFZ defines the 'space' within which estuaries function over longer time scales, because 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 (Van Niekerk & Turpie 2012, Van Niekerk et al. 2013, 2019c).

Estuaries are extremely productive ecosystems due to the combination of high nutrient river water with a shallow, sheltered habitat (Robins et al. 2006). They are also valued for their importance as nursery grounds for juvenile marine fish and invertebrates, which recruit to these protected and nutrient rich areas during their developmental stages (Beck et al. 2001). Despite their importance, estuaries are impacted by poor catchment management upstream including erosion, pollution and water abstraction. This, along with the development of harbours, has resulted in the majority of these estuarine ecosystems becoming severely degraded, leading to concern about the biota within the systems and the loss of ecosystem services estuaries provide. The local geomorphology, mean annual runoff (MAR) from the catchment, sediment movement, marine and estuarine water currents and wave action all play a role in determining the shape and nature of an estuary.

The Buffalo River Estuary is defined as a Warm Temperate, Predominantly Open system (see Section 4.1 for Estuarine Heath assessment) with a catchment of 1 281 km^2 (EOH Coastal and Environmental Services 2016, CSIR 2022). The EFZ of the Buffalo River estuary extends some 7.5 km from the mouth and encompasses the Port of East London, which falls within the lower 2 km of the system (CSIR 2022) (Figure 3.12). As such, (CSIR 2022) describes how the mouth is dredged regularly for maintenance, keeping the mouth open permanently. There are "no estuarine banks *per se* in the lower part of the estuary as the margins are given over to port infrastructure" (CSIR 2022). There are also no intertidal sand and mudflats and associated salt marshes in the lower system, because of the typography as well as the Port development (CSIR 2022).

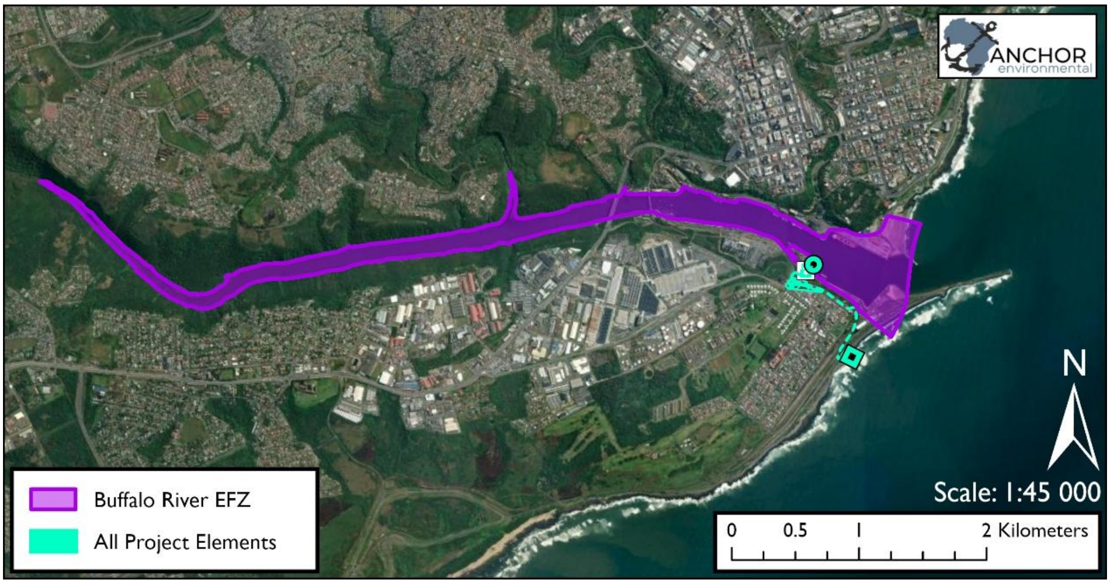

Figure 3.12. The Buffalo River Estuarine Functional Zone (EFZ) in the context of the proposed development.

WATER QUALITY

The hydrodynamic function and characteristics of an estuary is affected by several key drivers. As estuaries form the interface between the marine and freshwater environment, oceanic factors can play a significant role in the hydrodynamic and biogeochemical characteristics of a system. These oceanic influences include sea level variations from tides and weather effects (i.e., storm surges), as well as water quality parameters such as salinity (the most important in this case), temperature, dissolved oxygen and nutrient concentrations. In a similar fashion, the quantity and quality of freshwater entering the system (and changes thereof) is critical in shaping form and function. Channel morphology and sediment structure (which is often determined by freshwater inflow) as well as external influences on the system such as wind, rain, air temperature, insolation and evaporation, also affect the manner in which the water circulates and mixes within the estuarine system.

Water quality as well as sediment quality in the estuary has been studied extensively through the CSIR's Long-Term Ecological Monitoring Programme for the Port of East London (CSIR 2014, 2016, 2018, 2020, 2023c a). Results are shown in Figure 3.13 and Figure 3.14, and are summarised below.

Temperature is linked to season, with generally higher surface water temperatures during summer, especially at the sites further up the estuary (Figure 3.13). There is a stronger thermocline (difference between surface and bottom water temperatures) in summer, while the water column is more uniform in winter (Figure 3.13).

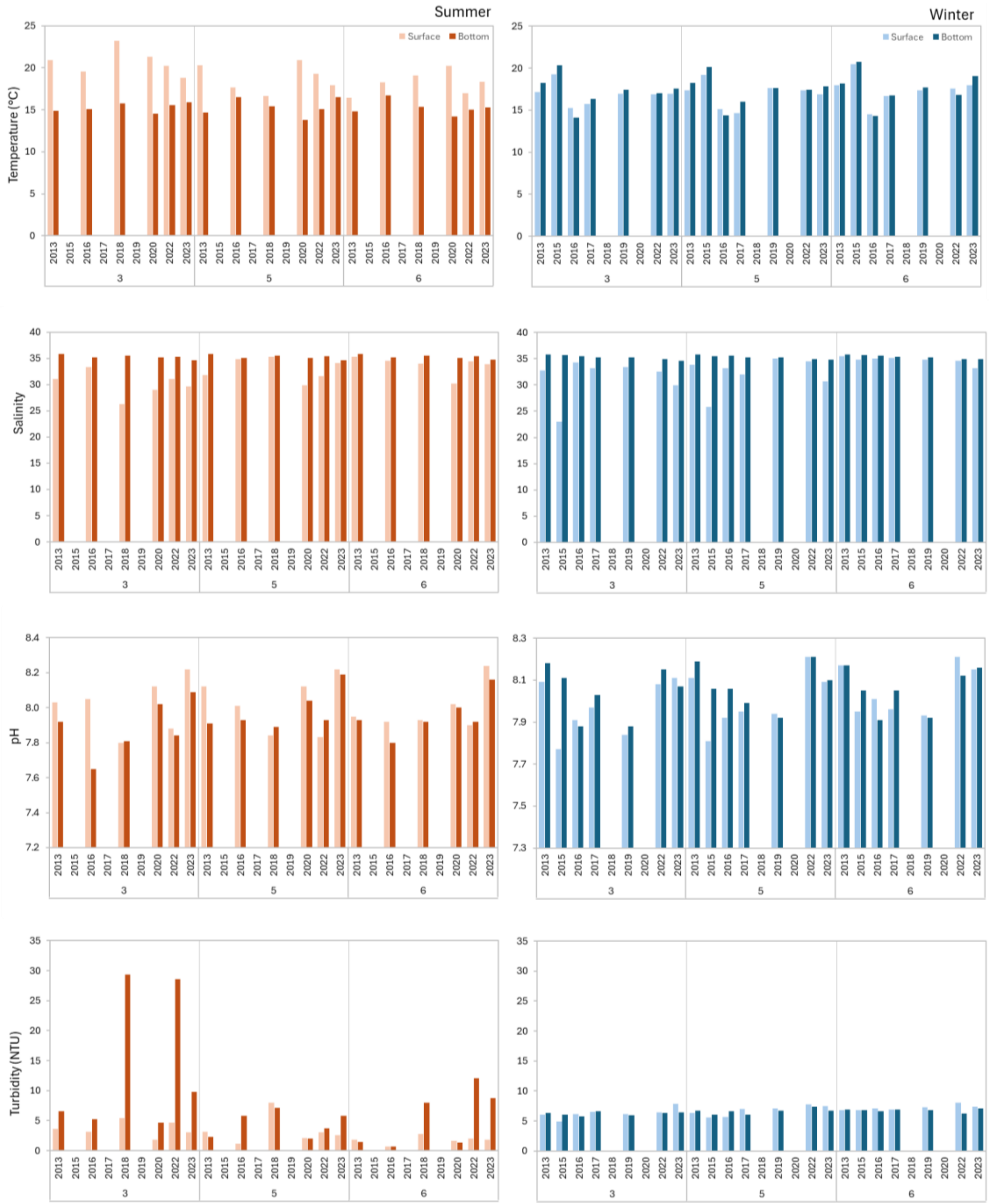

Figure 3.13. Physico-chemical parameters for summer and winter surveys at the surface and bottom of the water column at three stations: in the middle of the estuary (3), at the mouth (5) and just out to sea beyond the breakwater (6). Data from (CSIR 2014, 2016, 2018, 2020, 2023c a).

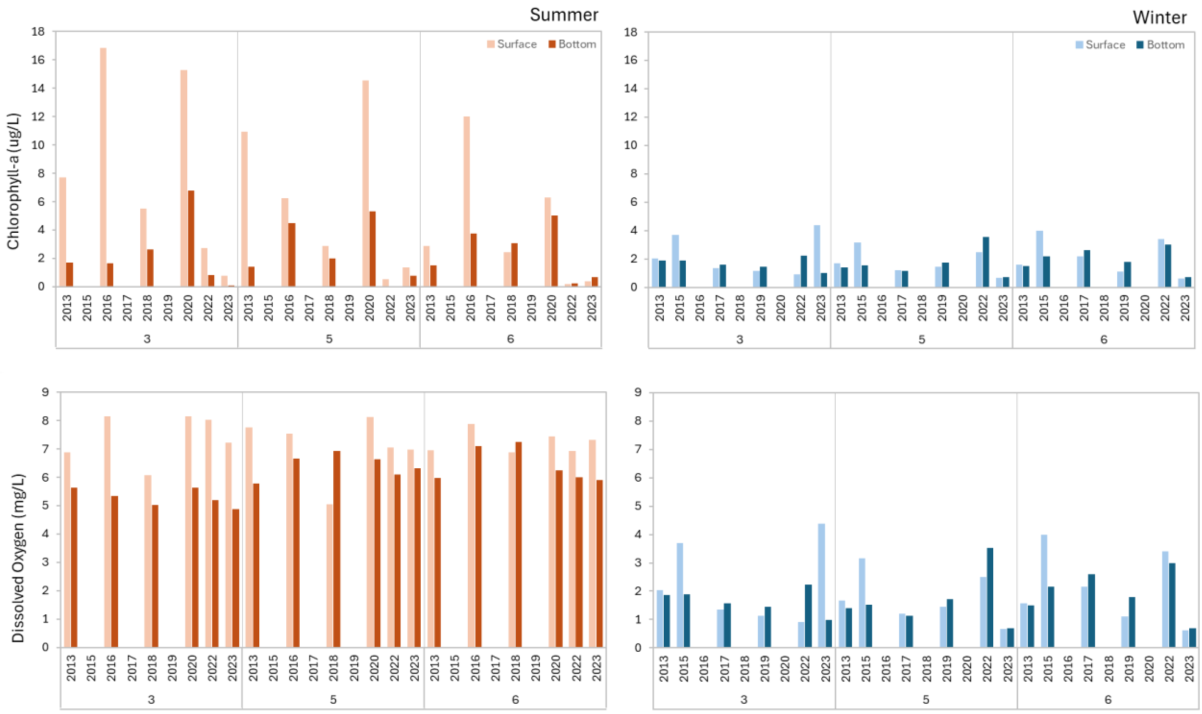

Figure 3.13 (cont.). Physico-chemical parameters for summer and winter surveys at the surface and bottom of the water column at three stations: in the middle of the estuary (3), at the mouth (5) and just out to sea beyond the breakwater (6). Data from (CSIR 2014, 2016, 2018, 2020, 2023c a).

The estuary is characterised by strong **salinity** gradients with depth and distance from the mouth, with more buoyant, less-saline freshwater from river flow at the surface and denser saline oceanic water entrained at the bottom (Figure 3.13, (CSIR 2022)). Mixing is dependent on tidal state, with fresh water penetrating further toward the estuary mouth at spring low tide or during high rainfall events (CSIR 2022). There is little difference in surface vs bottom salinities between summer and winter salinities (Figure 3.13). The lower water column is characteristically marine (salinity of ~35) across seasons, as a result of the permanently open mouth.

While the **pH** often showed similar gradients to salinity (Figure 3.13), other factors, such as the photosynthetic activity of microalgae in summer, can impact the pH gradients present between the river and sea (CSIR 2022).

Sufficient **dissolved oxygen (DO)** in sea water is essential for the survival of nearly all marine organisms. Fish and other mobile marine organisms tend to avoid DO concentrations below 5 mg/L. With the exception of a few species that are highly tolerant of hypoxia, physiological stress and mortalities begin at oxygen levels below 3-4 mg/L and nearly all marine species die if subjected to DO concentrations of less than 1.5 mg/L for extended periods (USEPA 2003). Long terms monitoring indicates that the DO concentrations in estuarine waters tend to be higher in summer than winter, and higher in surface waters compared to bottom waters (see Figure 3.13). Results indicate that the estuary and surrounding water are “sufficient to sustain healthy populations of aquatic life” (CSIR 2022). Indeed, in summer, the average DO for samples collected in the middle of the estuary (Site 3) from 2013-2023 was 7.41 mg/L in surface waters and 5.28 mg./L in bottom waters (Figure 3.13). In general, there is an increase in average DO in the lower water column at sites closer to the mouth (mean of 6.40 mg/L at the mouth (i.e., Site 5) in summer) (Figure 3.13). This is particularly noticeable in winter — the average DO in at the surface increased from 6.3 mg/L in the estuary to 7.2 mg/L outside the Port (Site 6), while lower water column DO increased from 6.2 mg/L to 6.8 mg/L (Figure 3.13). However, CSIR (2022) do note that DO concentrations can become low within the Port area due to highly anoxic sediments (see details below), and that organic rich runoff from upriver (from fertiliser, such as ammonia) may also result in elevated oxygen demands and cause local oxygen depletion.

Seasonal changes in freshwater flow typically result in changes in **turbidity** (i.e. the clarity of the water). Seawater tends to be comparatively clear relative to freshwater, which often contains high loads of particulate matter accumulated on the way to and down the main channel. Floods in particular carry a lot of silt from the catchment, increasing turbidity significantly, and generally occur during the high rainfall summer season. Indeed, higher turbidities were generally noted in the estuary compared to the surrounding marine systems, with peak elevations in in the bottom waters, which may reflect resuspension of sediments (Figure 3.13) (CSIR 2022).

Likewise, the **Total Suspended Solids** (TSS) concentrations peaked at 12.8 mg/L at Site 3 in summer of 2013, although 12 mg/L was also noted at the mouth in winter 2015 (Figure 3.14). Overall, there was a mean TSS concentration of 8.3 mg/L in summer (± 4.1 stdev) and 7.4 mg/L in winter (± 3.8 stdev) (Figure 3.14). These values are likely to increase substantially under high flow events (i.e., floods) (CSIR 2022).

The microbiological indicators monitored have shown high to very high levels of faecal contamination in the system over the monitoring period (Figure 3.14) (note that while *E. coli* and Faecal coliforms have been monitored at some points, the Faecal streptococci are the indicator monitored most frequently in the dataset available). These high levels have been linked by CSIR (2022) to sewage contaminated water inflow from the catchment of the Buffalo River.

In a similar manner, long term monitoring has noted frequent elevated nutrient concentrations (e.g. dissolved inorganic nitrogen, orthophosphate) in the estuary, which again has been linked to upstream runoff, such as nutrient discharges from some wastewater treatment works in the catchment (Figure 3.14, see CSIR 2022). These elevated nutrient levels are considered part of the driving factor behind occasional high to very high microalgal biomass in the water column in summer (as deduced from chlorophyll-a concentrations, as per CSIR (2022) (Figure 3.13 and Figure 3.14).

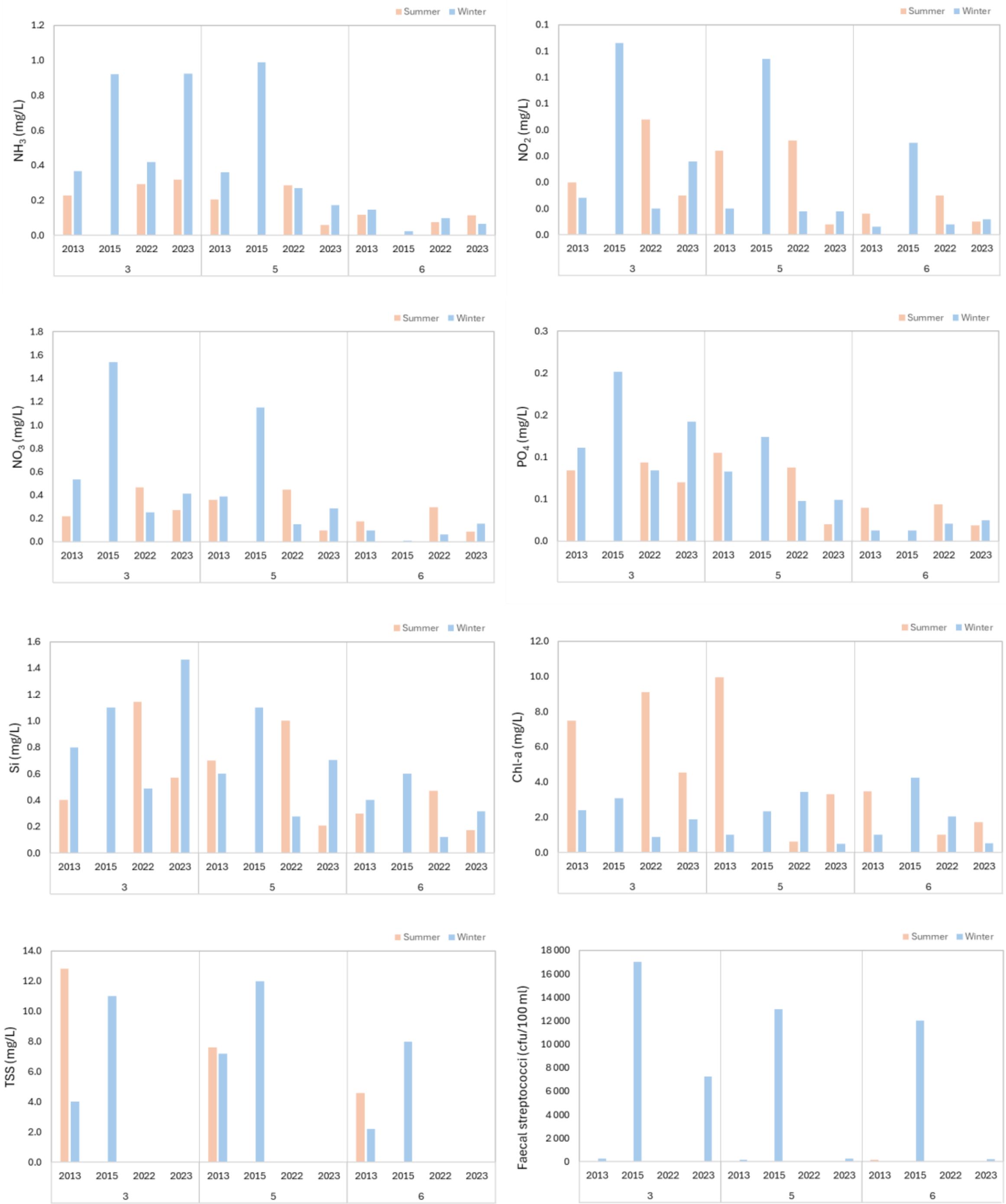

Figure 3.14. Nutrient and chlorophyll-a concentrations and faecal indicator bacteria colony forming unit counts in surface water at three stations: in the middle of the estuary (3), at the mouth (5) and just out to sea beyond the breakwater (6). Data from (CSIR 2014, 2016, 2018, 2020, 2023c a).

In general, summer surface water quality as of 2023 (the latest survey data available) was considered to be poor for stations sampled in the upper reaches of the estuary, and fair to good in the lower reaches and at the mouth (Figure 3.15). For the winter 2023 survey, surface water quality was considered to be fair for stations sampled in the upper reaches of the estuary, poor at stations adjacent to the Port, and fair to good in the lower reaches and at the mouth (Figure 3.15). The 'poor' water quality rating was specifically due to high microbiological and nutrient concentrations across a number of sites in both summer and winter (Figure 3.16).

Specific polycyclic aromatic hydrocarbon (PAH) risk surveys of the estuary have indicated that levels are high enough to pose some elevation in lifetime cancer risk to recreational users (Adeniji et al. 2017). The source of these PAHs have been identified as of pyrogenic in origin — industrial effluent discharges (both treated and untreated), leachate from landfills, stormwater runoff from the highways and Port activities, incomplete combustion of organic materials and release of noncombusted, petrogenic emissions (Adeniji et al. 2017).

Figure 3.15. Water quality indices for surface water in Buffalo River estuary for (left) the summer survey on 30 January 2023 and (right) the winter survey on 13 July 2023 (CSIR 2023b).

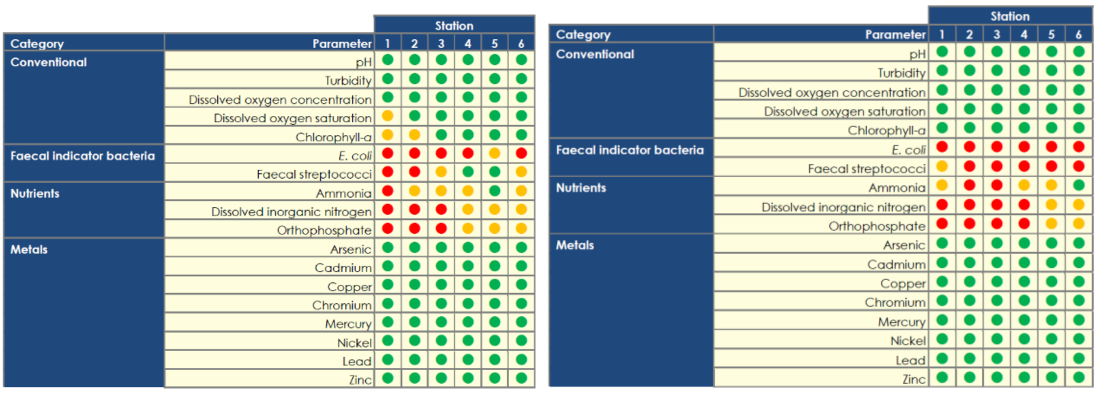

Figure 3.16. Water quality indices report card for surface water in Buffalo River estuary for (left) the summer survey on 30 January 2023 and (right) the winter survey on 13 July 2023 (CSIR 2023b).

An Aqua Troll CTD was moored to the harbour wall near the proposed desalination plant intake pipeline to collect long-term baseline temperature and salinity data at the intake site. The instrument was secured to a mooring line attached to a quay berthing tyre and anchored with a weight (e.g., a 0.5 railway track) to ensure vertical stability in the water column. The CTD was positioned at a depth of -5 m and recorded data from 23 July 2024 to 31 October 2024 (Figure 3.17).

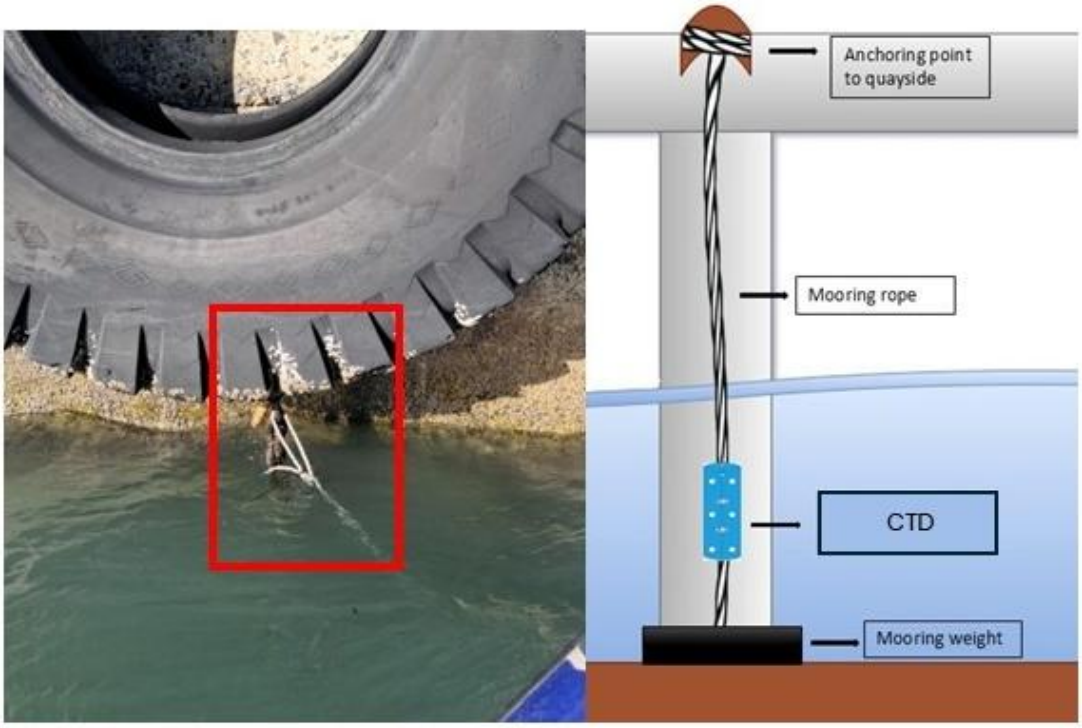

Figure 3.17. Schematic of the AquaTroll CTD deployed in the East London harbour, moored to an anchor chain (red box) and with the instrument seated below the surface at ~1.5 m above the seafloor.

The average water temperature recorded within the port ranged between 15.8-21°C, which aligns with expected seasonal variations for this region (Figure 3.18). This temperature range reflects the interaction between the Buffalo River's freshwater discharge and the coastal waters beyond the harbour wall. Corresponding salinity data exhibited an average of 35 PSU, with notable decreases during periods of increased freshwater input, likely driven by river runoff or precipitation events (Figure 3.18). However, a period of erroneous data was identified between 21 August - 18 September. This was attributed to the Aqua Troll CTD being buried in soft sediment, which impeded the sensors' ability to function adequately. It is assumed that wave action within the port subsequently uncovered the instrument, allowing it to resume normal data collection for the remainder of the deployment period.

These findings provide important baseline data to characterize the hydrodynamic and salinity systems within the harbour, contributing to the validation of hydrodynamic models used to predict the mixing zone of the desalination plant outfall. Such data are essential for ensuring compliance with environmental quality objectives outlined in the South African Water Quality Guidelines for Coastal Marine Waters.

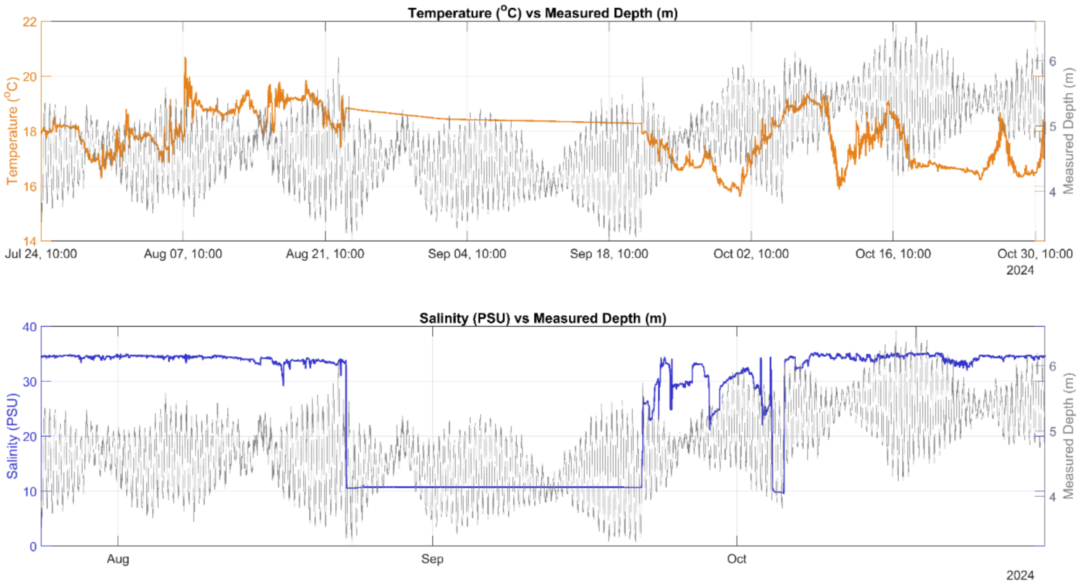

Figure 3.18. Timeseries of salinity (blue line) and temperature (orange line) data collected an Aquatroll CTD moored in ~ 5 m water depth in the East London Harbour between 23 July 2024 – 31 October 2024.

SEDIMENT QUALITY

The sediment quality in the buffalo River Estuary has been the subject of a number of studies, including monitoring of particle size distribution, total organic content, trace metals, polycyclic aromatic hydrocarbon (PAH) concentrations and pharmaceuticals (Fatoki & Mathabatha 2001, CSIR 2014, 2016, 2018, 2020, 2023c a, Adeniji et al. 2017, Ohoro et al. 2021).

Sediment particle size tends to follow a pattern typical of estuarine systems, with higher concentrations of mud in the upper reaches (carried from further up the catchment by freshwater inflow and deposited in the estuary) giving way to larger, sandy particles at the mouth (CSIR 2023b).

ECOLOGY

The Port development means that most of the primary productivity in the lower reaches of the system is driven by phytoplankton in the water column, rather than aquatic macrophytes (CSIR 2022). Some species have colonised the artificial hard substrate; these tend to be typical of Eastern Cape intertidal rocky shores and reflect the predominantly marine influence in the lower system (see Figure 3.13) (CSIR 2022).

Benthic macrofaunal communities are monitored as part of the Long-Term Ecological Monitoring Programme for the Port of East London (CSIR 2014, 2016, 2018, 2020, 2023c a). There tends to be a high degree of interannual variability between sites (CSIR 2022). The communities in the estuary are dominated by annelid worms and/or ostracods, with an increase in the number of taxonomic groups from upstream of the port area to the mouth (Figure 3.19). While this gradient may be linked to salinity influences, it is also important to consider the quality of the sediment at these sites — indeed, the sediment at Stations 1 and 2 are reported to sometimes be anoxic, which will greatly influence the macrofaunal community composition and abundance (CSIR 2022). Likewise, the benthic macrofauna communities at these sites are assessed to be 'extremely disturbed' (Figure 3.20) (CSIR 2023b). For the July 2022 survey, the community at the mouth of the estuary (Station 10) was classified as "moderately disturbed" because it was almost completely dominated by nematode worms (Figure 3.19 and Figure 3.20). The dominance of a single species/group tends to reflect that some shift has occurred in the community (be as a result of a pollution event, or storm impact on sediments, for example), and that dominant group is resilient to that disturbance or is able to rapidly respond after that disturbance.

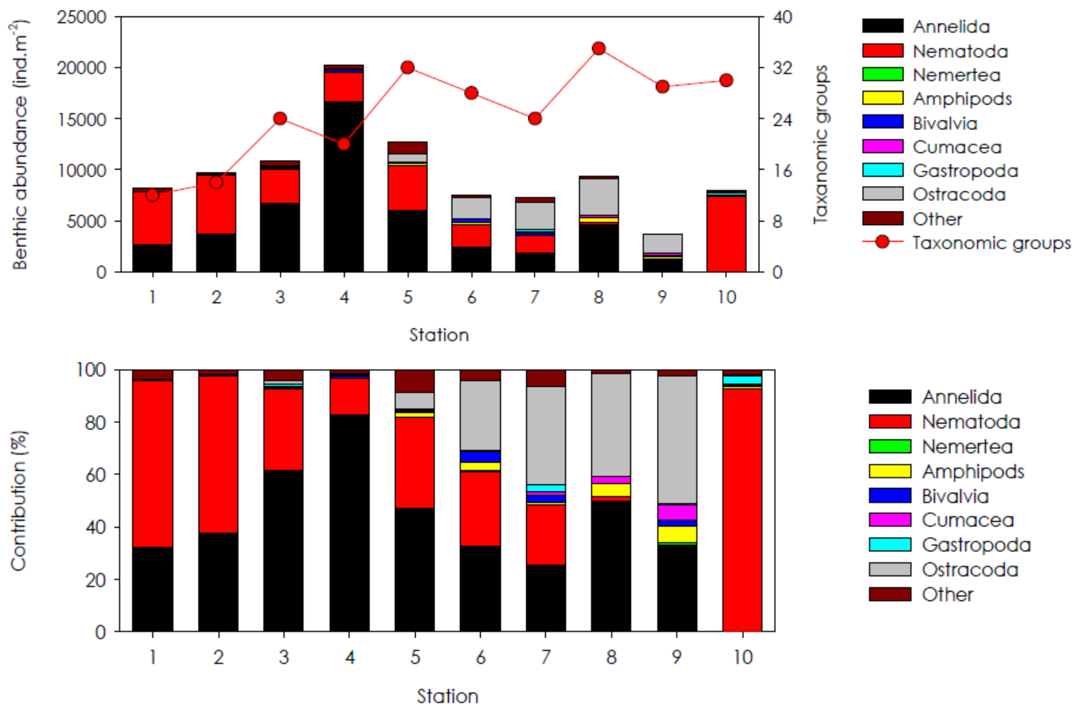

Figure 3.19. (Top) Abundance and number of taxonomic groups and (bottom) contribution of various taxonomic groups to benthic macrofaunal abundance at each station in the Buffalo River estuary in July 2022. Station 1 is furthest upriver, while Station 10 lies just outside the Port channel entrance (CSIR 2023b).

Given the lack of sand/mudflats, the species that typically inhabit such systems (such as migratory waders) are also, for the most part, "excluded from the estuary (CSIR 2022). Water bird species that have been recorded in the system include the African fish eagle *Haliaeetus vocifer* and goliath heron *Ardea goliath* (EOH Coastal and Environmental Services 2018), cormorants, gannets and terns (feeding in the lower estuary) as well as seagulls, heron, several species of kingfishers, and oyster catchers (CSIR 2022).

Estuaries in this region (including the Buffalo River Estuary) are important spawning/nursery areas for various oceanic and estuarine fish species, including white steenbras, dusky kob, ladyfish, blue spotted stingray, ragged tooth shark, white sea-catfish, estuarine roundherring, leervis, various mullet species, spotted grunter, elf, and Cape stumpnose (James & Harrison 2016, Weerts & Taljaard 2019). Estuarine dependent species generally recruit to estuaries in the region as juveniles and migrate into the adjacent nearshore marine environment as subadults or adults (Weerts & Taljaard 2019).

The EFZ at the proposed intake within the estuary is entirely comprised of artificial habitat, with a concrete and rock with no functional estuarine vegetation on the site(Figure 3.21).

Figure 3.20. Classification of benthic macrofaunal community status in the Buffalo River estuary in July 2022 based on the BPOFA index (CSIR 2023b).

Figure 3.21. The EFZ of the proposed intake site (site visit photos taken in August 2025).

3.5 Human uses and influences

Marine user groups can be broadly defined as recreational or commercial. Recreational marine activities occurring in East London include recreational boat (skiboat) fishing, recreational scuba diving and yacht sailing, as well as bathing and water sports. Several commercial marine activities take place within the broader region; these include shipping, marine ecotourism, and a range of commercial fisheries.

3.5.1 Litter

It was evident, across a number of site visits, that there is a significant and unacceptable litter problem within the Port system (Figure 3.22 and Figure 3.23). While it is likely that much of this litter originates from further up the catchment area, this needs to be addressed by Port authority as a matter of urgency, given that these areas are not accessible to the public.

3.5.2 Recreation

East London offers a diverse range of marine and estuarine recreational activities that are influenced by its rich aquatic environment. The city's beaches, including Eastern Beach and Nahoon Beach, are well-suited for bathing, surfing, and a variety of water sports (Figure 3.24). The warm waters of the Indian Ocean provide favourable conditions for activities such as kayaking, windsurfing, and stand-up paddleboarding, while the consistent waves attract surfers from both local and international communities. Additionally, East London is recognized as a destination for recreational SCUBA diving, with several dive sites in the surrounding waters that feature diverse marine life.

Figure 3.22. Litter clogs the launch area, as photographed on 25 July 2025.

The sheltered environment of the Buffalo River Estuary is ideal for more tranquil activities, including boat cruises, kayaking, recreational fishing, and birdwatching. Furthermore, sailing is a popular activity in both the ocean and estuarine waters, with sailing clubs in the area such as the Buffalo River Yacht Club.

Figure 3.23. An unacceptable amount of litter was present on the small beach within the estuary, as photographed on 25 April 2024.

Figure 3.24. The beaches and popular recreational areas of East London (www.sa-venues.com).

3.5.3 FISHERIES

COMMERCIAL/TRADITIONAL LINE FISHERY

The South African commercial (or Traditional) line fishery is a boat-based fishery that dates back to the 1500s (Thompson 1913). By the end of the 1990s there were approximately 3 000 fishing boats ranging from 3 m dinghies to 15 m deck boats carrying a total of around 3 000 crew (Griffiths 2000).

The primary target species in the South African commercial line fishery include temperate, reef-associated seabreams (e.g. roman, hottentot seabream, santer and slinger), coastal migrants (e.g. geelbek and dusky kob) and nomads (e.g. snoek and yellowtail) (Parker et al. 2018). Lines are set with no more than 10 baited hooks and boats operate inshore. Employing an estimated 27% of all fishers, the commercial line fishery has the largest fleet, but its catches make up only 6% of the total value of all commercial marine fisheries (DFFE 2023). Commercial fishing vessels range from 6-8 m ski-boats capable of surf-launching to harbour-based freezer vessels (generally longer than 20 m) that can remain at sea for more than 2 weeks at a time (Mann 2013). Fishers are constrained in terms of what species they can target, as well as by bag and size limits but effort is primarily limited by weather and sea conditions. Fishing takes place throughout the year but there is some seasonality in catches. Boats are limited to 40 nautical miles offshore and are constrained by MPAs. Marine recreational anglers in South Africa tend to use similar gear and target similar species to their commercial counterparts. The Total Allowable Effort (TAE) for the Traditional Linefish is set at a maximum of 455 standard vessels. The General Published Reasons (GPR) for Decisions on Appeals in the Traditional Linefish Sector: 2021/2022 (the Appeals GPR)[1] awarded TAE allocations in the sector as follows:

- Zone A (Port Nolloth to Cape Infanta): DA Allocation: 236; Appeals Allocation: 45, leaving 59 for Small Scale vessels.
- Zone B (Cape lnfanta to Port St Johns): DA location: 46; Appeals Allocation: 6, leaving 12 for Small Scale vessels.
- Zone C (Kwa-Zulu Natal): DA Allocation 43; Appeal Allocation: 2, leaving 6 for Small Scale vessels.

The results of DFFE stock assessments conducted in 2017 indicated that the drastic reduction of fishing effort from 2003 onwards resulted in the partial recovery of some species, including slinger, santer, hottentot seabream and carpenter. However, other important stocks such as silver kob are still being overfished (DFFE 2023).

According to the 2018 National Biodiversity Assessment fishing intensity calculations, the commercial linefishery is highly active near to the Port of East London (Figure 3.25) (Whitehead et al. 2019).

[1] https://www.dffe.gov.za/sites/default/files/legislations/appeals/28feb2023gpr_traditionallinefish.pdf

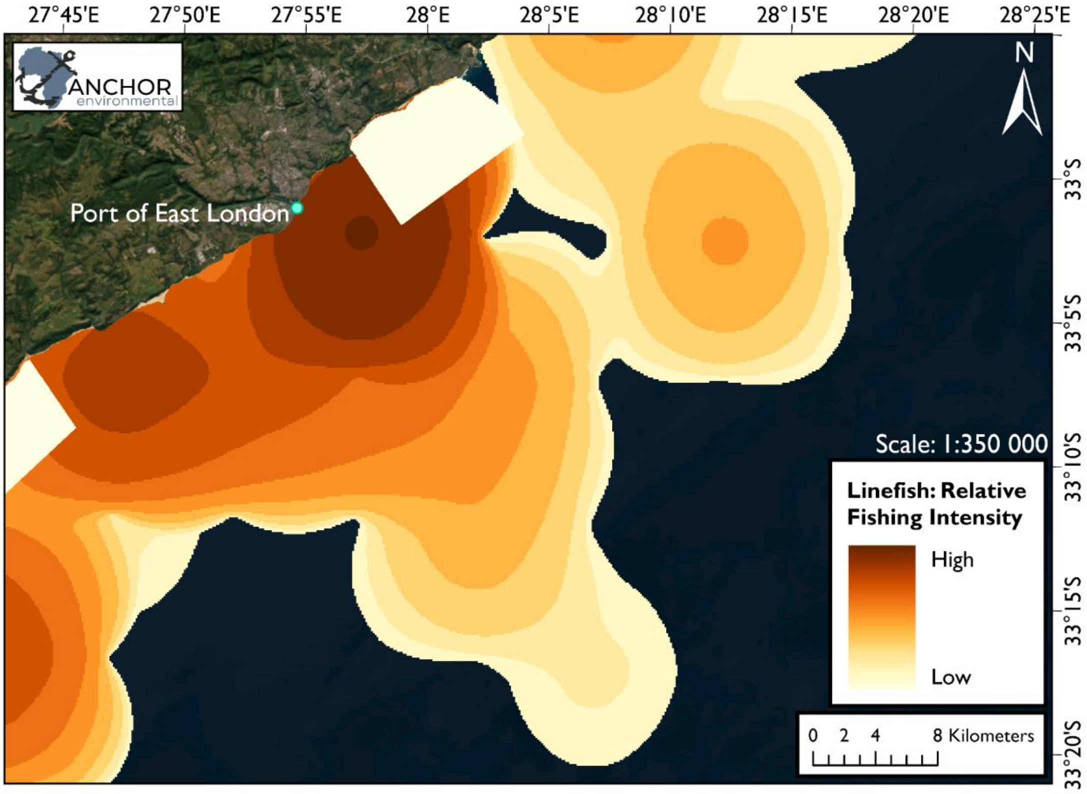

Figure 3.25. Relative fishing intensity of the commercial linefish fishery near East London (Sink et al. 2019a).

LARGE PELAGIC LONGLINE

The pelagic longline fishery targets large, predatory, highly mobile fish including bigeye tuna *Thunnus obesus*, yellowfin tuna *T. albacares*, southern bluefin tuna *T. maccoyii* and swordfish *Xiphias gladius*. The main bycatch species are albacore tuna *T. alalunga*, blue shark *Prionace glauca* and shortfin mako shark *Isurus oxyrinchus* (Whitehead et al. 2019, DFFE 2023). Drifting longlines can be as long as 100 km, with 700-1 500 hooks set per line, depending on the size of vessel. To reduce seabird mortality, lines are set at night. The lines are weighted and so are not visible at the surface, except at the positions of the floats and radio buoys (Figure 3.26). Longlines drift with the currents and thus have unpredictable movement, which can mean that they can drift into areas where they become entangled with the gear of other activities (Norman et al. 2018).

The South African large pelagic longline fishery employs a significant number of people, including fishermen, crew members, and workers in associated industries such as processing, marketing, and distribution. The wholesale value of catch landed by the sector during 2017 was R155 Million, or 1.6% of the total value of all fisheries combined, with landings of 2 613 tonnes (The South African Fishing Industry Handbook and Buyers' Guide 2019). The large pelagic longline fishery is highly dependent on export markets, with more than 90% of the catch destined for international markets.

The opportunity to catch larger quantities of the extremely valuable southern bluefin tuna, combined with the current under-utilisation of quotas for other important target species, emphasises the substantial development potential of South Africa's large pelagic fisheries sector, as perhaps the most promising in terms of landed value of South Africa's fisheries.

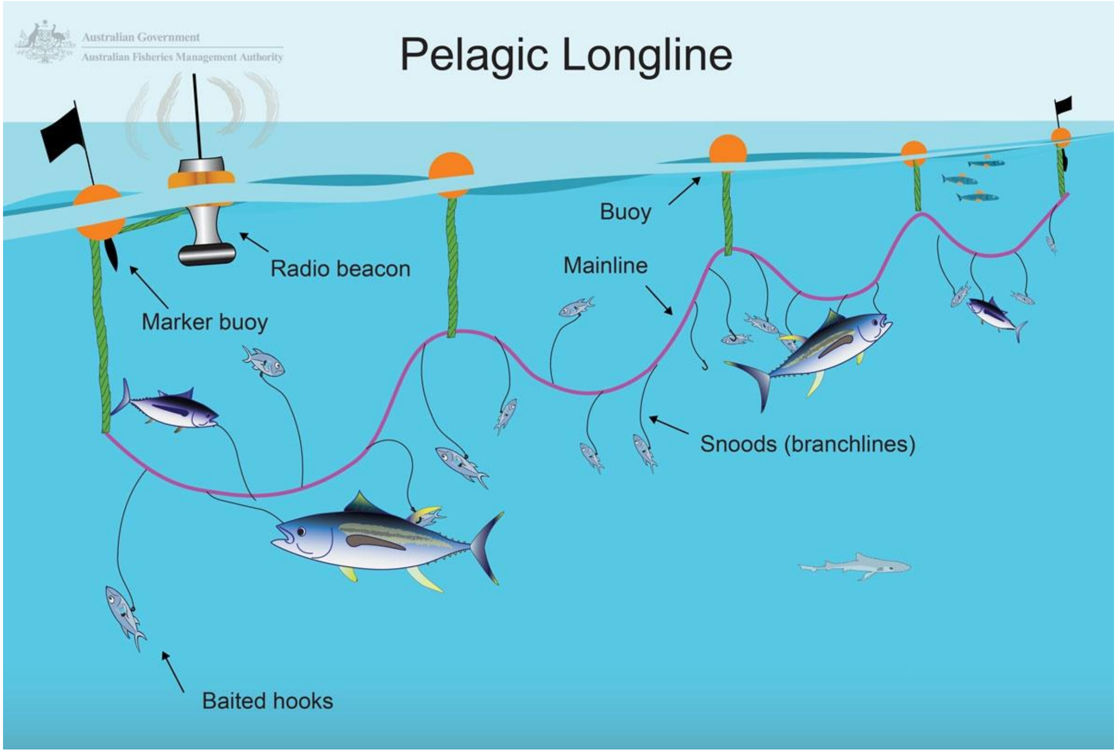

Figure 3.26. Typical large pelagic long-line gear. Source: https://www.afma.gov.au/fisheries-management/methods-and-gear.

In 2017, 60 fishing rights were allocated for a period of 15 years. The total number of active longline vessels within South African waters is 15 with a vessel size range of 20-32 m and a trip duration of 1-94 days (Parker et al. 2021). In 2020, 15 large pelagic longline vessels were active around South Africa, setting 572 461 hooks in that year. Rights Holders in the large pelagic longline fishery are required to complete daily logs of catches, specifying catch locations, number of hooks, time of setting and hauling, bait used, number and estimated weight of retained species, and data on bycatch.

The domestic component of the fleet historically fished out of Durban and Richards Bay Harbours, but vessels now operate predominantly out of the Cape Town and Hout Bay Harbours. The vessels currently in operation are typically small fibreglass or wooden hulled and have a maximum sea-going range of two weeks. This small size (~24 m) and short range of vessels limits the extent of their operations. Sixty new large pelagic longline fishing rights were allocated in 2017, for a period of 15 years, with 34 domestic South African registered vessels and three chartered (foreign) vessels authorised by DFFE to take part in the fishery (Norman et al. 2018). The fishery operates extensively within the South African Exclusive Economic Zone, primarily along the continental shelf break and further offshore (Whitehead et al. 2019), Figure 3.27). The pelagic longline fishery operates outside of the proposed development's area of influence (Figure 3.27).

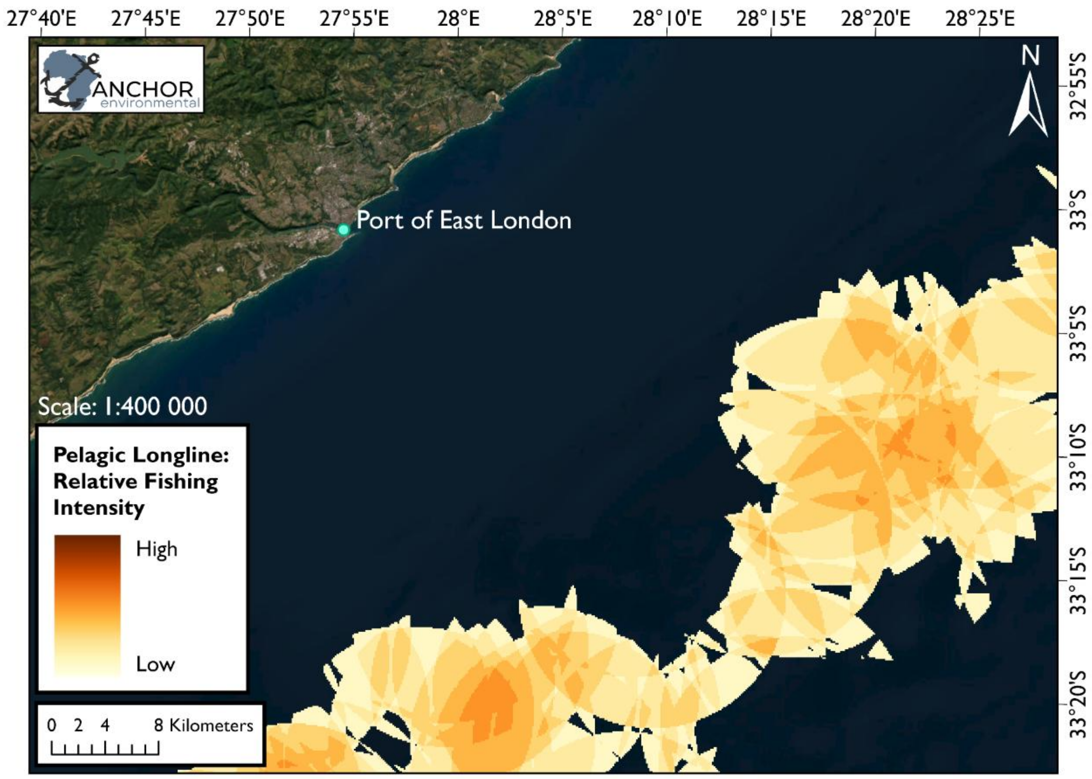

Figure 3.27. Relative fishing intensity of the pelagic longline fishery near to East London (Sink et al. 2019a).

SOUTH COAST ROCK LOBSTER

The South African longline trap fishery targets the endemic South Coast rock lobster (SCRL) *Palinurus gilchristi*. The SCRL fishing vessels are large, steel-hulled boats 30-60 m long, rigged for longline trap-fishing (Sauer et al. 2003). Each vessel uses 2 000-6 000 barrel-shaped plastic traps that are tied to longlines in sets of 100-200 traps, with each line of traps being 2-3 nautical miles long. Up to 12 lines may be set daily (Pollock 1989, Whitehead et al. 2019). Each line is weighted so that is lies along the seafloor and is connected at each end to a marker buoy on the sea surface. The traps set for period of 24 hours to several days (Norman et al. 2018).

The SCRL fishery mainly operates in rocky areas 90-200 m deep between Cape Point and East London, with the highest effort recorded off Gqeberha and East London(Pollock 1989, Groeneveld & Branch 2002, Whitehead et al. 2019). The fishery may extend up to 250 km offshore along the outer edge of the Agulhas Bank (DFFE 2023). There are currently 7 vessels operating from Cape Town and Gqeberha ports (Norman et al. 2018).

This fishery is labour intensive and as a result each vessel employs about 30 officers and crew, with a total of 300 sea-going employees. Additionally, about 100 land-based processing and administrative personnel are employed (DFFE 2023). The catch of SCRL was 319 000 tonnes (tail mass) in 2016, slightly low than the Total Allowable Catch (TAC) (Norman et al. 2018). In 2021, the total export value was approximately R353 million (DFFE 2023). In 2022, 15-year fishing rights were allocated to 10 companies. There is no perceived overlap between the proposed development area and South Coast rock lobster fishing effort (Figure 3.28).

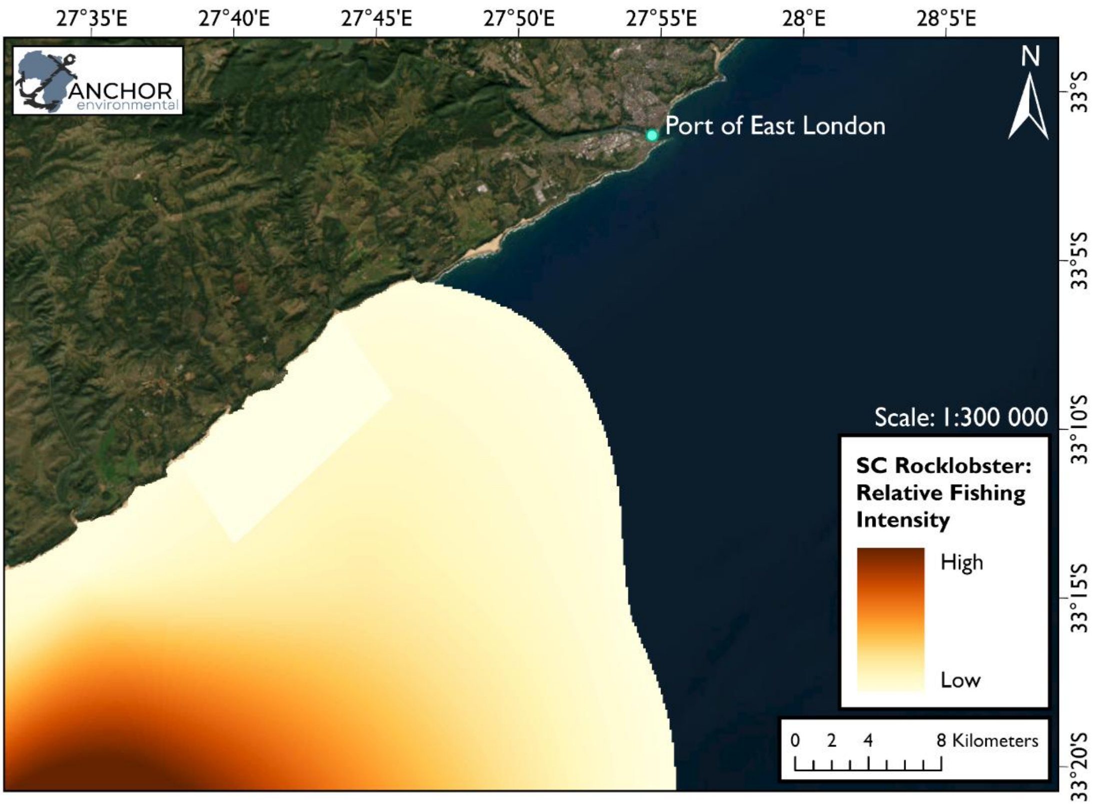

Figure 3.28. Relative fishing intensity of the South Coast rock lobster fishery near to East London (Sink et al. 2019a).

SMALL SCALE AND RECREATIONAL FISHERIES

Small scale fisheries, both in South Africa and abroad, are an important source of income and food security for many thousands of people, and has been so for generations (Clark et al. 2002, Sowman et al. 2014, Auld & Feris 2022). Small-scale fishing in South Africa has been considered to include various fishing methods targeting more than 30 species from a range of habitats (Griffiths & Branch 1997, Branch et al. 2002, Clark et al. 2002). Although small-scale fisheries contribute less than 1% to South Africa's GDP, they play an important role in the provision of protein and employment for an estimated 136 coastal communities distributed along South Africa's 3 000 km coastline (Figure 3.29). The extent and spread of small-scale fishers covers the four provinces with coastlines, especially the Western Cape, where fishing has been an important source of protein among the coastal communities since the 1700s (Isaacs 2013). Small-scale fishers are found both in urban and rural coastal areas.

Figure 3.29. Map of small-scale fishing communities in South Africa (Isaacs et al. 2022). Black dots represent small-scale fishing communities within each recognised 'basket' area.

Small scale fishery operations have historically not been included in the fisheries policy development in South Africa — the definition of "commercial fishing" as per the 1998 Marine Living Resources Act (MLRA) excluded small-scale and artisanal fishers who catch and sell fish to sustain livelihoods, despite commercial fisheries around South Africa spanning a wide spectrum, and in 2005, the government adopted long-term fishing policies that made no provision for small-scale fishers.

In response to an Equality Court order in 2007, South Africa's cabinet adopted the Small-Scale Fisheries Policy in June 2012, which sought to address imbalances of the past and ensure that small-scale fishers were accommodated and properly managed. The policy proposed that fishing rights be allocated on a group, rather than an individual, basis. The policy further aimed to support investment in community entities who could take joint responsibility for sustainably managing the fisheries resources and assist in addressing the depletion of critical fisheries stocks.

Accordingly, the MLRA was amended in 2014 (commencement date 8 March 2016) to allow the Department of Forestry, Fisheries and the Environment (DFFE) to proceed with the Small-Scale Fisheries Policy implementation process. As part of the amendments, a definition of 'small-scale fishers' and the communities involved was provided (Section 1) as follows:

'small-scale fisher' means a member of a small-scale fishing community engaged in fishing to meet food and basic livelihood needs, or directly involved in processing or marketing of fish, who—

a) traditionally operate in near-shore fishing grounds;
b) predominantly employ traditional low technology or passive fishing gear;
c) undertake single day fishing trips; and

d) is engaged in consumption, barter or sale of fish or otherwise involved in commercial activity, all within the small-scale fisheries sector".

'small-scale fishing community' means a group of persons who—

i. are, or historically have been, small-scale fishers;
ii. have shared aspirations and historical interests or rights in small-scale fishing;
iii. have a history of shared small-scale fishing and who are, but for the impact of forced removals, tied to particular waters or geographic area, and were or still are operating where they previously enjoyed access to fish, or continue to exercise their rights in a communal manner in terms of an agreement, custom or law; and
iv. regard themselves as a small-scale fishing community''

The amended MLRA also replaces any refence to 'subsistence fisheries' with 'small-scale fisheries', essentially encasing the 'subsistence' definition within the larger understanding of 'small-scale fisheries'. As such, all 'subsistence fisheries' are encompassed within the 'small-scale fisheries' group. In terms of resource management, the amended MLRA includes 'small scale fishing" alongside 'commercial fishing' in terms of fisheries management, and explicitly includes small-scale fishing within the definition of total allowable catch alongside commercial, recreational and foreign fishing (Section 1). In this way, small-scale operations range from fulfilling food security to full-blown commercial operations. The amended MLRA also replaces any refence to 'subsistence fisheries' with 'small-scale fisheries', essentially incorporating the 'subsistence' definition within the broader definition of 'small-scale fisheries'.

In terms of resource management, the amended MLRA includes 'small-scale fishing" alongside 'commercial fishing' in terms of fisheries management and explicitly includes small-scale fishing within the definition of total allowable catch alongside commercial, recreational and foreign fishing (Section 1). In this way, small-scale operations range from fulfilling food security to full commercial operations. The amended MLRA does not however provide a definition of 'small-scale fisheries', instead stating in Section 1 that "small-scale fishing must be interpreted accordingly".

In 2016, a Schedule pertaining to the Small-Scale Fishing Regulations in terms of Section 19 of the MLRA (as amended) was published. As per these regulations, communities wishing to be recognised as small-scale fishing communities needed to register their expression of interest with the Department, organise themselves into cooperatives, with small-scale fishing rights only being allocated to one cooperative per small-scale fishing community which includes within its membership, all the verified small-scale fishers in the community. The 2016 Small-Scale Fishing Regulations also required that, to be considered a small-scale fisher, a person must derive, "the major part of his or her livelihood from traditional fishing operations and be able to show historical dependence on fish, either directly or in a household context, to meet food and basic livelihoods needs." Later that same year, the former Department of Agriculture, Forestry, and Fisheries (DAFF) verified 8 488 individuals in fishing communities that had expressed interest in the small-scale fisheries sector. This was followed by the declaration of 2 802 registered small-scale fishers, but this process was considered inadequate which prompted re-evaluation. In the minutes of a 2022 meeting of the National Council of Provinces Committee Land Reform, Environment, Mineral Resources and Energy entitled, “Small-scale commercial fishery sector & aquaculture development; with Minister”, there were a reported 5 335 small-scale fishers in the Eastern Cape.

Of the estimated 30 000 small-scale fishers active along the South African coastline in 2002, 85% of them harvested linefish (Clark et al. 2002). In November 2019 and March 2020, the DFFE granted 15-year small-scale fishing rights to 73 small-scale fishing co-operatives in the Eastern Cape (OR Tambo, Alfred Ndzo and Amatole Municipalities) (DFFE 2021). The basket of species granted to these fishers included squid (see below), hake hand line, traditional linefish, seaweed, South Coast rock lobster and abalone ranching. The majority of species applied for were linefish species, some of which required use of a vessel. The small-scale fishing sector has been allocated a portion of the TAE in the finalised 2023 rights-allocation process for the Sector. Allocations as part of other Sectors are still being finalised pending the 2021 Fishing Rights Allocation appeals process. Many species allocated to the small-scale “baskets” are primary targets of the commercial and recreational linefish sectors, and these shared resources will need to be carefully monitored given the increased fishing pressure expected. Furthermore, the number of recreational angling permits may have to be limited to accommodate the newly established small-scale fisheries sector so as not to compromise resource sustainability.

In 2021, the DFFE allocated 15% of the squid catch to the small-scale fisheries sector (with the provision that this could be increased to up to 25% in the future). Prior to this decision, squid was not in the basket of species available to the 15 co-operatives and 600 individual small scale fisher men and women who operate in the areas of the Eastern Cape where squid is harvested. Small scale allocation for hake handline in 2023 allocation was 2 081 tonnes (1.5% of the total TAC). There is no specific small-scale allocation for South Coast rock lobster (2022), with 359 tonnes and 2 525 Sea Days allocated across the whole fleet.

The South Coast area of South Africa in which the proposed development area lies has a number of recognised small-scale fishing communities (Figure 3.29). These communities comprise of estuarine fishers (42%) and marine fishers (58%) which target a range of intertidal invertebrates (marine and estuarine) and fish (Figure 3.30).

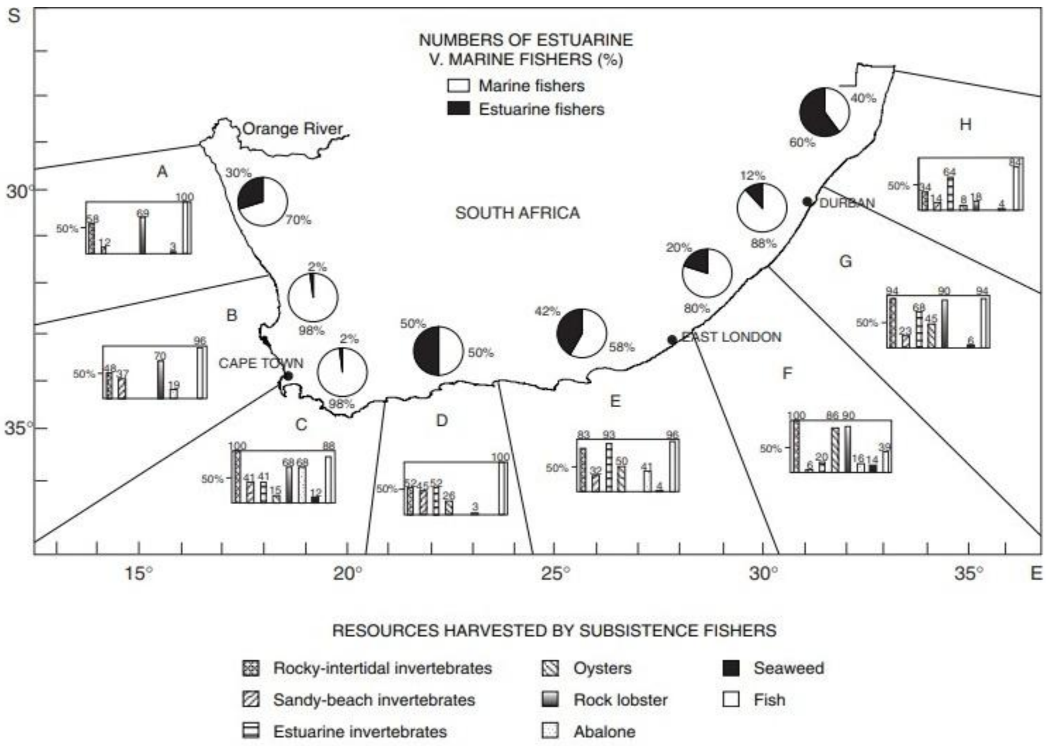

Figure 3.30. Proportions of marine and estuarine fishers, and relative importance of various different resources to 'subsistence' fishers in each of eight regions taken from (Clark et al. 2002).

Recreational fishers: Recreational fisheries in South Africa include line fisheries, rock lobster fisheries and harvesting of intertidal resources such as mussels, redbait and oysters (Griffiths et al. 2004, Cooke & Cowx 2006, Lewin et al. 2006, Winker et al. 2014, Maggs et al. 2016, Parker et al. 2016, Kerwath et al. 2019, Steyn et al. 2019). In the MLRA, "recreational fishing" means any fishing done for leisure or sport and not for sale, barter, earnings or gain. The recreational fishing sector is managed by a permitting scheme for entrants and catches are subject to TAE like the other fishing sectors. Recreational linefishing is a popular activity in South Africa and takes place along the entire coast. Between 1994 and 1997, the first nation-wide survey was conducted to evaluate participation in South Africa's recreational shore angling fishery, and its management (Brouwer et al. 1997, Mann et al. 2003). Recreational fishing in South Africa includes participation from approximately 1.32 million fishers, of which approximately half are marine, targeting mainly linefish and rock lobster (Potts et al. 2021). The MLRA legally recognises recreational fishers and along South Africa's South Coast there are a number of areas where recreational fishers operate very close to shore, or from the shore, including near to the Port of East London (Figure 3.31).

3.5.4 AQUACULTURE AND MARICULTURE

The proposed development is situated within a Priority Ranching Area for abalone (Figure 3.32). However, there is very little information available on this ranching area, and it is unlikely that it is currently operational.

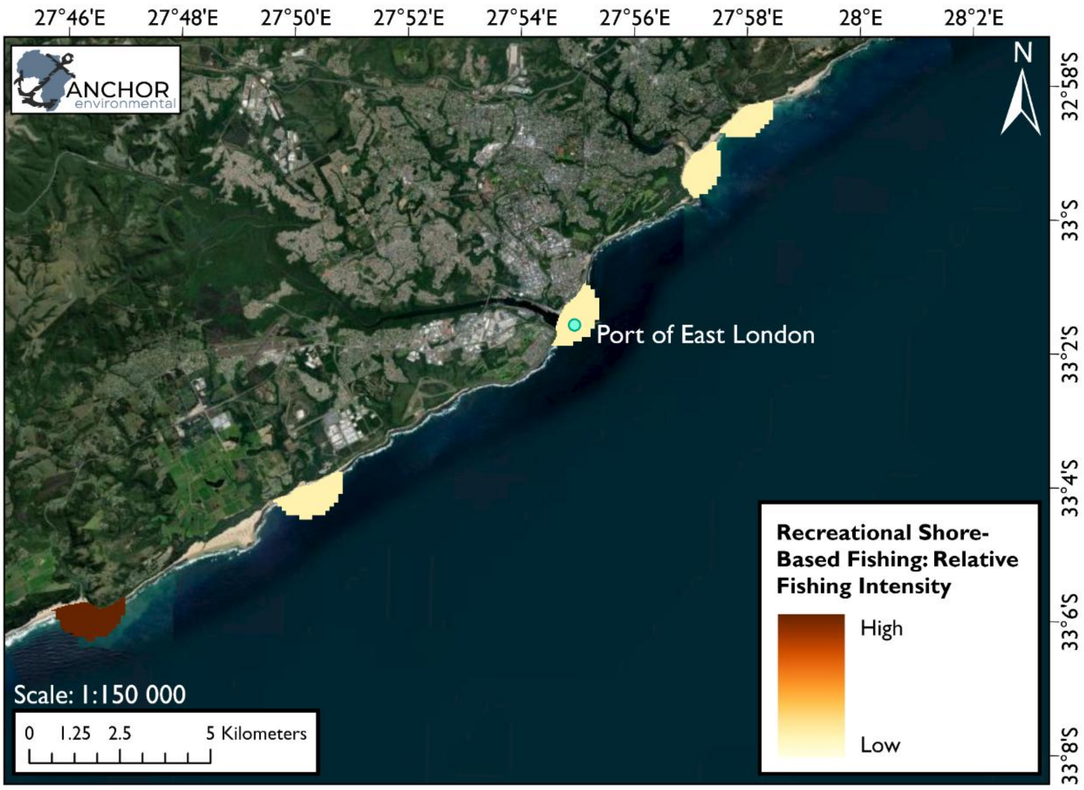

Figure 3.31. Relative fishing intensity of the recreational shore-based fishery near to East London (Sink et al. 2019a).

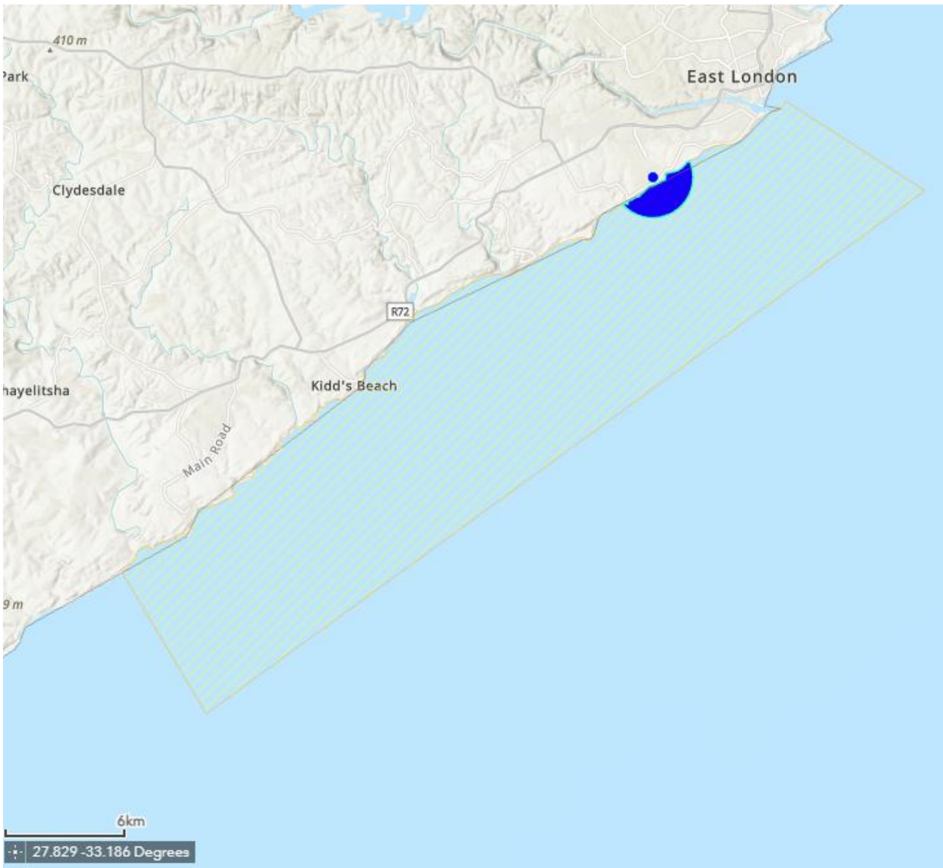

Figure 3.32. Priority Abalone Ranching area in the area of interest (Operation Phakisa 2020).

4 SPATIAL CONSTRAINTS

4.1 Estuarine Health Status

The Estuarine Health Index 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 2012). How much the present conditions differ from 'Pristine' is represented as a percentage and used to place the system in a health category. This method standardises health assessment across estuaries of varying size, type, and climatic region (Table 4.1). It is important to note that the A to F scale represents a continuum, with conceptual rather than precise boundaries. This introduces a level of uncertainty as to which category some estuaries may fall into, potentially having components that have membership in two categories. Taking this into account the 2018 NBA assessment introduced straddling categories, denoted by A/B, B/C, C/D etc, to represent scores ±3 from the category boundary scoring range (Van Niekerk et al. 2013, 2019c).

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

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	

The 2018 NBA rated the condition or Present Ecological State (PES) of the Buffalo River Estuary as a "D" or "Heavily Modified", the same as the previous 2011 NBA (Van Niekerk & Turpie 2012) and the Estuarine Management Plan (EMP) (Department of Environmental Affairs 2018) which indicates that the system is not declining, but neither is it improving. The estuary is heavily impacted by changes to hydrology ("F"), habitat loss and modification ("E"), and poor water quality ("D"). Biotic elements of the estuary have been affected by changes to the physical components, with birds being the most affected aspect ("E"), followed by invertebrates, fish and microalgae ("D") (Van Niekerk et al. 2019a).

The Recommended Ecological Category (REC) signifies the desired state assigned to an estuary (generally from a flow perspective) to protect ecosystem services within the system and biodiversity across South Africa. The REC considers the estuary biodiversity importance and its conservation importance (Protected Area status). According to the 2018 NBA, the REC for the Buffalo River Estuary is a category "D" (Van Niekerk et al. 2019a). Thus, at a minimum, the current state of this system must be maintained, and human activities must be managed to prevent further degradation.

Table 4.2. Present Ecological State of the Buffalo River Estuary (Van Niekerk et al. 2019a c).

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

4.2 Ecosystem Threat Status

The Ecosystem Threat Status developed by (SANBI 2018) is an indicator of how threatened ecosystems are, specifically the degree to which ecosystems are still intact or alternatively losing vital aspects of their structure, function, or composition (Harris et al. 2018). Ecosystem types are categorised as "Critically Endangered", "Endangered", "Vulnerable", "Near Threatened" or "Least Concern", based on the proportion of the original extent of each ecosystem type that remains in good ecological condition relative to a series of biodiversity thresholds.

The marine ecosystems in which the proposed development lies (Agulhas Exposed Rocky Shore and Agulhas Inner Shelf Mosaic) are categorised as "Vulnerable", while the Buffalo River Estuary has an Estuarine Threat Status of "Vulnerable" (Figure 4.1) (Sink et al. 2019c, Van Niekerk et al. 2019d).

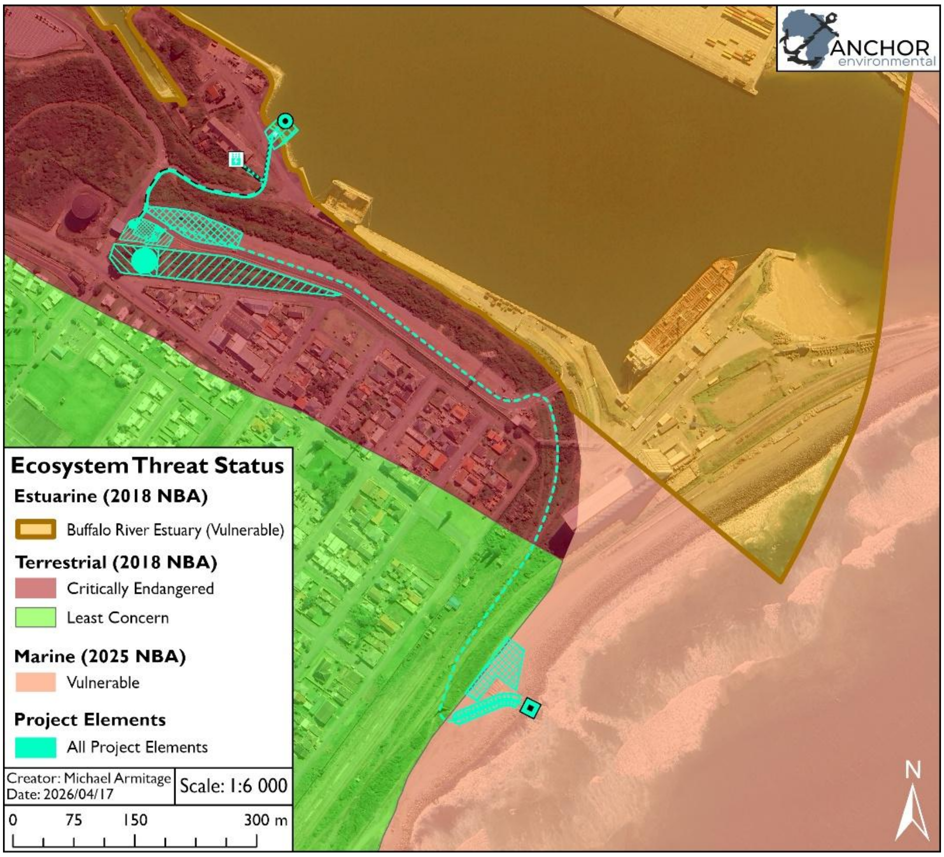

Figure 4.1. Ecosystem Threat Status of estuarine, terrestrial and marine habitats in the vicinity of the proposed development (Sink et al. 2019c, Van Niekerk et al. 2019d).

4.3 MARINE PROTECTED AREAS

The implementation of Marine Protected Areas (MPAs) in South Africa is enabled through the National Environmental Management: Protected Areas Act 2003 which provides the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. Two pieces of Legislation most commonly used in the management of MPAs is the NEMA:PAA (National Environmental Management Act – Protected Areas Act) and the MLRA (Marine Living Resources Act). South Africa now has 41 MPAs in the marine environment around its mainland as well as the very large MPA surrounding the Prince Edward Islands that covers more than 30% of the Southern Ocean territory (Whitehead et al. 2019).

The nearest MPA to the Port of East London is the Amathole MPA, of which the Gonubie section of the MPA is some 15 km from the Port (Figure 4.2). The Amathole MPA was established on 16 September 2011 and consists of three marine areas: Gxulu, Gonubie, and Kei. Due to drastic overfishing, the ecosystem within this area was negatively impacted. To address this, the MPA was declared with the following aims: 1) to conserve the marine environment and biodiversity in the Amathole region; 2) to provide a sanctuary for species impacted by boat-based exploitation; 3) to provide benchmark areas for scientific research and monitoring aimed at the protection and conservation of biodiversity and ecosystems; and 4) to control activities in the MPA to reduce the risks of habitat degradation (WWF 2025). This primary aim of this MPA complex is to protect the endemic reef fish, such as red steenbras, seventy-four, black musselcracker and dageraad, which have all been heavily overexploited (SANBI 2025). This MPA does not include estuaries, and allows shore-based angling, spearfishing and bait-collecting activities, but does not allow boat fishing (WWF 2025).

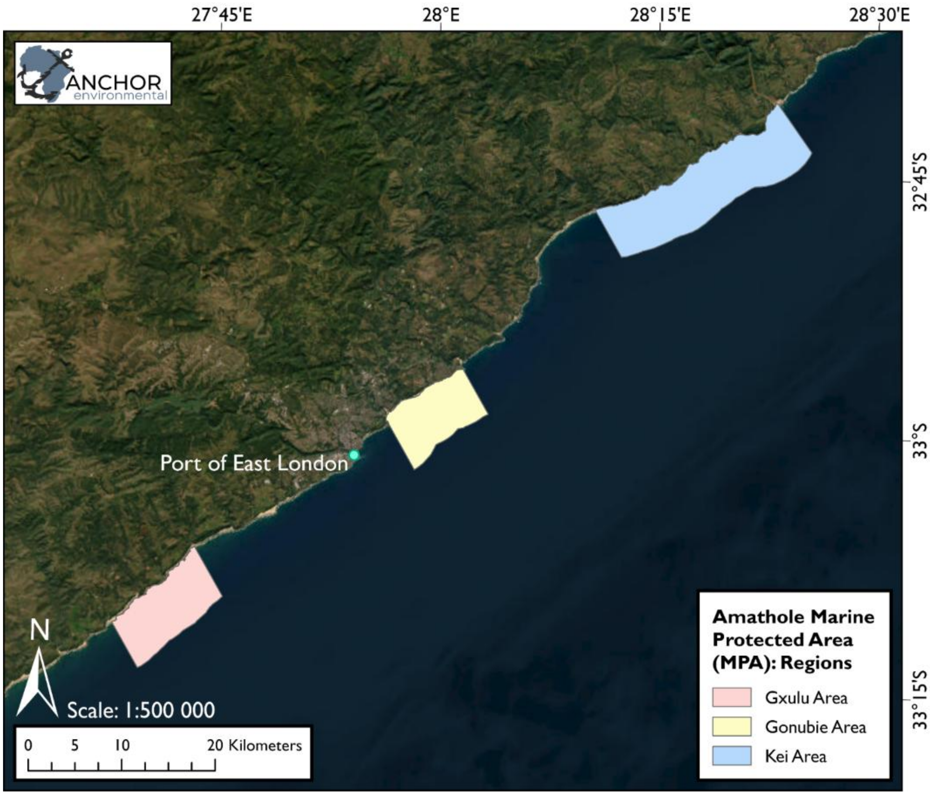

Figure 4.2. Regions of the Amathole Marine Protected Area.

4.4 Ecologically or Biologically Significant Areas (EBSAs)

Ecologically or Biologically Significant Marine Areas (EBSAs) are defined by the Convention on Biological Diversity (CBD) as "geographically or oceanographically discrete areas that provide important services to one or more species/populations of an ecosystem or to the ecosystem as a whole, compared to other surrounding areas or areas of similar ecological characteristics, or otherwise meet the [EBSA] criteria". In the marine realm, South Africa has a network of EBSAs, based on original focus areas for offshore MPAs, which were adopted by the CBD in 2014 (see (CBD 2016) and (MARISMA 2020)). The Benguela Current Commission (BCC) and its member states have been working on a regional Marine Spatial Management and Governance Programme (MARISMA 2014-2020). The intent is to refine the boundaries of existing EBSAs and identify relevant new ones, assess their status and management requirements, and incorporate these into Marine Spatial Planning (MSP) processes in each country to achieve sustainable ocean use in the Benguela Current (Harris et al. 2019). Through the MARISMA Project (https://cmr.mandela.ac.za/Research-Projects/EBSA-Portal/MARISMA), South Africa currently has 12 EBSAs solely within its national jurisdiction and shares 8 transboundary EBSAs with other countries (Namibia and Mozambique) and/or the high seas.

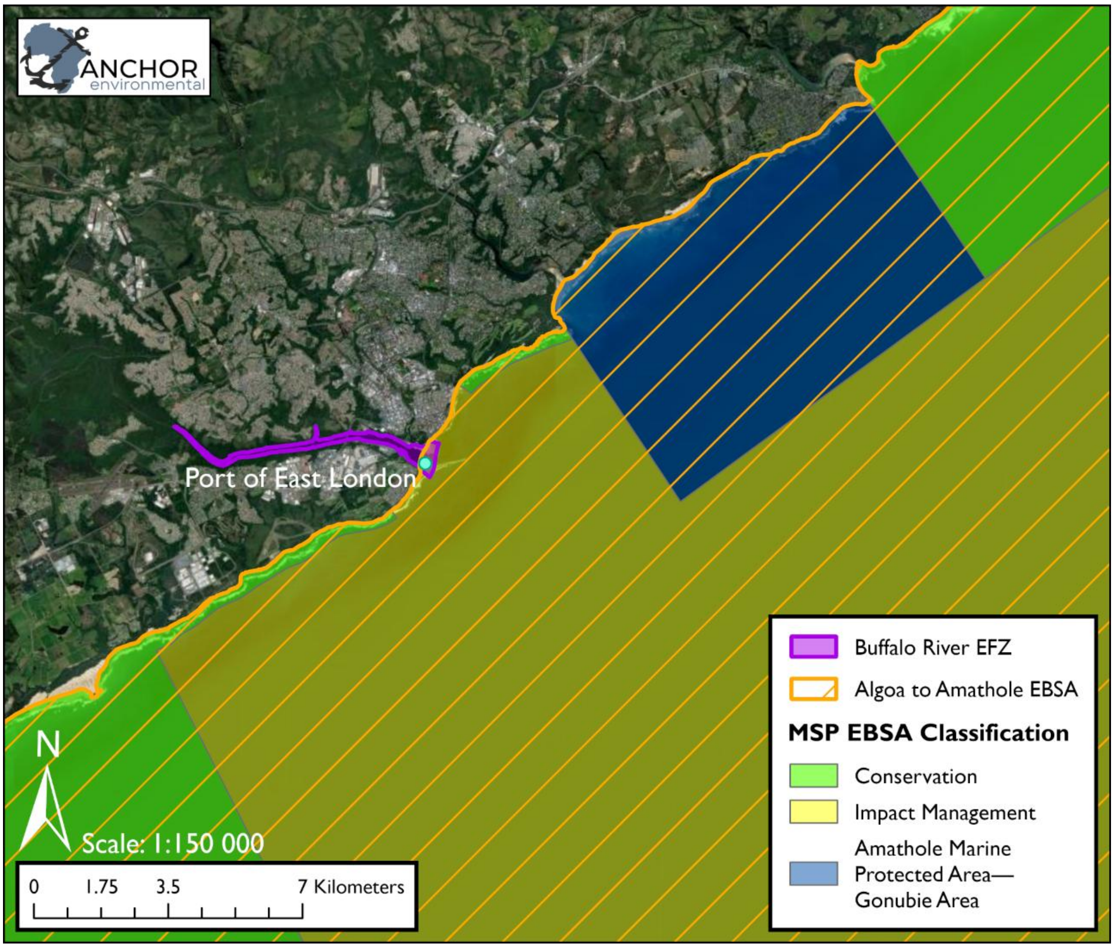

Figure 4.3. The location of the proposed development within the Algoa to Amathole EBSA (MARISMA EBSA Workstream 2020).

The principal objective of these EBSAs is identification of features of higher ecological value that may require enhanced conservation and management measures. The Port of East London is located within the Algoa to Amathole EBSA (Figure 4.3), which spans the Eastern Cape shoreline between the Sardinia Bay MPA and the Amathole MPA at the Kei River mouth, up to the continental shelf break. This EBSA encompasses what is likely the biggest single collection of special marine features in South Africa that also support key ecological processes. The circulation of the Agulhas Current in this area supports spawning areas, nursery areas and key transport pathways for fish, which in turn provide food for many top predators and supports seabird breeding and foraging areas. This EBSA is made up of 36 ecosystem types, of which 18 area threatened (MARISMA 2020).

The proposed development is situated within a section of EBSA zoned for ‘Impact Management’ (Figure 4.3). Implications of EBSAs and other spatial management tools for this project are discussed in detail in Section 4.6.

4.5 MARINE SPATIAL PLANNING: BIODIVERSITY SECTOR

The Marine Spatial Planning (MSP): Biodiversity Sector Plan defines an integrated set of spatial biodiversity priority areas, along with the required management specifications for these areas (Marine Biodiversity Sector Plan 2024). The tool for achieving the Sector’s objectives in priority areas is the designation of marine biodiversity zones, with associated spatial regulations (Marine Biodiversity Sector Plan 2024). This Sector Plan presents a spatial plan for the natural environment, designed to inform planning and decision-making in support of sustainable development. Spatial planning maps have been developed using the principles of systematic biodiversity planning ((SANBI 2017), Proposed Approach to Spatial Development and Management for South Africa’s Marine Planning Areas 2019, the Draft marine sector plan for the Biodiversity Sector 2023 and the finalised 2024 Marine Biodiversity Sector Plan. A new Decision Support Tool for Marine Spatial Planning activities in terms of the Marine Spatial Planning Act (Act no. 16 of 2018) has been produced (https://ocims.environment.gov.za/msp/) that provides the proposed future delineated biodiversity priority areas.

The Biodiversity Sector Plan comprises two categories of proposed biodiversity priority areas, namely Strict Biodiversity Conservation Zones (translated from “Critical Biodiversity Areas”), and Biodiversity Impact Management Zones (translated from “Ecological Support Areas”) (Marine Biodiversity Sector Plan 2024). Strict Biodiversity Conservation Zones consists of three sub-categories: MPAs, Biodiversity Conservation Areas (Natural), and Biodiversity Restoration Areas (Modified). The management objectives of Biodiversity Conservation Areas (Natural) are to maintain these areas in a natural or near-natural ecological condition, while for Biodiversity Restoration Areas (Modified), the objective is to prevent further impacts to the biodiversity features for which the area was identified as important, and avoid further deterioration in overall ecological condition, ideally improving the state of key biodiversity features and ecological condition, if possible (Marine Biodiversity Sector Plan 2024). For Biodiversity Impact Management Zones, the objective is to manage cumulative impacts on biodiversity in order to keep the area in at least a functional state. (Marine Biodiversity Sector Plan 2024).

The marine components of the proposed development area lie entirely within a Biodiversity Impact Management Zone (or ESA) (Figure 4.4). The implications of this for management are presented in Section 4.6.

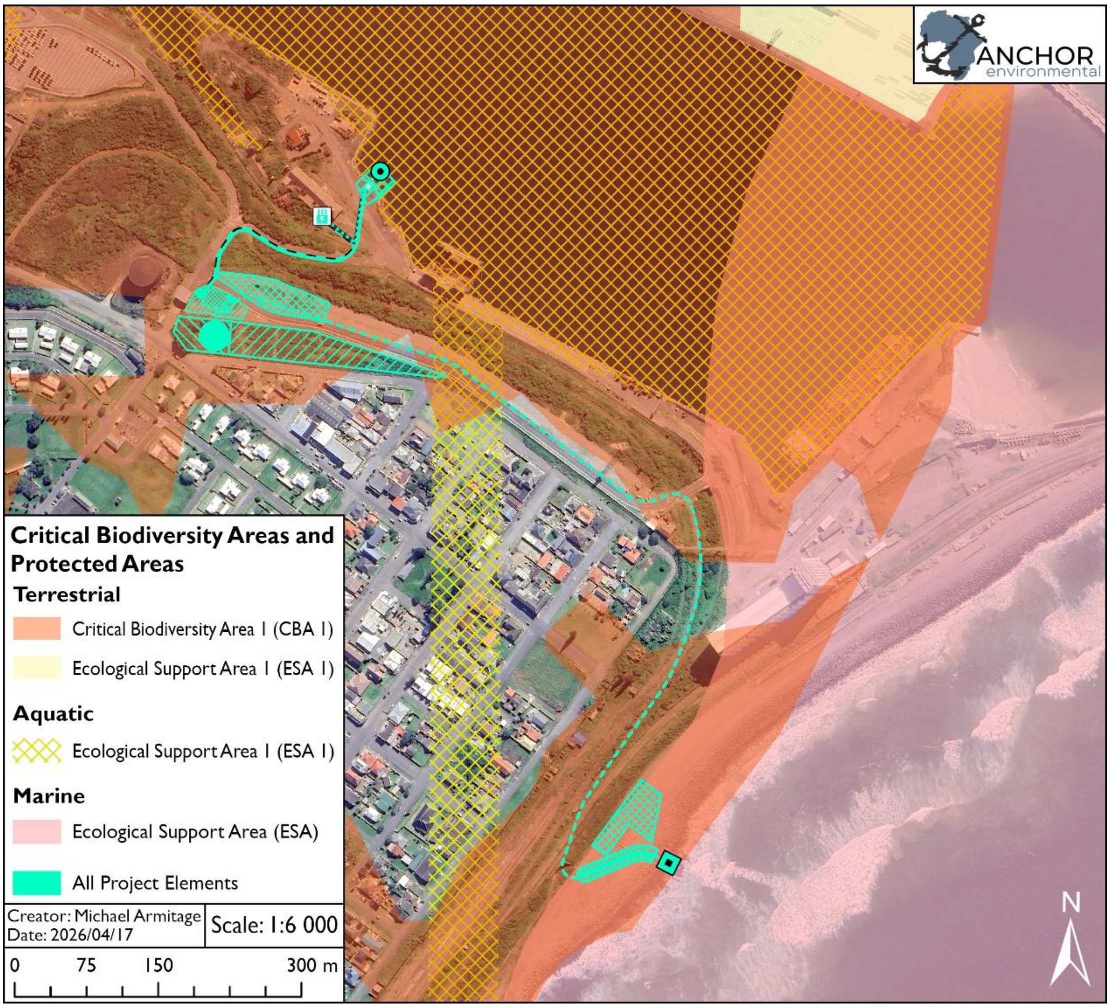

Figure 4.4. Terrestrial, aquatic and marine Critical Biodiversity Areas and Ecological Support Areas in the vicinity of the proposed development (Harris et al. 2022).

4.6 Implications for management

For the marine environment, the Impact Management zones of EBSAs, Strict Biodiversity Conservation Zone and Biodiversity Impact Management Zone areas are encouraged to be managed by place-based regulations, informed by the reasons for their classification. A range of sea-use activities and recommendations as to their permissibility, subject to compatibility with different Critical Biodiversity Areas, is presented in Table 4.3 (from Harris et al. (2022), the finalised 2024 Marine Biodiversity Sector Plan and the Proposed Approach to Spatial Development and Management for South Africa's Marine Planning Areas 2019). Activities that were assessed as being compatible with the management objectives of Strict Biodiversity Conservation Zones and EBSAs are recommended to be permitted in those areas according to the existing rules and regulations for that activity; activities that are not compatible are recommended to be prohibited.

In this case, the proposed development area lies entirely within a Biodiversity Impact Management Zone, meaning that the activities listed in Table 4.3 are **compatible**, except for new land-based coastal developments, which have **restricted compatibility** in this area.

Restricted compatibility means that “A robust site-specific, context-specific assessment is required to determine the activity compatibility depending on the biodiversity features for which the site was selected. Particularly careful attention would need to be paid in areas containing irreplaceable to near-irreplaceable features where the activity may be more appropriately evaluated as not permitted. The ecosystem types in which the activities take place may also be a consideration as to whether or not the activity should be permitted, for example. Where it is permitted to take place, strict regulations and controls over and above the current general rules and legislation would be required to be put in place to avoid unacceptable impacts on biodiversity features” (Harris et al. 2022). Compatible activities should be allowed and regulated by current general rules.

Table 4.3. Sea use activities, Marine Spatial Planning (MSP) Zones and compatibility with the management objective of Biodiversity Conservation Areas (Natural), Biodiversity Restoration Areas (Modified) and Biodiversity Impact Management Zones. Activity compatibility is given as Y = yes, compatible, R = restricted compatibility, or N = not compatible. Source: 2024 Marine Biodiversity Sector Plan.

Broad sea use	Associated MSP zones	Associated sea use activities	MPAs	Biodiversity Conservation Areas (Natural),	Biodiversity Restoration Areas (Modified)	Biodiversity Impact Management Zones
Abstraction and Disposal	Sea-water abstraction and disposal (e.g., desalination)	Sea-water abstraction and disposal (e.g., desalination)		RC	RC	Y
		Sea-water abstraction and disposal (e.g., aquaculture disposal)		N	RC	Y

5 NEAR FIELD DISPERSION MODELLING

5.1 Introduction

Dispersion modelling studies provide an estimation of 1) dilution rates for effluent and associated key contaminants and 2) an estimate of the footprint of the plume after effluent discharge into the environment. This in turn will facilitate an assessment of the likely impacts of effluent discharge on the environment and other potential beneficial uses thereof.

Near-field dispersion modelling was performed using the Cornell Mixing Zone expert system software (CORMIX) (v12.0GTS) to assess dilution potential and dispersion of the brine effluent from the proposed Port of East London RO plant. Near-field models are designed to resolve initial dilution processes that occur in the immediate area around the discharge. The main objective of this modelling study was therefore to determine key near-field design parameters to achieve a sufficient level of initial dilution in accordance with regulatory requirements. Discharge options were chosen to limit ecological impacts of the effluent discharge, while taking engineering and cost limitations into account.

This section outlines the modelling methods and assumptions (Section 5.2), modelling effluent profile (Section 5.3.2) and ambient conditions (including data collected in situ, see Section 5.3.1). In addition, this Section provides insight as to whether the estimated concentrations of constituents in the effluent will meet the required WQGs within the RMZ (Section 5.4).

5.2 Assumptions

CORMIX computational models are applicable from near to moderate-far field empirical simulations to project likely geometries and dilution characteristics within the initial RMZ of a discharge. The system is, however, also able to leverage empirical data and theoretical frameworks to provide possible outcomes with defined levels of confidence over larger distances. CORMIX classifies discharge flows according to generic qualitative descriptions (Doneker & Jirka 1990, 2002). Based on these flow classifications, CORMIX can identify solutions which are included in the resulting model analysis. In addition, the system can predict quantitative aspects of the hydrodynamic mixing processes such as dilution ratio and plume trajectory Methods. CORMIX is considered by its authors to be applicable in more than 80% of cases except for highly complex discharge geometries or regions prone to non-uniform flow leading to local recirculation (Doneker & Jirka 2002).

While CORMIX is applicable to a wide array of applications, ranging from dams and rivers to estuaries and open coastlines, the model requires the receiving water body to be highly simplified or “schematized” (Doneker & Jirka 1990, 2002). Any area which may be non-uniform in reality must be depicted as a relatively simple, uniform, rectangular channel within the model. A channel is typically assumed to comprise two boundaries representative of a river, canal or estuary. In coastal applications the schematization is considered to be unbounded. This is achieved by placing the discharge in close proximity to one boundary (typically a shoreline), while the second boundary is assumed to be far beyond the reach of any impacts. In the open ocean, the system is unbounded by definition.

Another major assumption of CORMIX is that of a steady state. As such, all parameterisations (e.g., receiving water body width, depth, ambient current, temperature and stratification) are held constant during any simulation. In applications where ambient currents are strongly impacted by tidal fluctuations (e.g., estuaries or lagoons), quasi-steady analyses are recommended. These involve quantifying the interplay between variation in sea level height and ambient velocity during tidal cycles.

One of the proposed outfall options involves discharge into the surf zone off the dolosse, and area of shore that exhibits highly complex mixing, dispersion and transport of an effluent plume. Processes influences behaviour of a plume within a surf zone include tidal and wind generated currents, wave action (breakers), wave generated currents and wind shear. These processes cannot be resolved by the CORMIX model. However, typical shorelines are characterised by symmetrical circulation cells (due to the wave direction being perpendicular to the coastline) (Figure 5.1), with effluent tending to be confined in a circulation cell, and the impact limited to the length of the circulation cell. Assuming the effluent is trapped in a circulation cell, a straight forward and conservative estimate is the volumetric dilution, assuming all the seawater in the "cell" will be replaced within 1 day (2 diurnal tidal cycles and rip currents) (WAMTechnologies 2015). This approach is followed here, and results are compared to CORMIX outputs.

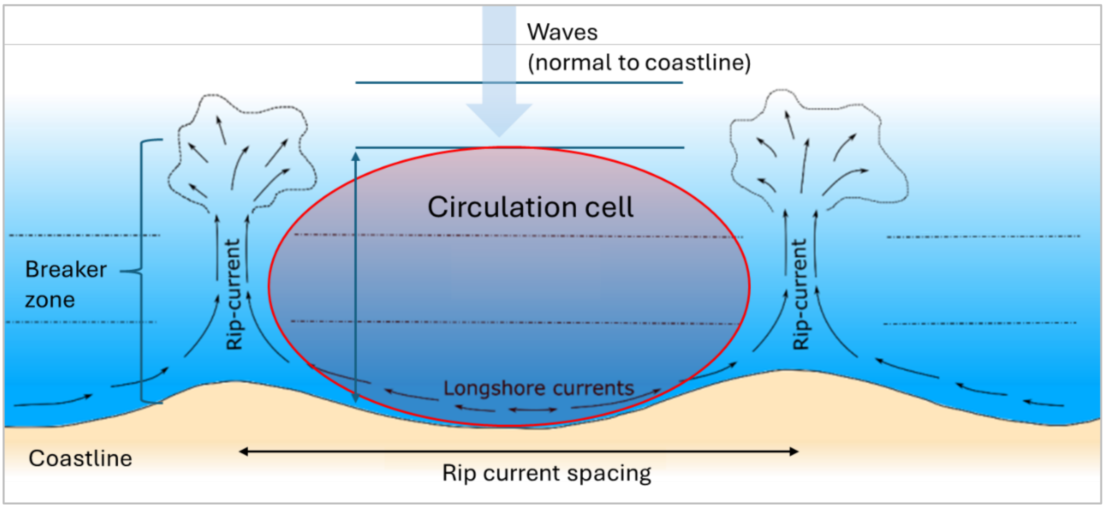

Figure 5.1. Wave-induced nearshore currents showing longshore currents and offshore-directed rip-currents (adapted from (Van Zyl 2018).

Note that CORMIX results are presented both at the RMZ (which is defined by the CWDP conditions), and the Zone of Initial Dilution (ZID), which is the end of the zone of initial mixing, beyond which CORMIX applies an ambient spreading model and consideration of wind induced mixing in far field. This is done because of the uncertainties inherent in the empirical expressions beyond the area of initial dilution (Zhao et al. 2011).

5.3 Methods

5.3.1 Ambient conditions

As per Section 2, the water quality-based effluent limits approach to discharges into the marine environment determines site-specific effluent limits that are calculated based on the WQGs (or standards) of a given water body, the effluent volume and concentration, as well as the site-specific assimilative capacity of the receiving environment. As such, it is of crucial importance to include accurate data on background/ambient parameters of the system into which the discharge is proposed.

When selecting environmental conditions to simulate, it is considered best practice to consider worst-case scenarios i.e., the environmental conditions that lead to the poorest outcomes from a water quality and environmental perspective. It is also imperative to cover a range of environmental conditions that are expected to occur at the discharge site. As such, this modelling study takes into consideration wind, tidal, wave and weather conditions as appropriate to the site under investigation. Water current data (speed and direction), temperature, salinity, bathymetry, and background constituents are discussed below. These parameters are used to determine which environmental conditions are used in the dispersion model.

Tides, swell and currents

The prospective discharge points are positioned within the port and adequate understanding of the tidal dynamics are crucial to the impact on plume behaviour. The East London region exhibits tidal characteristics marked by slight diurnal inequality. Tidal elevations range from 1.82 m relative to Chart Datum (CD) at mean spring high tide to 0.23 m CD at mean spring low tide. The highest recorded Astronomical Tide is 2.08 m CD (CSIR 2022). The tidal range in the Port of East London area is 1.67 m, with the highest astronomical tide of 2.04 m (TNPA 2010). These tidal variations exert a significant influence on current velocities in the adjacent Buffalo River Estuary, where mean current speeds are approximately 5 cm/s, with observed variations of 1-19 cm/s. Additionally, there is a noticeable lag in tidal phase between the estuary and the ocean (CSIR 2022). Understanding the tidal dynamics and associated current flows is critical for predicting the behaviour of plume dispersal, particularly in areas where discharge points are located within the port.

To investigate the hydrodynamic environment in the vicinity of the discharge site (detailed measurements of current speed and direction), a SonTek Argonaut Acoustic Doppler Current Profiler (ADCP) was deployed on 23 July 2024 for 37 days until its battery was depleted (Figure 5.2). This dataset provides a robust basis for assessing tidal variability and developing a comprehensive hydrodynamic model to better understand plume dispersion under a range of environmental conditions. A custom-built ADCP mooring system (~1 x 1 x 0.5 m) was designed to ensure stable placement on the seafloor. The mooring was carefully deployed by lowering it to the seabed, where divers descended to secure the instrument in position. Following a monitoring period of approximately three months, the ADCP was retrieved by divers. Data collected by the ADCP were subsequently downloaded, cleaned, and processed using SonTek software. Further data analysis was conducted using Python, enabling the visualization of current patterns through current roses, frequency histograms, and time-series plots of current velocity and direction.

Figure 5.2. Configuration of the SonTek Argonaut ADCP bottom mounted mooring deployed outside of the East London Harbour for an operational period of 37 days.

Preliminary analysis of the ADCP data revealed that the predominant current direction was towards the northeast (NE), with a moderate reversal towards the southwest (SW). These reversals are likely influenced by wind forcing. The prevailing NE flow aligns closely with the dominant SW winds, which are a characteristic feature of this coastal region (Rehman et al. 2022). A detailed examination of the velocity profile showed bottom current velocities ranging between 0.1-0.3 m/s, increasing progressively towards the surface (Figure 5.3). Surface currents were observed to range between 0.3-0.5 m/s, with occasional extremes exceeding 0.8 m/s (Figure 5.3). These higher velocities are likely associated with gusts of strong SW winds experienced during the winter months of the deployment.

A review of the time series data provides a holistic view of the temporal variability with distinct fluctuations in both the current velocity and direction throughout the deployment period (Figure 5.4 and Figure 5.5). Initially, from 25-29 July, the current velocity shows a high peak exceeding 0.5 m/s, followed by a sharp decline to below 0.2 m/s (Figure 5.5). Interestingly the time series for the current directional data highlights the change in direction which occurs ~4 days within the data set and likely linked to the change in wind conditions experienced in the area (Figure 5.4). Towards the end of the deployment period 17-25 August 2024, the variability becomes more pronounced, with a gradual increase in peak velocities, reaching a maximum of approximately 0.7 m/s. Despite this increase, the data consistently show cyclical fluctuations, highlighting the dynamic nature of the current velocity over the observed period. The findings emphasize the importance of accurately capturing both tidal and wind-driven components of the predominant current flow to enhance the predictive capability of plume dispersion models.

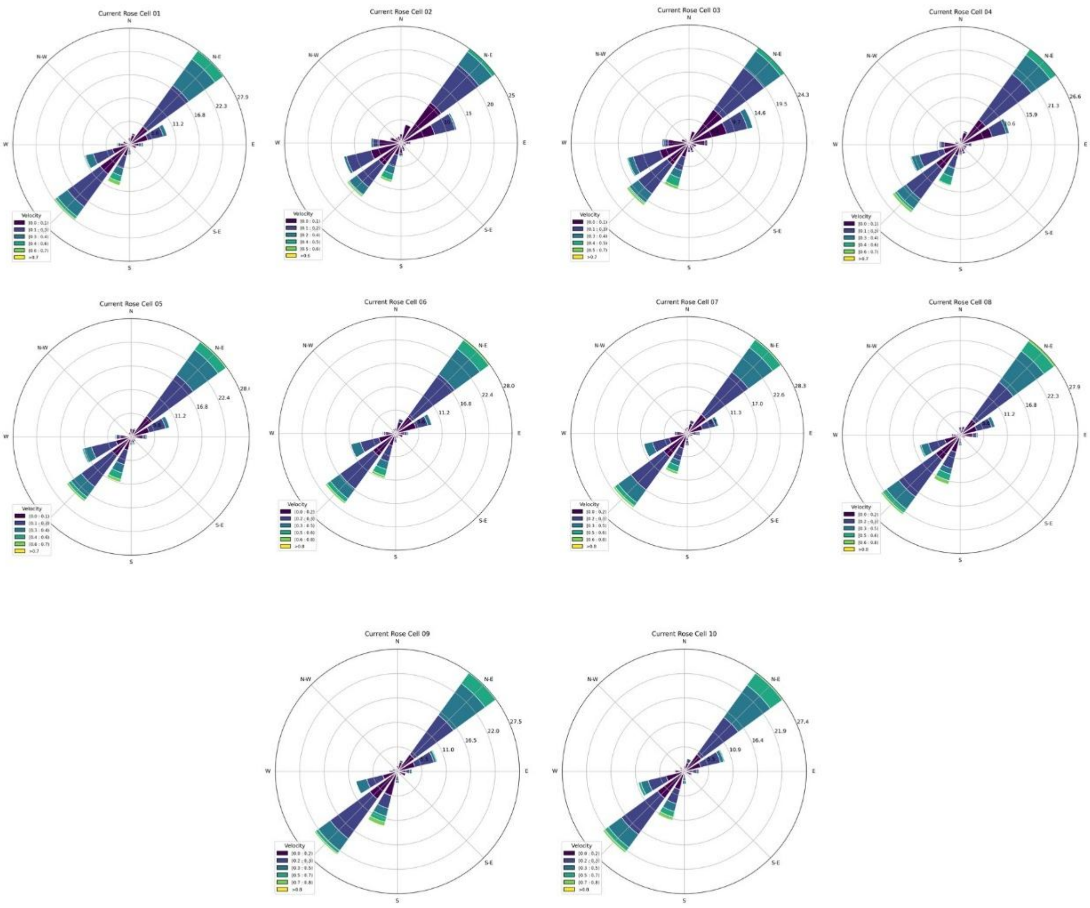

Figure 5.3. Ocean current data from the SonTek Argonaut ADCP, with colour bands representing current velocity (m/s). The size and direction of the longest spoke indicate the dominant current direction and frequency. Cell 01 is the 1 m bin above the ADCP (bottom water), with each subsequent cell representing 1 m bins up to Cell 10, which is a representation of the surface currents.

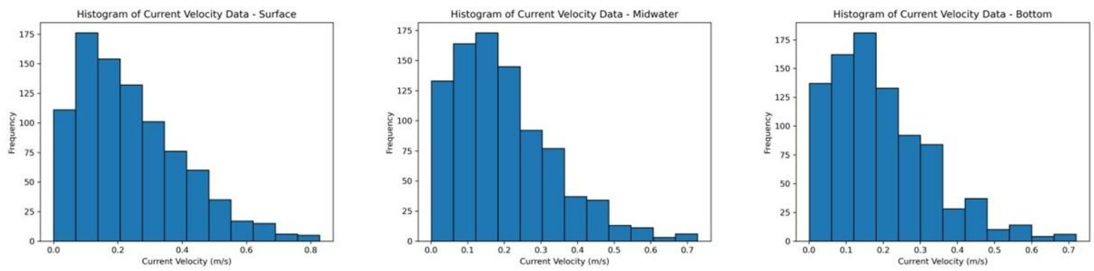

Figure 5.4. Histograms of current velocities: the first graph (left) shows surface currents (~2 m depth), the middle shows midwater currents (~5 m depth), and the last graph is representation of bottom currents (~12 m).

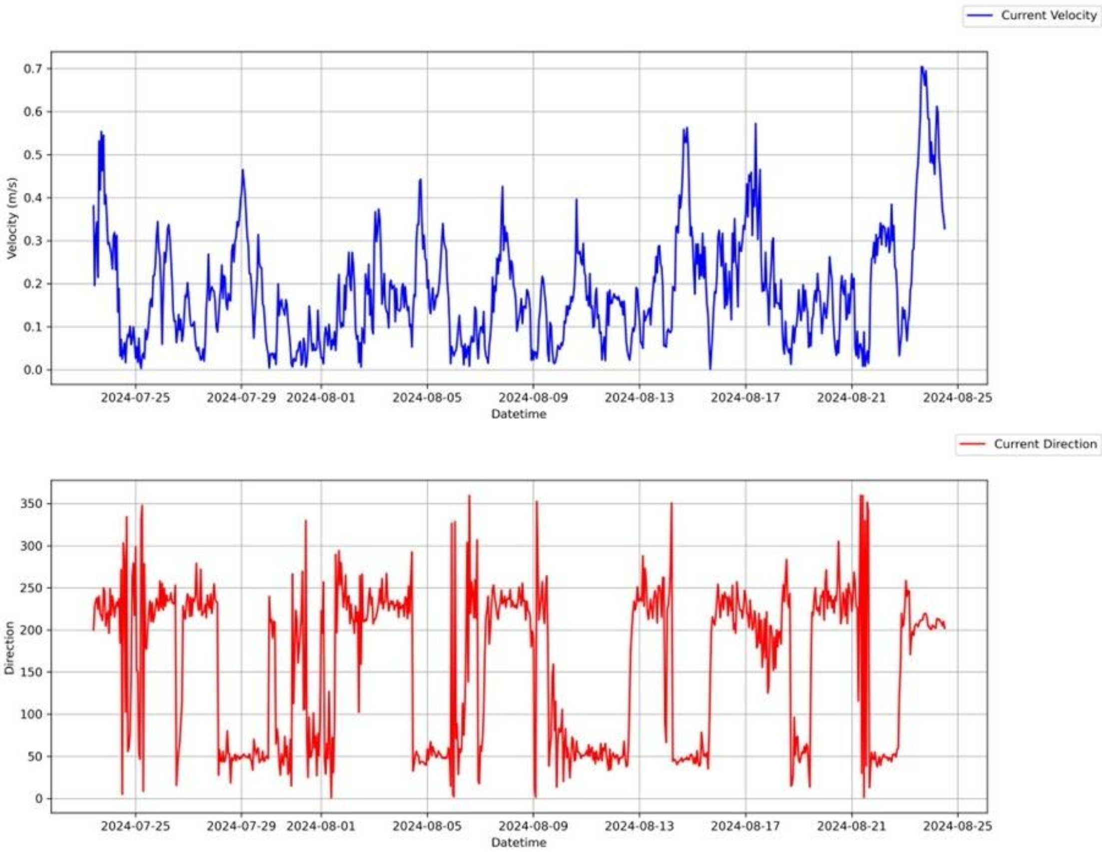

Figure 5.5. Times-series of SonTek Argonaut ADCP current velocity data (top panel) and current direction (bottom panel) covering a period of 37 sampling days, from the 23 July 2024 – 25 August 2024.

SURF ZONE PROCESSES

The surf zone characteristics is detailed in Table 5.1. The surf zone typically varies between 60-120 m under a south westerly swell from the south, although in extreme calms it can decrease to <50 m, while under storm events it can exceed 200 m width (Table 5.1). Under a westly swell however, the surf zone measures about 100 m, with no clear surf zone ‘cells’ visible (Table 5.1).

Table 5.1. Surf zone characteristics for the Port of East London breakwater.

Swell direction	Surf zone width (m)	Current cell width (m)	Example
South westerly	<50	No pattern	Figure 5.6
	100	26-60 (mean of 38)	Figure 5.7
	150-200	60-150 (mean of 100)	Figure 5.8
Westerly	100	No pattern	Figure 5.9

Figure 5.6. Example surf zone under calm conditions (Google Earth image: August 2022).

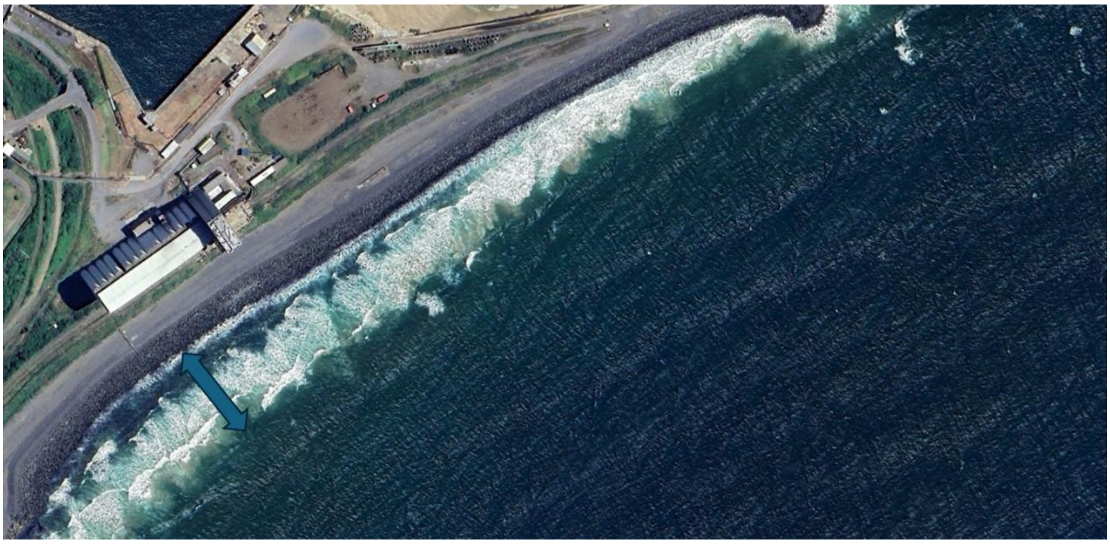

Figure 5.7. Example surf zone under typical conditions (Google Earth image: February 2024).

Figure 5.8. Example surf zone under high energy conditions (Google Earth image: Marach 2025).

Figure 5.9. Example surf zone under typical westerly swell (Top: Google Earth image December 2022. Bottom: Google Earth image November 2022).

When discharging an effluent into the surf zone, the initial dilution is described as cross-shore dilution (dilution into the bore) and the concentration of a constituent after mixing in the bore can be expressed as equation (1). Where C_e is the effluent concentration and V_x is the cross shore mixing coefficient represented by equation (2).

$$Effluent\ concentration: C_O = \frac{C_e}{V_x} \tag{1}$$

$$Cross\ shore\ mixing\ coefficient: V_x = \frac{H_{br}.X_b}{\mathrm{T}} \tag{2}$$

$$Breaker\ height\ (root\ mean\ square)(m): H_{br} \tag{2.1}$$

$$Surf\ Zone\ width: X_b \tag{2.2}$$

$$Incident\ wave\ period\ (s): T \tag{2.3}$$

Wave heights in the breaker zone at the outfall locations will mostly be around 1–2 m, with a wave period of 10 s. Surf zone widths varies most of the time between 150–300 m (Table 5.1). For a wave height of 2 m, wave period of 10 s the cross-shore mixing coefficient will vary between 20 and 30.

The CORMIX model was set up assuming a discharge into a system 'bounded' by rip currents at each end (i.e., within a cell with a 60 m diameter). An ambient velocity of 0.3 m/s was modelled.

BATHYMETRY

The project involves the construction of a pipeline to discharge effluent from the land-based facility over the dolosse into the surf zone. Conservatively, the depth here is likely to be 1.5 m close to the breakwater at the base of the dolosse (Figure 5.10).

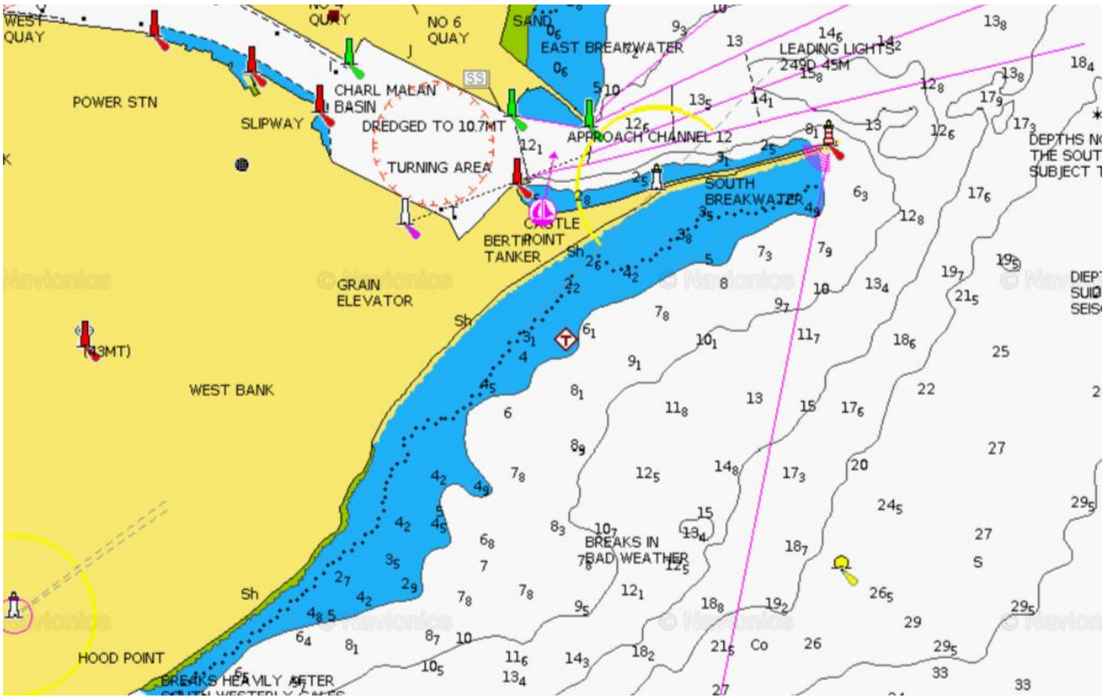

Figure 5.10. General bathymetry in the area of the proposed pipeline discharge (webapp.navionics.com).

WIND

The average monthly windspeed for East London is presented in Table 5.2 below. The average windspeed across the summer period (20.2 km/h) is very similar to that over the winter (20.6 km/h). Therefore, an average windspeed of 20 km/h was modelled - this is considered to be sufficient for this set up, given that the effluent is denser than ambient seawater and will immediately sink to the bottom of the water column, with limited wind mixing.

Table 5.2. Mean monthly wind speed (km/h) for East London (weatherspark.com).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
km/h	20.1	20.0	19.3	19.0	19.3	20.3	20.6	21.4	22.0	22.5	21.9	20.6

WATER QUALITY

A SeaCAT 19 Plus V2 CTD was used to collect baseline water quality data, focusing on the following parameters; temperature, salinity, pH, dissolved oxygen, turbidity and fluorescence (Figure 5.11). The environmental baseline survey was conducted in July 2024, completing a total of 17 CTD casts at a series of locations surrounding the proposed outfall (Table 5.3). This winter-specific data was compared to results from previous CSIR surveys predominantly carried out during the summer months, revealing seasonal trends consistent with expectations. The cast data was later downloaded, processed using SBE Seasave 7 software, and the down-cast data was analysed and visualised using Python.

In addition to the CTD profile data, a Niskin bottle was used to collect in-situ water samples at 5 m (surface) and bottom water (Figure 5.12).

Figure 5.11. Water quality sampling locations at which CTD profiles and water samples were collected during the winter survey (23 – 24 July 2024).

Table 5.3. CTD cast site details for the winter survey (23 – 24 July 2024).

Site Name	Date	Time	Latitude	Longitude
A	23.07.2024	14:11	33.03461	27.91755
B	23.07.2024	14:18	33.03422	27.91804
C	23.07.2024	14:14	33.03419	27.91759
D	23.07.2024	14:05	33.03461	27.91801
E	23.07.2024	13:46	33.03499	27.91699
F	23.07.2024	13:56	33.03377	27.91859
G	23.07.2024	13:51	33.03369	27.91711
H	23.07.2024	14:01	33.03511	27.91845
I	23.07.2024	13:42	33.03619	27.91539
J	23.07.2024	13:30	33.03276	27.92036
K	23.07.2024	13:36	33.03648	27.9199
L	23.07.2024	12:55	33.01113	27.93117
M	23.07.2024	13:13	33.00438	27.94458
N	23.07.2024	13:07	33.00552	27.94342
O	24.07.2024	09:35	33.02923	27.91427
P	24.07.2024	09:25	33.02844	27.91481
Q	24.07.2024	09:20	33.02876	27.91569

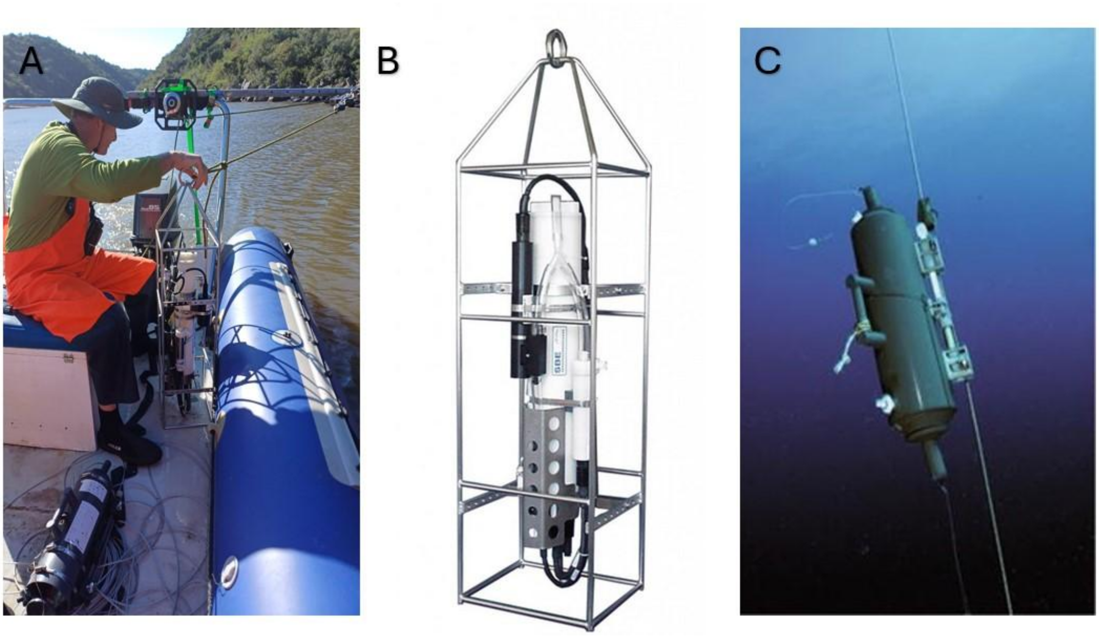

Figure 5.12. Deployment of SeaCAT CTD profiler: Panel A, Researcher using the pole mounted rig to deploy the CTD over the side of the small craft. Panel B, SeaCAT 19 Plus V2 CTD and panel C, is a Niskin bottle attached to a hauling line and used to collected 5 L water samples at a desired depth.

During the winter survey, water **temperatures** ranged between 17.5°C and 18.5°C, with no significant thermocline observed (Figure 5.13). The absence of a thermocline indicates that the water column was well-mixed, likely driven by prevailing winds and the increased coastal storm activity typical of the winter months. Unlike summer surveys, which often report strong stratification between surface and bottom layers, winter conditions promoted uniform temperature distribution throughout the entire water column.

The **salinity** data mirrored the temperature trends, with surface salinities exceeding 35 and a thin layer of less saline water immediately below the surface (~2 m) (Figure 5.13). This surface pattern can be attributed to river runoff or rainwater input. However, salinity stratification was markedly less pronounced compared to summer surveys, reflecting homogenization across the water column. Salinity values increased slightly with depth (~35.4), suggesting the presence of denser, saline-rich waters near the seafloor, a feature consistent with well-mixed winter conditions (Figure 5.13).

The **pH** recorded during the survey averaged 8.2, aligning with standards for marine environments and further indicating the presence of a well-mixed water column (Figure 5.13). This homogeneity in pH values is attributed to the high wave energy and mixing induced by winter weather conditions, such as storms and wind-driven currents.

As outlined earlier in the report, **dissolved oxygen (DO)** is critical for the survival of marine organisms. Historically, summer surveys have shown higher DO concentrations at the surface compared to bottom layers. However, the winter survey data exhibited well-mixed conditions, with DO concentrations consistently ranging between 6-8 mg/L throughout the water column (Figure 5.13). These uniform levels further affirm the suitability of the estuary and surrounding waters to support healthy aquatic life (CSIR 2022).

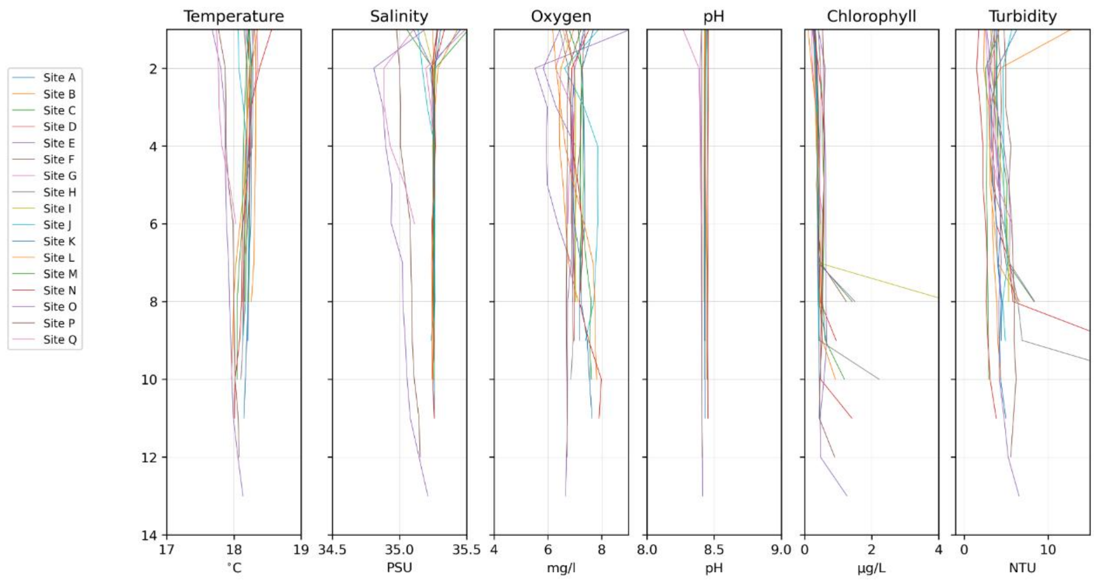

Figure 5.13. CTD profiles (Site A-Q) from the baseline water quality monitoring survey conducted in July 2024. Sites close to the proposed outfall = Sites A-K; Sites close to the proposed outfall = Sites O, P, Q; Control = Sites L, M, N.

Chlorophyll-a concentrations were minimal at the surface but exhibited notable increases below 6 m across most sampling stations (Figure 5.13). This trend suggests that phytoplankton activity is concentrated in deeper waters, potentially linked to moderate surface turbidity and enhanced nutrient availability at depth. Turbidity remained relatively uniform across the water column, with a slight increase (>10 NTU) at greater depths, indicative of suspended particulate matter settling closer to the seafloor (Figure 5.13).

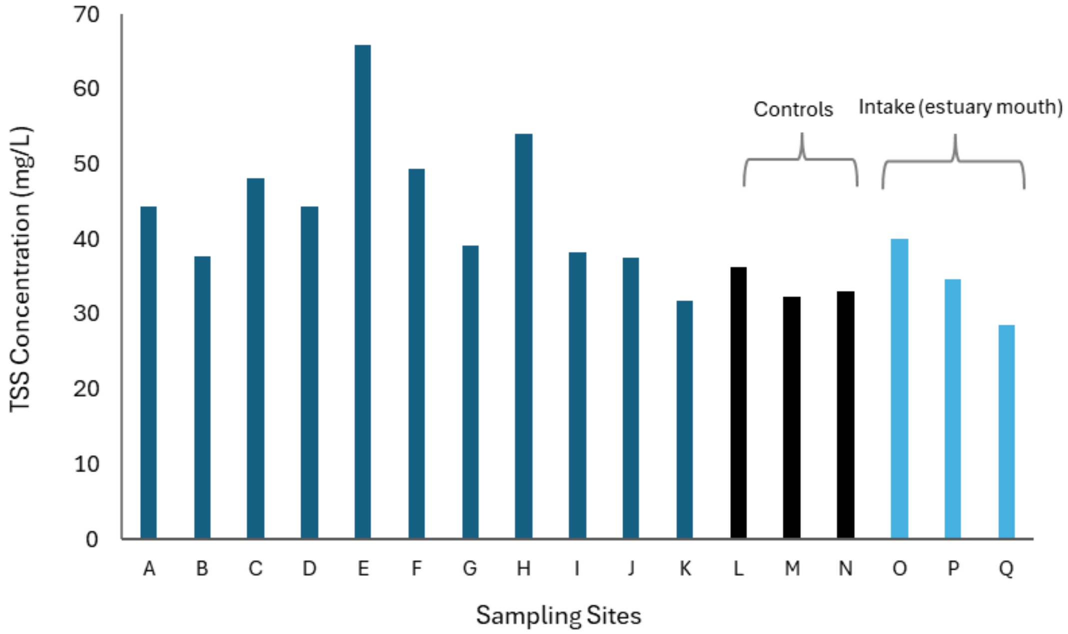

Figure 5.14. Measured Total Suspended Solids (TSS) concentrations (mg/L) collected in July 2024 across all sites close to the proposed outfall (medium blue), the intake (light blue) and control sites (black).

In-situ water samples were collected at all CTD cast locations (Sites A-Q) to assess **Total Suspended Solids (TSS)** and chlorophyll concentrations throughout the water column. The highest TSS concentrations were observed in samples collected within the proposed discharge outfall zone (Sites A-K), with particular emphasis on Sites E, F, and H, where TSS levels ranged from 50-70 mg/L (Figure 5.14). This range is consistent with typical TSS concentrations found in marine environments, where average TSS values generally fluctuate between 60.0-115.0 mg/L (Buana et al. 2021). These observed TSS concentrations reflect the presence of substantial detritus and debris that was visible within the collected samples — there were large swells on the day of sampling, post heavy rainfall, and therefore these results are likely higher than previously reported (Section 3.4.7), but likely represent a worst-case scenario.

Chlorophyll concentrations at Sites E, F, and H were approximately 0.14 µg/L, 0.16 µg/L, and 0.12 µg/L, respectively (Figure 5.15). The elevated TSS and chlorophyll concentration suggests a link between suspended particulate matter and phytoplankton biomass. Oceanographic parameters such as salinity (~35) (Figure 5.13) and TSS were found to be within ranges conducive to phytoplankton growth, further supporting this relationship (Buana et al. 2021).

Furthermore, long-term monitoring has documented frequent elevated nutrient concentrations, including dissolved inorganic nitrogen and orthophosphate, in the estuary (CSIR 2022). These elevated nutrient levels have been linked to upstream runoff, particularly from nutrient discharges associated with wastewater treatment works in the catchment area. These nutrients are considered a key driver behind occasional blooms of microalgal biomass, as reflected in elevated chlorophyll-a concentrations, especially during the summer months (CSIR 2022). Given the proximity of the sites in relation to the Buffalo River, it is likely that river runoff similarly contributes to the elevated TSS and chlorophyll concentrations observed, further supporting the hypothesis that such runoff plays a substantial role in shaping local water column productivity and nutrient dynamics.

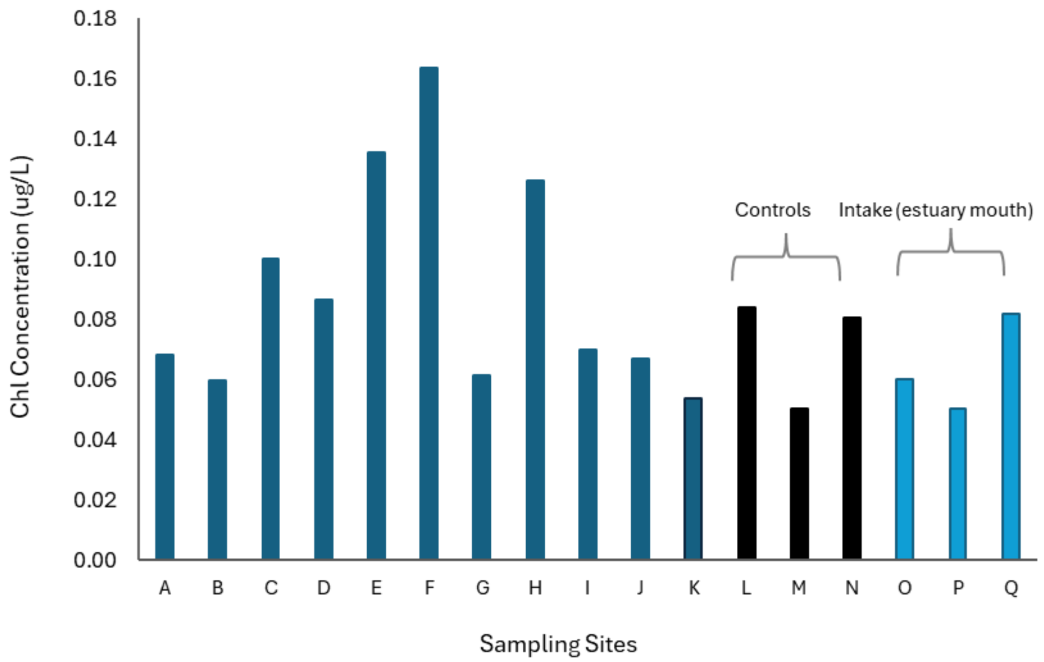

Figure 5.15. Calculated chlorophyll – a concentration (ug/L) collected in July 2024 across all sites close to the proposed outfall (medium blue), the intake (light blue) and control sites (black).

5.3.2 Effluent profile and RMZ limits

Saline water will be abstracted directly from the estuary via a direct intake pipeline. The intake water will undergo desalination (salt removal) at the plant, producing 2 ML (2 Megalitres) of fresh water per day. Intake water is pumped through numerous pored polymeric membranes by a high-pressure feed pump and an energy recovery device (ERD), where it leaves the dissolved salts and other solutes behind on the concentrate side of the membrane. The recovery of water in this first pass is generally around 40–45% of the incoming seawater. This recovered water is “fresh” or near-potable water, also known as permeate. The rest of the water will consist of highly saline brine (55-60 g/L). This brine is then either treated further (if economically feasible) or discharged into the ocean via a diffuser system

This brine, which may also contain traces of chemicals used during the desalination process (such as cleaning agents and anti-scalants), is classified as effluent. It will be discharged via a pipeline to a marine outfall, where it is expected to rapidly dilute and mix with ocean water. Before discharge, the brine will be tested and, if necessary, diluted to ensure that it meets required marine water quality standards and does not pose a risk to the surrounding marine environment.

Two design scenarios will be assessed in this study, an initial phase and a full capacity phase (as summarised in Table 5.4). A worst-case temperature increase of 5°C above ambient (Section 3.4.7) is modelled for a maximum brine salinity of 60 (Table 5.4). It is presumed that effluent quality will remain the same across the project phases, with only the volume of potable water (and therefore, brine) increasing as the plant ramps up to full capacity production (Table 5.4).

The updated South African Water Quality guideline for salinity (Table 2.1) stipulate that limits be derived from a baseline ambient, as defined by the 20th and 80th percentiles of the seasonal/event driven ambient range. The ambient data available for the outfall site (Section 5.3.1) shows a salinity range in the surface waters of 35.2-35.5 (typical of the South Coast), with a predicted median salinity limit of 35.4. This is considered overly restrictive in the area under consideration (i.e., open coast area with high wave energy). Given the strong marine saline influence noted in the lower estuary, regardless of season (see Section 3.4.7), a limit of 35.4 (0.1 above ambient) is considered overly restrictive. Using a limit of 10% above the lowest ambient value would result in a threshold of 38.7, which exceeds the maximum limit prescribed in previous gazetted WQGs (Table 2.1). Therefore, a salinity limit of 36 has been used in this study, following the 1995 WQGs (DWAF 1995). Given the strong evidence for potential impacts at a salinity of 4 above ambient (Ballegooyen et al. 2007), and the small mixing zone (30 m), an ambient threshold of 36 (0.8 above ambient) is considered suitably conservative.

Measured Total Suspended Solids (TSS) concentrations in the system are reported as typically around at 12.8 mg/L (Figure 3.14). However, these values are likely to increase substantially under high flow events (i.e., floods) (CSIR 2022) or storm events. A discharge TSS concentration of some 25 mg/L under typical operating conditions was assumed (Table 5.4).

Intermittent biocide dosing using sodium hypochlorite (NaOCl) is assumed at concentrations of 2-5 mg/L (based on a target value of 0.1 mg/l downstream of the dual media filters (as RO membranes do not tolerate exposure to oxidants) (Table 5.4).

The Required Dilution of the effluent (Table 5.4) required to ensure compliance with water quality guidelines is calculated as follows:

$$Required\ dilution = \frac{C_E - C_A}{C_G - C_A} \tag{3}$$

where

C_E is the constituent concentration in the effluent;

C_G is the target or guideline constituent concentration that is not be exceeded, according to the relevant water quality guideline (Table 2.1);

C_A is the ambient (or background) constituent concentration in the marine environment

Table 5.4. East London desalination effluent quality (winter conditions) (Swart et al. 2025).

Parameter	Unit	Effluent		Water quality target limits	Required dilutions
		Initial Phase	Full capacity		
Brine flow rate	m^3/s	0.009	0.038		

Parameter	Unit	Effluent		Water quality target limits	Required dilutions
		Initial Phase	Full capacity		
Temperature	°C	22			
Salinity	(ppt)	60		36	25
Density	kg/m^2	1 042.9			
Total Suspended Solids	mg/L	25		14.08	9.53
NaOCl	mg/L	0.05		0.003	16.67

5.3.3 Outfall design

The discharge assessed here is via a single pipeline with a single discharge point. This outfall discharges through the dolosse of the Port East London breakwater. Given the uncertainties around the design requirements, a pipe end diameter of 0.15 m was set to accommodate the maximum capacity flow rate (0.038 m^3/s), and the model makes provision for a subtidal placement of the pipe end in 0.5 m of water, angled upwards at 45°.

5.4 Results

5.4.1 Calculated concentrations

The calculated constituent concentrations after initial cross-shore dilution (dilution into the surf zone cell, as per Section 5.3.1) is presented in Table 5.5 below. Note that these calculations do not account for effluent volume directly, and there is no differentiation made between the Initial Phase and Full capacity discharge volumes.

Salinity concentrations exceed the threshold at 60 m when the swell height is 1-1.5 m under extremely small surf zone widths (10 m) but were compliant across all other conditions (Table 5.5). From available satellite imagery, it is exceedingly rare for the surf zone width to be > 10 m wide, and it is likely that this non-compliance will be temporary and limited to the immediate discharge area.

Table 5.5. Calculated concentrations after initial cross-shore dilution for salinity. Concentrations that exceed the limits are indicated in red.

Constituent	Breaker height (m)	Surf zone width (m)			
		10	20	30	60
Salinity (60 ppt)	1.0	60.0	30.0	20.0	10.0
	1.5	40.0	20.0	13.3	6.7
	2.0	30.0	15.0	10.0	5.0
	2.5	24.0	12.0	7.5	4.0
	3.0	20.0	10.0	6.7	3.3

These calculations likely represent above worst-case, and do not capture other mixing processes that are taking place within the surf zone. For example, field experiments conducted in False Bay (CSIR 1991) presented longshore achievable dilutions versus distance (note that these represent effluent discharge rates of <0.2 m^3/s, 22 times the volume for the Initial Phase, and 7 times higher than that discharged from the plant at full capacity, see Table 5.4) (Figure 5.16). Indeed, the discharge constituents that are transported via rip currents beyond the surf zone will be diluted further through by ambient currents (for example, via eddy diffusion). For a discharge of 0.2 m^3/s, a dilution of 58 is achieved 60 m from the outfall (Figure 5.16). The proposed worst-case full production discharge (flow rate of 0.038 m^3/s with a salinity of 60) requires a dilution of 25 for compliance with salinity threshold limits at 30 m from the outfall (see Section 2.2.2).

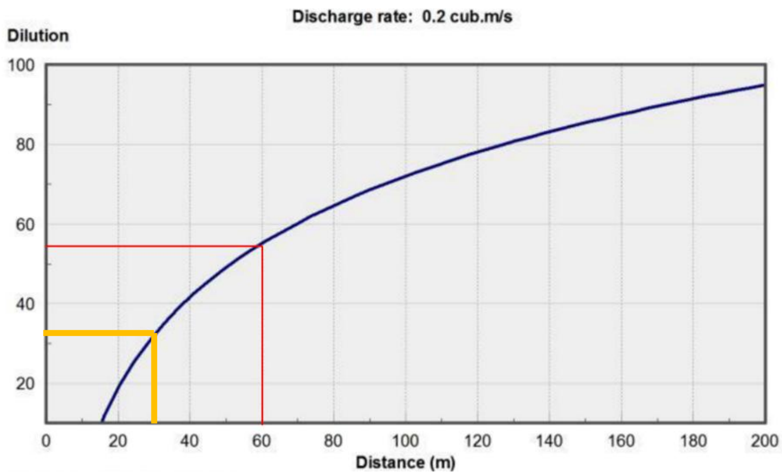

Figure 5.16. Long shore achievable dilutions versus distance calculated from False Bay field experiments (CSIR 1992). Achievable dilutions at 60 m and 30 m are shown in red in yellow receptively.

5.4.2 Modelled concentrations

All results at specific locations in the near field were determined according to the worst-case concentration of effluent exiting the pipe end. Dilutions were calculated through CORMIX and applied to the outlet concentration to find concentrations at the 30 m RMZ and the ZID. Note that CORMIX modelling provides a concentration above ambient, and the ambient concentrations are only considered post simulation.

For the proposed outfall, the effluent discharges upwards (due to the 45° angle of pipe end) from the discharge point. The discharge configuration is hydrodynamically "stable", that is the discharge strength (measured by its momentum flux) is weak in relation to the layer depth. Within the near-field region (i.e. within the ZID), which is characterised by strong initial mixing (Figure 5.17 and Figure 5.18), the flow is initially dominated by the effluent momentum (jet-like) and is weakly deflected by the ambient current. Eventaully, the negatively bouyant effluent starts to sink, and approaches the benthos. Beyond the ZID, the plume spreads laterally along the benthos while being advected by the ambient current. The mixing rate is relatively small and the plume may interact with nearby banks or shorelines.

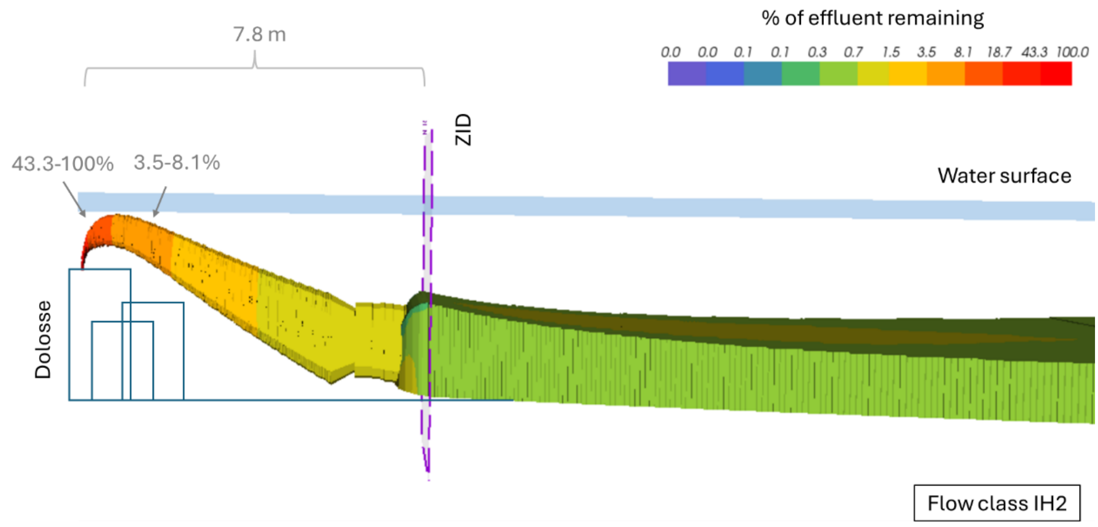

Figure 5.17. Proposed outfall CORMIX visualization of the ZID (flow class IH2) for Full Capacity flow rates. The proportion (%) of modelled effluent remining is given (note that the effluent was modelled as a conservative tracer initially set at 100%).

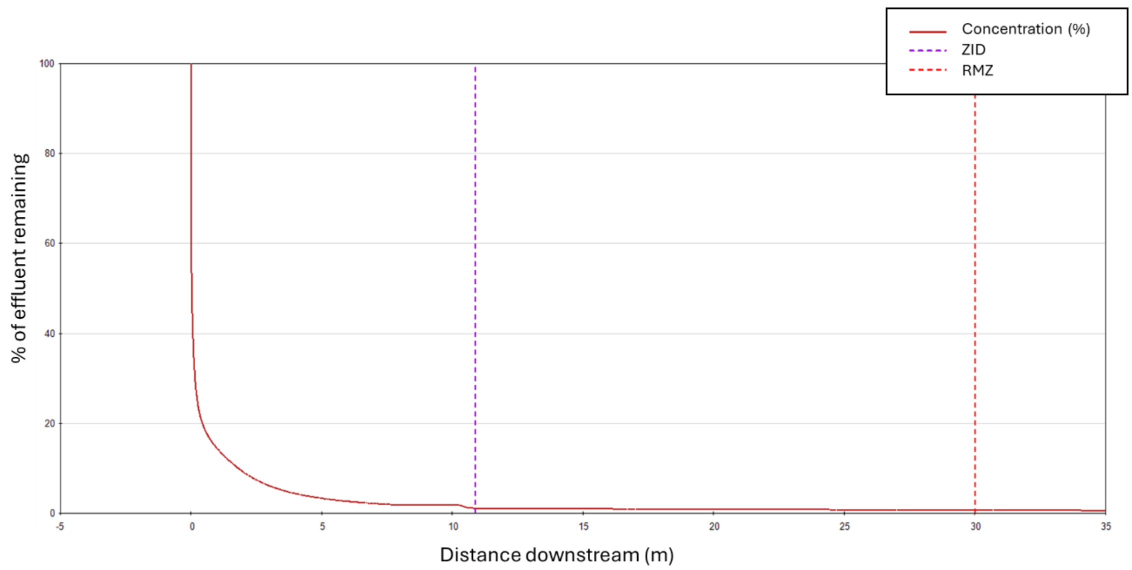

Figure 5.18. Proposed outfall CORMIX concentration (%) against downstream distance (m) for Full Capacity flow rates. The ZID (in purple) and RMZ (in red) are indicated.

Modelled conservative tracer concentrations (as a %) at the 30 m RMZ and at the edge of the ZID are presented in Table 5.6, along with the dilutions achieved (note the required dilutions specified in Table 5.4), the plume dimensions and predicted bank attachment. The model predicts that the plume will interact with the bank at 38.7 m and 57.3 m downstream from the outfall for the Initial Phase and Full Capacity phase respectively, which is well beyond the RMZ and ZID.

While validation of the model results is limited, the ability of the model to reproduce similar dilution values as those presented in Figure 5.16 lends some confidence to these results.

Table 5.6. Modelled steady state CORMIX outputs at the 30 m RMZ and ZID for the proposed outfall. All distances and concentrations are measured from the plume centreline and from the centre of the diffuser (pipe end dimeter 0.15 m).

Model outputs		**Initial Phase (flow 0.009 m^3/s)**	**Full Capacity (flow 0.038 m^3/s)**
30 m from outfall	Conservative tracer concentration (%)	2.10	1.78
	Dilutions achieved	56.00	47.60
	Distance from outfall (m)	30	30
	Plume thickness (m)	5.64	9.24
	Plume width (m)	0.30	0.65
At the ZID	Conservative tracer concentration (%)	2.88	3.07
	Dilutions achieved	32.60	34.80
	Distance from outfall (m)	6.55	7.78
	Plume thickness (m)	1.40	2.96
	Plume width (m)	0.70	1.48
Potential bank interaction (m)		38.7	57.3
Discharge velocity (m/s)		0.51	2.15

Modelled salinity, TSS and NaOCl concentrations at the edge of the ZID and 30 m RMZ for both Initial Phase and Full Capacity operations are presented in Table 5.7. All parameters modelled meet the receiving environment limit (see Section 2.2.2) at the 30 m RMZ under all operation phases (Table 5.7). These limits are also met at the ZID for all paraments under assessment. Compliance to WQG limits at the edge of the ZID is considered to be the gold standard — this is the most mathematically 'stable' leading to increased confidence in predicted compliance at the RMZ. Sufficient dilutions in the near-field (ZID) are likely to translate to similar, sufficient dilutions in the far-field (at the RMZ), with a higher degree of confidence in the result at the 30 m RMZ.

Table 5.7. Modelled CORMIX concentrations at the 30 m RMZ and ZID for the proposed outfall (pipe end dimeter 0.15 m).

Modelled outputs		**Parameter**		
		Salinity	**TSS (mg/L)**	**NaOCl (mg/L)**
Initial Phase	Effluent concentration	60.0	25.00	0.050
	WQG limit	36.0	14.08	0.003
	Concentration at RMZ	35.5	13.32	0.001
	Concentration at ZID	35.8	13.52	0.002
Full Capacity	Effluent concentration	60.0	25.00	0.050
	WQG limit	36.0	14.08	0.003
	Concentration at RMZ	35.5	13.25	0.001
	Concentration at ZID	35.7	13.57	0.001

6 IMPACT ASSESSMENT

6.1 INTRODUCTION

In the estuarine/marine environment a disturbance can be relatively short-lived (e.g., accidental spill which is diluted in the water column below threshold limits within hours) but the effect of such a disturbance may have a much longer lifetime (e.g., attachment of pollutants to sediment which may be disturbed frequently). The assessment and rating procedure described in Appendix I addresses the effects and consequences of this disturbance (i.e., the impact) 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. Both 'worst case' impacts and cumulative impacts are assessed in this report. Negative impacts associated with the activities fall into the following main categories:

- Construction phase impacts, including water quality impacts related to the construction activities, associated impacts of noise and light impacts on marine/estuarine fauna as well as the direct loss of habitat by placement of infrastructure;
- Operational phase impacts, which includes impacts on water quality and marine/estuarine fauna as a result of operational activities of the RO plant; and
- Decommissioning phase impacts.

Each of these impacts is likely to affect the associated biota in different ways and at varying intensities depending on the nature of the affected habitat and the sensitivity of the biota. Results of each assessment are presented in Table 6.1 to Table 6.10 and are summarised in Table 6.12.

As stated in Section 3.4.5, the DFFE Environmental Screening Tool found one Species of Conservation Concern (SCC) that may occur within the project area: the rocky kurper fish *Sandelia bainsii*, which is listed as Endangered on the IUCN Red List (IUCN 2025). However, this species only occurs in freshwater habitats (Mayekiso 1986, Skelton 2001), and as such is highly unlikely to be present in the estuarine or marine habitats within which the project area falls. Therefore, potential impacts on this species have been screened out of this impact assessment.

The proposed mitigation measures are based on the mitigation hierarchy which allows for consideration of five different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. When project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible. If such avoidance is not attainable, the impacts must be minimised as far as possible by the implementation of recommended, applicable mitigation measures.

6.2 Construction phase impacts

6.2.1 Disturbance of intertidal and subtidal marine habitat

Outfall infrastructure will be constructed intertidally, mostly across rocky shore and artificial breakwater habitats (see Figure 3.4). The communities near to proposed construction are likely to be typical of Eastern Cape intertidal rocky shores and reflect the predominantly marine influence in the lower system (see Figure 3.13) (CSIR 2022). The construction of these pipelines will result in disturbance of the rocky intertidal surfaces, and the associated macrofauna and flora will experience displacement and direct mortality. Therefore, it is expected that a significant, short-term decrease in macrofaunal abundance and biomass will occur as a result of the proposed construction operations.

Pipeline construction may involve some traffic on the breakwater by heavy vehicles and machinery. These activities will be localised and confined to within a few hundred metres of the construction footprint.

The relatively small footprint of the discharge pipes and 'short-term' nature of construction activities will result in the impact being felt over a very limited spatial scale and will not noticeably influence the ecology of the area as a whole. Since this disturbance will not result in a net loss of habitat, the significance of this impact is rated as 'very low' (Table 6.1). Mitigation measures should include rehabilitation of the disturbed area immediately following construction by removing all artificial materials not related to the permanent fixture of the pipeline. If these tasks are actioned, the impact is considered to be 'insignificant' (Table 6.1). The reversibility of this impact is considered to be high.

Table 6.1. Impact 1: Disturbance of intertidal and subtidal habitat.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Short term 1	Very Low 3	Probable	**VERY LOW**	-ve	High
Essential mitigation measures: • Rehabilitate the disturbed area in the intertidal area immediately following construction by removing all artificial materials not related to the permanent fixture of the pipeline • Limit duration of construction activities in the coastal zone. • Constrain spatial extent of impacts to the minimum required.								
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Possible	**INSIGNIFICANT**	-ve	High

6.2.2 Disturbance of pelagic open water habitat

Construction of the proposed intake infrastructure may result in the temporary disturbance of pelagic habitat within the construction footprint and surrounds. However, mobile fish and elasmobranchs (sharks, rays and skates) that utilise the habitat will be able to move to adjacent areas. There are no seabird colonies of particular concern in the vicinity of the proposed expansion. As such, this impact is considered 'insignificant' (Table 6.2).

Table 6.2. Impact 2: Disturbance of pelagic open water habitat.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Short term 1	Very Low 3	Possible	**INSIGNIFICANT**	-ve	High
Recommended mitigation measures: • Not considered necessary due to low significance.								

6.2.3 Disturbance and loss of estuarine habitat

Construction of the proposed infrastructure will result in the temporary disturbance and loss of EFZ habitat within the construction footprint and surrounds. Construction may involve traffic within the EFZ or within 20 m of the EFZ at the intake site by heavy vehicles and machinery, earth moving work and hardening of surfaces. The proposed pipeline routing options mostly follow existing corridors, or within the Port area, with no removal of any estuarine vegetation (Figure 1.1). The intake pipeline from the intake point to the RO Plant will be approximately 290 m in length (Figure 1.1).

The portion of the EFZ within the area of the proposed intake site is already a highly transformed site, with no little to no connectivity to the estuarine system (due to the Port quay development itself and the modified, artificial bank) (Figure 3.21). As such, the area of proposed development itself has little environmental significance to the functioning of the surrounding estuarine system. Therefore, the proposed development is not anticipated to cause direct disturbance of the estuary or cause loss of estuarine function, because the development site is effectively isolated by the breakwater from the rest of the EFZ and the Buffalo River Estuary itself and is no longer functionally linked with the estuary. As such, it is unlikely that the construction of intake infrastructure will result in significant or long-term impacts on the estuarine system.

The relatively small footprint and 'short-term' nature of construction activities will result in the impact being felt over a very limited spatial scale and will not noticeably influence the ecology of the estuary in question. A such, the significance of this impact is assessed to be 'very low' prior to mitigation (Table 6.3).

Table 6.3. Impact 3: Disturbance of estuarine habitat.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Short term 1	Very Low 3	Probable	**VERY LOW**	-ve	High
Essential mitigation measures: • Rehabilitate the disturbed area in the estuarine area immediately following construction by removing all artificial materials not related to the permanent fixture of the pipeline • Limit duration and spatial extent of construction activities in the EFZ to the minimum required. • Ensure suitable stormwater management is in place to minimize run-off to the estuarine system.								
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Possible	**INSIGNIFICANT**	-ve	High

6.2.4 WASTE GENERATION AND DISPOSAL

During the construction and initiation phase of the reverse osmosis system, offcuts and fragments of piping and other materials used or bought to site during construction, may enter the sea. The problem of litter entering the marine 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, but unfortunately these laws are seldom rigorously enforced. 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). If allowed to enter the ocean, solid waste may be transported by currents for long distances out to sea and around the coast. Therefore, unlike fuel or sewage contamination, the extent of the damage caused by solid waste is potentially large. The impact of floating or submerged solid materials on aquatic life (especially birds and fish) can be lethal and can affect rare and endangered species.

In order to reduce this, all domestic and general waste generated must be disposed of responsibly. All reasonable measures must be implemented to ensure there is no littering and that construction 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 ‘low’ without mitigation for the intake and both outfall options and is reduced to ‘very low’ by implementing the actions outlined in Table 6.4.

Table 6.4. Impact 4: Waste generation and disposal during construction.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional 2	Low 1	Medium term 2	Low 5	Probable	**LOW**	-ve	High

Essential mitigation measures:

- Suitable handling and disposal protocols must be clearly explained, and sign boarded.
- A “reduce, reuse, recycle” approach must be followed.
- Provide suitable containers for the disposal of all waste, including recycling.
- Regular litter sweeps should be carried out around the construction site.
- Intentional disposal of any litter into the environment is strictly prohibited, while accidental spillage must be prevented, contained and reported to the responsible Environmental Officer, Environmental Control Officer or other relevant party immediately.
- Inform and train all staff about sensitive estuarine species and the responsible disposal of construction waste. This training must be integrated into toolbox talks or onsite awareness sessions to ensure that waste management practices are understood and followed diligently. Additionally, contractors must prepare a method statement outlining specific waste management procedures, which must be approved by the resident engineer before construction activities commence.
- Waste disposal at licensed landfill sites by qualified contractors is mandatory, with proof of disposal submitted to the appointed Environmental Officer. Waste management certification must be obtained, and detailed records of all stored and disposed waste, including quantity, nature, and fate, must be maintained for auditing purposes.
- Adequate sanitary facilities and ablutions must be provided for all personnel throughout the project area. Enforcement of facility usage and cleanliness is crucial.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
With mitigation	Regional 2	Low 1	Medium term 2	Low 5	Possible	**VERY LOW**	-ve	High

6.2.5 EFFECTS OF HAZARDOUS SUBSTANCE SPILLS

The risk of spillage of a variety of hazardous substances may occur during the use of heavy machinery, construction vehicles and construction vessels. For example, spillage may occur as a result of fuel leaks, refuelling, or collision. Hydrocarbons are toxic to aquatic organisms and precautions must be taken to prevent them from contaminating the environment. This impact can be mitigated successfully if authorities implement a rigorous environmental management and control plan to limit ecological risks from accidents.

All fuel and oil must be stored with adequate spill 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 considered to be of 'low' significance (Table 6.5).

Table 6.5. Impact 5: The effect of the spillage of hazardous substances on marine biota

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	High 3	Medium-term 2	Medium 6	Probable	**MEDIUM**	-ve	Medium
Essential mitigation measures: • Implementation of a rigorous environmental management and control plan (including procedures for remediation). • All fuel and oil is to be stored with adequate spill protection. • No leaking vehicles are permitted on site. • All hazardous substances must be accompanied by a permit, a hazard report sheet, and may only be handled by suitably trained operators. • Implement leak detection and maintenance programmes for valves, flanges, fittings, seals, hydraulic systems, hoses, etc. All hydraulic systems should be adequately maintained, and hydraulic hoses should be frequently inspected. All process areas should be bunded to ensure drainage water flows into the closed drainage system. Drip trays should be used to collect run-off from equipment that is not contained within bunded areas and the contents routed to the closed drainage system. • Low-toxicity biodegradable detergents should be used in the cleaning of all spillages. • Intentional disposal of any substance into the environment is strictly prohibited, while accidental spillage must be prevented, contained and reported to the responsible Environmental Officer, Environmental Control Officer or other relevant party immediately.								
With mitigation	Local 1	High 3	Medium-term 2	Medium 6	Improbable	**LOW**	-ve	Medium

6.3 Operational phase impacts

6.3.1 Disturbance and/or mortality of marine life due to the intake of seawater

The impacts of seawater abstraction on marine life can include entrainment and impingement. Entrainment occurs when organisms pass through intake structures and into the processing equipment (Pankratz 2004). Impingement occurs when larger marine organisms are trapped against intake screens by the velocity of the water flow (Bamber & Seaby 2004, California Coastal Commission 2004).

While the significance of both impingement and entrainment is related to the location of an intake, impingement is primarily a function of intake velocity, and entrainment depends largely on the overall volume of water drawn into plant. Intake structures should be positioned away from sensitive environments or areas with high species diversity or abundance, like rocky reefs, and should not draw in water from the upper one metre of the water column, as planktonic organisms tend to concentrate in this zone. The intake should also avoid the bottom one metre of the water column to minimise intake of suspended sediment. Impingement and entrainment can be mitigated through optimal designs to open water intakes. The horizontal extraction of water should aid in reducing fish entrainment as fish have been shown to avoid rapid changes in horizontal flow (Pankratz 2004). There is a broadly accepted rule that water extraction velocities should not exceed 0.15 m/s to minimize debris and marine life impingement (Fedorenko 1991). Intake velocities can be reduced to the requisite 0.15 m/s through the use of footer valves which increase the area of intake, resulting in a decrease in intake velocity to safe levels. The impacts are expected to last for the duration that the plant is in operation for the lifetime of the plant. Predicted impacts are rated as ‘low’ significance before mitigation and ‘very low’ following mitigation (Table 6.6).

Table 6.6. Impact 6: Disturbance and/or mortality of marine life due to the intake of seawater.

<table>
<tr><th></th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td>Without mitigation</td><td>Local
1</td><td>Medium
2</td><td>Medium term
2</td><td>Low
5</td><td>Probable</td><td>LOW</td><td>-ve</td><td>High</td></tr>
<tr><td colspan="9">Essential mitigation measures:
• Intake velocities should be kept below 0.15 m/s to ensure that fish and other mobile organisms can escape the intake current.
• Intake structures should ensure the horizontal intake of water. This can be achieved through use of footer valves.
• Intake structures should be positioned away from sensitive environments or areas with high species diversity or abundance, like rocky reefs, and should not draw in water from the upper meter of the water column.</td></tr>
<tr><td>With mitigation</td><td>Local
1</td><td>Low
1</td><td>Medium term
2</td><td>Very Low
4</td><td>Probable</td><td>VERY LOW</td><td>-ve</td><td>High</td></tr>
</table>

6.3.2 Impacts of increased salinity on system function and biota

The primary purpose of desalination is the separation of dissolved salts and other solutes from the fresh product water. As such, the primary impacts on marine environments associated with desalination plants are associated with negatively buoyant, highly saline brine discharge.

All marine organisms have a range of tolerance to salinity, which is related to their ability to regulate the osmotic balance of their individual cells and organs to maintain positive turgor pressure. Aquatic organisms are commonly classified in relation to their range of tolerance as stenohaline (able to adapt to only a narrow range of salinities) or euryhaline (able to adapt to a wide salinity range), with most organisms falling into the first category. Salinity changes may affect aquatic organisms through direct toxicity, which initiates physiological changes (particularly osmoregulation), and indirect toxicity by modifying species distributions. Salinity changes can also cause changes to water column structure (e.g., stratification) and water chemistry (e.g., dissolved oxygen saturation and turbidity). For example, fluctuation in the salinity regime has the potential to influence dissolved oxygen concentrations, and changes in water stratification could result in shifts in the distribution of organisms in the water column and sediments. Behavioural responses to changes in the salinity regime can include escaping in the case of mobile animals such as fish and macrocrustaceans, or avoidance by sessile animals (e.g., barnacles and mussels) by closing shells or by retreating deeper into sediments. In marine ecosystems, a reduction (rather than an increase) in salinity is expected to have adverse effects in species distribution (ANZECC 2000). Very little information exists on the effect of an increase in salinity on organisms in coastal marine systems, with most studies being done either on the effects of a decline in salinity due to an influx of freshwater, or on salinity fluctuations in estuarine environments where most of the fauna are euryhaline.

Sub-lethal effects of salinity stress can include modification of metabolic rate, change in activity patterns, or alteration of growth rates (McLusky 1981). The limited data available include a reported tolerance of adults of the mussel *Mytilus edulis* of up to 60 PSU, and successful fertilization and development of its larvae at a salinity of up to 40 PSU (see Barnabe 1989 and Bayne 1965, respectively). The alga *Gracilaria verrucosa* can tolerate salinity ranges from 9 to 45 PSU (Engledow & Bolton 1994). The shrimp *Penaeus indicus* was capable of tolerating a salinity range of 1 to 75 PSU if allowed an acclimation time of around 48 hours, the oyster *Crassostrea gigas* tolerated salinities as high as 44 PSU, and the shrimp *Penaeus monodon* survived in 40 PSU saline water (McClurg 1974, King 1977, Kungvankij & Chua 1986, Kungvankij et al. 1986). A higher moulting frequency in juveniles of the prawn *Penaeus chinensis* at a salinity of 40 PSU has been reported (Chen et al. 1992). Lethal effects were reported for seagrass species: for example, salinities of 50 PSU caused 100% mortality of the Mediterranean seagrass *Posidonia oceanica*, 50% mortality at 45 PSU, and 27% at 40 PSU. Salinity concentrations above 40 PSU also stunted plant growth and no-growth occurred at levels exceeding 48 PSU (Latorre 2005).

High salinity can also lead to an increase in water turbidity, which is likely to reduce light penetration, an effect that can disrupt photosynthetic processes and reduce the production of plankton, particularly of invertebrate and fish larvae (Miri & Chouikhi 2005). One of the main factors of a change in salinity is its influence on osmoregulation, which in turn affects uptake rates of chemical or toxins. Indeed, metal toxicity generally increases with decreasing salinity, while the toxicity of organophosphate insecticides increases with increasing salinity (Heugens et al. 2001). For other chemicals, no clear relationship between toxicity and salinity has been observed. Some evidence, however, exists for an increase in the uptake of certain trace metals with an increase in salinity (Rainbow & Black 2002).

Various ecological studies have been undertaken to examine the effects of high salinity discharges from desalination plants on the receiving communities. A study on the sandy macrobenthic community off the coast of Blanes in Spain, adjacent to a desalination plant discharging brine at 33 707 m^3/day, showed no significant variation between communities within and outside of the impact area both before and after the plant start up and operation (Raventos et al. 2006). This was partly attributable to high natural variability as well as to the rapid dilution of the hypersaline brine upon leaving the discharge pipe. Other studies, however, indicated that large volume brine discharges have led to reductions in fish populations and to die-offs of plankton and coral in the Red Sea; and to mortalities in mangrove and marine angiosperms in the Ras Hanjurah Lagoon in the United Arab Emirates (Mabrook 1994, Vries et al. 1997) respectively).

Model results show that salinity limits are met at both the 30 m RMZ and at the edge of the ZID under both Initial Phase and Full Capacity flows (Table 5.6). The impact can be fully reversed once operations cease, and decommissioning is completed. Given some uncertainty around discharge into a surf zone, this impact is conservatively assessed as of 'very low' significance prior to mitigation (Table 6.7).

Table 6.7. Impact 7: Increases in salinity.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Medium term 2	Low 5	Possible	**VERY LOW**	-ve	High
Essential mitigation measures: • Effluent discharged must meet end of pipe concentrations modelled here (Section 5.3.2). • Monitoring of end of pipe concentrations must be conducted and dosing levels should be adjusted should adverse effects be detected by the monitoring program.								
With mitigation	Local 1	Low 1	Medium term 2	Low 5	Possible	**VERY LOW**	-ve	High

6.3.3 Impacts of decreased dissolved oxygen concentrations

Dissolved oxygen (DO) is an essential requirement for most heterotrophic marine organisms. Natural levels in seawater are largely governed by local temperature and salinity regimes, as well as by organic content. Coastal upwelling regions are frequently exposed to hypoxic conditions owing to extremely high primary production and subsequent oxidative degeneration of organic matter.

Hypoxic water (defined as concentrations of less than 2 millilitres of oxygen per litre) has the potential to cause mass mortalities of benthos and fish (Diaz & Rosenberg 1995). Marine organisms respond to hypoxia by first attempting to maintain oxygen delivery by increasing respiration rates, by increasing the number of red blood cells, or by increasing the oxygen binding capacity of haemoglobin. They then start conserving energy through metabolic depression, down regulation of protein synthesis and modification of certain regulatory enzymes and eventually resort to anaerobic respiration upon exposure to prolonged hypoxia (Wu 2002). As a result, hypoxia reduces growth and supresses feeding, which may eventually affect individual fitness. The effects of hypoxia on the reproduction and development of marine animals remains almost unknown. Many fish and marine organisms can detect and actively avoid hypoxia as seen during rock lobster “walk-outs” and migration of macrobenthos from their burrows to the sediment surface, rendering them more vulnerable to predation. Hypoxia may eliminate sensitive species, thereby causing changes in species composition of benthic fish and phytoplankton communities. Decreases in species diversity and species richness are well documented, and changes in trophodynamics and functional groups have also been reported. Under hypoxic conditions, there is a general tendency for suspension feeders to be replaced by deposit feeders, demersal fish by pelagic fish and macrobenthos by meiobenthos (Wu 2002). Further anaerobic degradation of organic matter by sulphate-reducing bacteria may additionally result in the production of hydrogen sulphide, which is detrimental to marine organisms (Brüchert et al. 2003).

Because oxygen is a gas, its solubility in seawater is dependent on salinity and temperature. Increases in these parameters results in a decline of dissolved oxygen levels. The 1995 South African Water Quality Guidelines for Coastal Marine Waters (Table 2.1) state that the south and east coasts, the dissolved oxygen should not fall below 5 mg/L (99% of the time) and below 6 mg/L (95% of the time) (Section 2.2.2).

A critical factor that also needs to be observed is that oxygen depletion in the effluent might also occur through the addition of sodium metabisulfite, an oxygen scavenger, should it be used as a neutralizing agent for chlorine to protect the RO membranes (Hoepner & Lattemann 2003). In this case, aeration of the effluent is recommended prior to discharge should effluent oxygen values fall below 6 mg/L 95% of the time.

Indirect changes in dissolved oxygen content of the water column and sediments due to changes in hydrodynamic and ecosystem functioning may also occur if chemicals that can act as nutrients are added to the effluent (i.e. sodium tripolyphosphate and trisodium phosphate). As these chemicals are not expected in the co-discharge, this source of DO alteration is not applicable.

Given the achievable dilutions suggested by the modelling study (Section 5.4), the high wave energy characteristic of the discharge site, the impact is expected to be of ‘low’ significance prior to mitigation (Table 6.8). The impact can be fully reversed once operations cease and decommissioning is completed.

Table 6.8. Impact 8: Reduced physiological functioning due to decreased dissolved oxygen.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Medium term 2	Low 5	Probable	**LOW**	-ve	High

Essential mitigation measures:

- Effluent discharged must meet end of pipe concentrations modelled here (Section 5.3.2).
- Aeration of the effluent prior to discharge must be undertaken if oxygen scavengers (such as sodium metabisulphite) are utilised.
- Monitoring of end of pipe concentrations must be conducted and dosing levels should be adjusted should adverse effects be detected by the monitoring program.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
With mitigation	Local 1	Low 1	Medium term 2	Low 5	Possible	**VERY LOW**	-ve	High

6.3.4 IMPACTS OF CHANGES IN PH TO SYSTEM FUNCTION AND BIOTA

The pH of the discharged seawater will be impacted by the addition of cleaning chemicals, which may include highly alkaline (pH 11-12) or acidic (pH 2-3) solutions with additives such as detergents. Alkaline cleaning solutions are used for removal of silt deposits and biofilms, whereas acidified solutions are used to remove metal oxides and scales. Other chemicals that may be added to improve cleaning efficiency are detergents, oxidants, complexing agents or biocides for membrane disinfection.

Neutralization of extremely alkaline or acidic solutions and treatment of additional cleaning agents is recommended before discharge to the ocean to remove any potential toxicity (Burger & Du Plessis 2010). For example, spent cleaning-in-place (CIP) solutions are either acidic or alkaline and must be neutralized within the CIP system before discharge. It must also be noted that seawater is also highly buffered and has a strong neutralising effect on acids. As such, the significance of the impact regarding the reduction in the physiological functioning of biota as a result of a reduction in pH through the release of co-discharges is assessed in Table 6.9. The effects are considered to be of very low intensity, will likely remain localised, and will persist for the duration of plant operation. As a result, the impact is assessed to be 'insignificant' with mitigation (Table 6.9).

Table 6.9. Impact 9: Reduced physiological functioning due changes in water pH.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Medium term 2	Low 5	Possible	**LOW**	-ve	High
Essential mitigation measures: • Effluent discharged must meet end of pipe concentrations modelled here (Section 5.3.2). • Neutralization of extremely alkaline or acidic solutions and treatment of additional cleaning agents is required prior to discharge. • Monitoring of end of pipe concentrations must be conducted and dosing levels should be adjusted should adverse effects be detected by the monitoring program.								
With mitigation	Local 1	Low 1	Medium term 2	Low 5	Possible	**VERY LOW**	-ve	High

6.3.5 POTENTIAL IMPACTS OF CO-POLLUTANT DISCHARGES

Co-pollutants are often discharged to the receiving environment as a result of the extensive pre-treatment of source water required to prevent clogging and biofouling of plant infrastructure. Pre-treatment typically includes filtration (aided by the addition of coagulants), pH control, the addition of anti-scalants, biocide, cleaning-in-place (CIP) chemicals (weak acids and detergents) as well as neutralizer (if an oxidizing biocide is used). Any residual chemicals or other additives used in pre-treatment are frequently co-discharged after dilution with the brine into the receiving environment (usually the sea). Provided that the brine is discharged into a suitable area with adequate mixing and offshore dilution, and a sufficient distance from sensitive habitats (reefs, estuaries, surf zones etc), impacts on the marine environment should be spatially limited and can be mitigated to some extent by discharge design. Another critical factor that also needs to be observed is that oxygen depletion in the effluent might also occur through the addition of sodium metabisulfite, an oxygen scavenger, should it be used as a neutralizing agent for chlorine to protect the membranes used in the desalination process (Hoepner & Lattemann 2003).

In general, the toxicity of the various chemicals most likely to be used in the pre-treatment and CIP process (with the exception of any chorine biocides) is relatively low. Model results show that NaOCl limits are met at both the 30 m RMZ and at the edge of the ZID under both Initial Phase and Full Capacity flows (Table 6.10). The impact can be fully reversed once operations cease, and decommissioning is completed.

Suitable mitigation measures, including the removal of particulates from the backwash sludge, neutralization of strong acidic and alkaline solutions, and properly considered dousing regimes are likely to result in the 'low' significance of impacts on the marine environment (Table 6.10). Mitigation measures reduce the potential impact to 'very low' significance (Table 6.10).

Table 6.10. Impact 10: The impacts of discharged co-pollutants on marine biota.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Low 1	Medium 2	Medium term 2	Medium 6	Possible	**LOW**	-ve	Medium
Essential mitigation measures: • Effluent discharged must meet end of pipe concentrations modelled here (Section 5.3.2). • Aeration of the effluent prior to discharge must be undertaken if oxygen scavengers (such as sodium metabisulphite) are utilised. • Corrosion resistant materials should be used. • Strong acidic and alkaline solutions must be neutralised prior to discharge. • There must be continual release of small volumes of chemicals used during the Clean-in-Place (CIP) process with the brine discharge to allow for maximum dilution before release into the environment. • Monitoring of end of pipe concentrations must be conducted and dosing levels should be adjusted should adverse effects be detected by the monitoring program.								
With mitigation	Low 1	Low 1	Medium term 2	Low 5	Possible	**VERY LOW**	-ve	High

6.4 Decommissioning Phase

No decommissioning procedures or restoration plans have been compiled at this stage, although impacts are expected to be less than those assessed during the construction phase. The potential impacts during the de-commissioning phase are expected to be minimal and no key issues related to the estuarine environment have been identified at this stage. The same mitigation procedures as those explained in the construction phase should be adhered to in the decommissioning phase in order to mitigate for any of the impacts listed above.

6.5 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).

By definition, cumulative marine environmental impacts emanating from the proposed project are related to the overlap with various other sources of anthropogenic disturbance in the vicinity of the impact proposed project activities, under normal operating conditions. In this case, these impacts would include 1) disturbance of estuarine/marine habitat, 2) other systems of estuarine water intake and 3) cumulative effects of other brine discharges.

As discussed in Section 6.2.1, intertidal and subtidal impacts related to construction will not result in a net loss of habitat, and affect an already transformed communities that area already subject to high levels of disturbance (though wave energy), resulting in an impact of 'very low' significance before mitigation. In a similar way, impacts to estuarine habitat resulting from the proposed development are limited in scale, and are not expected to noticeably influence the ecology of the estuary. There are no other known developments in the area of impact that would result in any cumulative effects of greater significance. There may be cumulative impacts of waste generated (especially litter), should strict project controls to control the generation and management of such waste not be implemented. To reduce potential cumulative impacts, and be cognisant of the significant amount of litter already on site (Figure 3.22 and Figure 3.23), the active clean-up of the Port environment must be undertaken, with weekly beach clean ups undertaken by TNPA as a matter of urgency.

Cumulative impacts related to intake and brine discharge are only relevant should similar operations exist within the impacted 'area of influence'. As no such developments exist, there are no anticipated cumulative effects of concern.

Table 6.11. Cumulative impacts

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Short term 1	Very Low 3	Probable	**VERY LOW**	-ve	High
Essential mitigation measures: • Rehabilitate the disturbed area in the intertidal area immediately following construction by removing all artificial materials not related to the permanent fixture of the pipeline • Limit duration of construction activities in the coastal zone.								

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
• Constrain spatial extent of impacts to the minimum required. • Ensure suitable stormwater management is in place to minimize run-off to the estuarine system. • The active clean-up of the Port environment must be undertaken, with weekly beach clean ups undertaken by TNPA as a matter of urgency. • Suitable handling and disposal protocols must be clearly explained, and sign boarded. • All staff must be informed about the detrimental impacts of pollution on aquatic species, as well as about the suitable disposal of construction waste.								
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Possible	**INSIGNIFICANT**	-ve	High

6.6 Summary of potential impacts

Table 6.12. Summary of potential impacts of the proposed development on the marine environment

Phase	Impact identified	Severity	Probability	Significance	Status	Confidence
Construction	Impact 1: Disturbance of intertidal and subtidal habitat	Very Low	Probable	**VERY LOW**	-ve	High
	With mitigation	Very Low	Possible	**INSIGNIFICANT**	-ve	High
	Impact 2: Disturbance of pelagic open water habitat	Very Low	Possible	**INSIGNIFICANT**	-ve	High
	Impact 3: Disturbance of estuarine habitat.	Very Low	Probable	**VERY LOW**	-ve	High
	With mitigation	Very Low	Possible	**INSIGNIFICANT**	-ve	High
	Impact 4: Waste generation and disposal during construction	Low	Probable	**LOW**	-ve	High
	With mitigation	Low	Possible	**VERY LOW**	-ve	High
	Impact 5: The effect of spillage of hazardous substances on marine biota	Medium	Probable	**MEDIUM**	-ve	Medium
	With mitigation	Medium	Improbable	**LOW**	-ve	Medium
Operation	Impact 6: Disturbance and/or mortality of marine life due to the intake of seawater	Low	Probable	**LOW**	-ve	High
	With mitigation	Very Low	Probable	**VERY LOW**	-ve	High
	Impact 7: Increases in salinity	Low	Possible	**VERY LOW**	-ve	High
	With mitigation	Low	Possible	**VERY LOW**	-ve	High
	Impact 8: Reduced physiological functioning due to decreased dissolved oxygen.	Low	Probable	**LOW**	-ve	High
	With mitigation	Low	Possible	**VERY LOW**	-ve	High
	Impact 9: Reduced physiological functioning due changes in water pH	Low	Possible	**LOW**	-ve	High
	With mitigation	Low	Possible	**VERY LOW**	-ve	High
	Impact 10: The impacts of discharged co-pollutants on marine biota.	Medium	Possible	**LOW**	-ve	Medium
	With mitigation	Low	Possible	**VERY LOW**	-ve	High
All	Cumulative impacts	Very Low	Probable	**VERY LOW**	-ve	High
	With mitigation	Very Low	Possible	**INSIGNIFICANT**	-ve	High

7 CONCLUSIONS

7.1 Dispersion modelling

Pollutant levels at the edge of the Recommended Mixing Zone (RMZ) are expected to comply with published Water Quality Guidelines (WQGs). A conservative 30 m RMZ was used for assessment of modelling outputs.

The calculated constituent concentrations after initial cross-shore dilution (dilution into the surf zone cell indicate that salinity WQG concentrations exceed the threshold at 60 m when the swell height is 1-1.5 m under extremely small surf zone widths (10 m) but were compliant across all other conditions. From available satellite imagery, it is exceedingly rare for the surf zone width to be > 10 m wide, and it is likely that this non-compliance will be temporary and limited to the immediate discharge area. Note that these calculations do not account for effluent volume directly, and there is no differentiation made between the Initial Phase and Full capacity discharge volumes.

Numerical modelling was performed using the Cornell Mixing Zone expert system (CORMIX) to predict the geometry and dilution characteristics of the discharge and to determine the outfall design/effluent quality requirements to achieve compliance with these WQGs. All results at specific locations in the near field were determined according to the worst-case concentration of effluent exiting the pipe end. Dilutions were calculated through CORMIX and applied to the outlet concentration to find concentrations at the 30 m RMZ and the Zone of Initial Dilution (ZID). The model predicts that the plume will interact with the bank at 38.7 m and 57.3 m downstream from the outfall for the Initial Phase and Full Capacity phase respectively, which is well beyond the RMZ and ZID.

Compliance to WQG limits at the edge of the ZID is considered to be the gold standard — this is the most mathematically 'stable' result, leading to increased confidence in predicted compliance at the RMZ. Sufficient dilutions in the near-field (ZID) are likely to translate to similar, sufficient dilutions in the far-field (at the RMZ), with a higher degree of confidence in the result at the 30 m RMZ. The model results suggest that compliance at the ZID is achieved under both the Initial Phase and Full Capacity phases for salinity, TSS and NaOCl (Section 5.4.2).

7.2 Impact assessment

For this assessment, the focus was on water quality impacts under future operations based on the dispersion modelling assessment (Section 5.3.1). The impact assessment addressed impacts related to the construction phase (direct disturbance, habitat loss etc.), as well as the operational phase (including increased salinity, TSS and NaOCl concentrations in the surf zone). Model results indicate that WQG limits are unlikely to be exceeded at the 30 m RMZ.

As such, three of the impacts are assessed as of 'very low' significance prior to mitigation (wither remaining as such or reduced to 'insignificant' with mitigation). One impact is considered 'insignificant' prior to mitigation, while five impacts are assessed as of 'low' significance (reduced to 'very low' significance with mitigation). The effect of spillage of hazardous substances on marine biota is considered to be an impact of 'medium' significance prior to mitigation, which can be successfully mitigated to 'low' significance.

By definition, cumulative marine environmental impacts emanating from the proposed project are related to the overlap with various other sources of anthropogenic disturbance in the vicinity of the impact proposed project activities, under normal operating conditions. In this case, these impacts would include 1) disturbance of estuarine/marine habitat, 2) other systems of estuarine water intake and 3) cumulative effects of other brine discharges. Intertidal and subtidal impacts related to construction will not result in a net loss of habitat and affect an already transformed communities that area already subject to high levels of disturbance (though wave energy), resulting in an impact of 'very low' significance before mitigation. In a similar way, impacts to estuarine habitat resulting from the proposed development are limited in scale, and are not expected to noticeably influence the ecology of the estuary. There are no other known developments in the area of impact that would result in any cumulative effects of greater significance. There may be cumulative impacts of waste generated (especially litter), should strict project controls to control the generation and management of such waste not be implemented. To reduce potential cumulative impacts, and cognisant of the significant amount of litter already on site, the active clean-up of the Port environment must be undertaken, with weekly beach clean ups undertaken by TNPA as a matter of urgency. Cumulative impacts related to intake and brine discharge are only relevant should similar operations exist within the impacted 'area of influence'. As no such developments exist, there are no anticipated cumulative effects of concern.

Construction phase mitigation measures include the following:

- Rehabilitate the disturbed area in the intertidal area immediately following construction by removing all artificial materials not related to the permanent fixture of the pipeline
- Limit duration and spatial extent of construction activities in the coastal zone to the minimum required.
- Ensure suitable stormwater management is in place to minimize run-off to the estuarine system.
- Suitable handling and disposal protocols must be clearly explained, and sign boarded. All staff must be informed about the detrimental impacts of pollution on aquatic species, as well as about the suitable disposal of construction waste. A "reduce, reuse, recycle" approach must be followed.
- Intentional disposal of any substance into the environment is strictly prohibited, while accidental spillage must be prevented, contained and reported immediately.
- Implementation of a rigorous environmental management and control plan (including procedures for remediation).
- All fuel and oil is to be stored with adequate spill protection.
- No leaking vehicles are permitted on site.
- All hazardous substances must be accompanied by a permit, a hazard report sheet, and may only be handled by suitably trained operators.

Operational phase mitigation measures include the following:

- Intake velocities should be kept below 0.15 m/s to ensure that fish and other mobile organisms can escape the intake current.

- Intake structures should ensure the horizontal intake of water. This can be achieved through use of footer valves.
- Intake structures should be positioned away from sensitive environments or areas with high species diversity or abundance, like rocky reefs, and should not draw in water from the upper meter of the water column.
- Effluent discharged must meet end of pipe concentrations modelled here (Section 5.3.2).
- Monitoring of end of pipe concentrations must be conducted and adjust dosing levels should adverse effects be detected by the monitoring program.
- Aeration of the effluent prior to discharge must be undertaken if oxygen scavengers (such as sodium metabisulphite) are utilised.
- Neutralization of extremely alkaline or acidic solutions and treatment of additional cleaning agents is required prior to discharge.
- Corrosion resistant materials should be used.
- Strong acidic and alkaline solutions must be neutralised prior to discharge.
- There must be continual release of small volumes of chemicals used during the Clean-in-Place (CIP) process with the brine discharge to allow for maximum dilution before release into the environment.
- Monitoring of end of pipe concentrations must be conducted and adjust dosing levels should adverse effects be detected by the monitoring program.

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APPENDIX I: IMPACT ASSESSMENT METHODS

Impact Assessment Methodology

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 1 – 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 1:

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:

- Essential: must be implemented and are non-negotiable; and
- 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 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.

ANCHOR
environmental

CURRICULUM VITAE

LILY ASTRID BOVIM

ACADEMIC QUALIFICATIONS:

MSc Marine Biological Resources Management, 2020, Ghent University (Belgium), University of the Algarve (Portugal), Galway-Mayo Institute of Technology (Ireland)
BSc (Hons) Biological Sciences, 2015, University of Cape Town
BSc Marine Biology and Ocean & Atmosphere Sciences, 2014, University of Cape Town

OTHER QUALIFICATIONS AND TRAINING:

Class V Commercial/Scientific Diver, 2023, UCT Research Diving Unit
Marine Mammal Observer (MMO) Mitigation Training, 2024, JNCC
Basic Offshore Survival Induction Emergency Training (BOSIET) with CA-EBS, 2022, OPITO
SASS5 Biomonitoring Course, 2017, Freshwater Research Centre
WRC Seagoing Safety Familiarization (STCW A-VI/I) Certificate, 2016
Advanced Open Water Diver, PADI
Level 1 First Aid, 2023, MST & PEC

COUNTRY EXPERIENCE: South Africa, Guinea, Germany, Portugal, Mozambique, Nigeria, Madagascar, Ghana
LANGUAGE PROFICIENCY: English (Excellent), Afrikaans (Basic), French (Basic)

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EMPLOYMENT HISTORY:

2022-present: Consultant: Marine Ecosystems & Resources (Anchor Environmental Consultants)
April-June 2019: Intern (Thünen Institute of Baltic Sea Fisheries, Germany)
2017-2018: DST-NRF Intern (Freshwater Research Centre)

SUMMARY PROFILE

Lily Bovim is a marine ecologist with a strong academic foundation and diverse field experience across Southern Africa and beyond. She holds an MSc in Marine Biological Resources Management (*magna cum laude*), awarded jointly by Ghent University, the University of the Algarve, and the Galway-Mayo Institute of Technology. She also holds a BSc Honours degree in Biological Sciences and a BSc in Marine Biology and Ocean & Atmosphere Sciences (Oceanography) from the University of Cape Town. She is a registered Professional Natural Scientist (SACNASP 172158). As a Consultant in Anchor's Marine Ecosystems & Resources team, Lily contributes to a wide range of marine and estuarine projects through impact assessments, environmental audits, baseline surveys, monitoring programme design, scientific diving, and specialist studies. Her fieldwork experience includes ichthyofauna and rocky intertidal surveys, benthic sampling, water and effluent quality sampling, and offshore oceanographic and deep-sea sampling. She has in-country scientific experience across South Africa and in Guinea, Mozambique, Portugal, and Germany. Lily is a medically fit Class V Scientific Commercial Diver and certified Marine Mammal Observer. Her technical skills include data analysis (R, PRIMER), GIS mapping, and basic graphic design.

SKILLS: R programming, MS Office Suite, PRIMER, GIS, Inkscape, MMO, scientific diving

SELECT PROJECT EXPERIENCE

Period	Country	Clients	Project, Tasks
2026	South Africa	Trans Atlantic Diamonds	**Basic Assessment Report for the proposed prospecting in sea Concession Area 11C.** Marine and fisheries specialist
2026	South Africa	Infinity Environmental	**Hydrodynamic Modelling and Estuarine Impact Assessment for the dredging of the Zand Estuary, Cape Town** Estuarine ecology specialist
2025-2026	South Africa	Gansbaai Marine	**Marine survey report (water quality, effluent quality, rocky shore survey, toxicity testing and impact assessment) in fulfilment of CWDP conditions** Project lead, marine ecology specialist
2026	Ghana	SLR/ Helios	**Environmental Carrying Capacity Due Diligence assessment for Nile Tilapia aquaculture farming, Lake Volta, Ghana** Co-author
2025-2026	South Africa	WSP Group Africa (Pty) Ltd	**Thyspunt and Bantamsklip proposed Nuclear Power Plant Environmental and Social Impact Assessment (ESIA): Marine Ecology and Fisheries Impact Assessment Specialist Study** Field scientist
2025	South Africa	CES - Environmental and Social Advisory Services	**Marine Impact Assessment and Dispersion Model studies for a CWDP Application for a Brackish Water Reverse Osmosis Desalination Plant Discharge at Port Alfred** Field scientist
2025	Mozambique	Kenmare/ Acer Africa	**Long-term water quality, coral reef, reef fish, turtle and fisheries monitoring programme at Caldeira and Njovo Islands, Mozambique** Marine ecology specialist
2025-2026	South Africa	uMngeni-uThukela Water	**Biannual Coastal Waters Discharge Permit effluent quality compliance audits** Data analyst, audit specialist
2025	Madagascar	ERM for Base Resources Limited	**IFC compliant marine coastal specialist studies for the Base Toliara Project ESIA, Madagascar.** Marine ecology specialist
2025	South Africa	ECA Consulting	**Marine/Estuarine Impact Assessment for the proposed development of a Liquefied Petroleum Gas Terminal, Island View Precinct, Port of Durban** Marine/estuarine ecology specialist
2023-2026	South Africa	Saldanha Bay Water Quality Trust	**The State of Saldanha Bay and Langebaan Lagoon; ongoing annual ecological monitoring of Saldanha Bay and Langebaan Lagoon.** Ichthyofauna specialist and co-editor
2024-2025	South Africa	WSP Group Africa (Pty) Ltd	**Port of Durban Point Container Terminal Reconfiguration Environmental and Social Impact Assessment (ESIA): Marine Ecology and Avifauna Impact Assessment Specialist Study** Marine ecology specialist
2025	South Africa	Gansbaai Marine	**Development of a Marine Monitoring Programme** Project lead and marine ecology specialist
2025	South Africa	Creocean Environnement & Océanographie	**Total Energies E&P South Africa Offshore Environmental Baseline Study** Benthic expert on board the Pacific Goldfinch, assisting with oceanographic data collection, benthic sampling and identification of deep-sea fauna from video footage.
2025	South Africa	Diamond Coast Abalone	**Environmental monitoring and stock assessment for abalone ranching in Hondeklipbaai, Northern Cape.** Marine ecology specialist and scientific diver
2025	South Africa	Port Nolloth Sea Farms	**Abalone Ranching Concession Area NC3 Environmental Monitoring Survey Report** Scientific diver and marine ecology specialist
2024-2027	South Africa	Department of Forestry, Fisheries and the Environment (DFFE)	**Environmental Specialist Monitoring of the Saldanha Bay Aquaculture Development Zone.** Scientific diver for the deployment and servicing of oxygen and nitrate probes, benthic macrofauna, Annual Chemical Survey and Reef survey in the ADZ.

2024-2025	**South Africa**	**Infinity Environmental (Pty) Ltd**	**Estuarine Impact Assessment and Hydrodynamic Modelling study to assess impacts of the proposed dredging of Milnerton Lagoon on estuarine function and water quality**. Marine/estuarine ecology specialist
2024	**South Africa**	**Kleinzee Holdings**	**Marine and Coastal Impact Assessment for mining activities in the Buffels Marine Mining Area, Kleinzee, Northern Cape** Field scientist, marine ecology specialist
2024	**South Africa**	**Diamond Coast Aquaculture**	**Environmental monitoring and stock assessment for abalone ranching in Kleinzee, Northern Cape**. Marine ecology specialist, scientific diver
2024	**South Africa**	**Gansbaai Marine**	**Gansbaai Marine Effluent Analysis Compliance Audits** Project lead, main audit author
2024	**South Africa**	**Transnet National Ports Authority**	**Baseline survey for marine fauna and flora monitoring, Port of Mossel Bay** Scientific diver, field scientist, ichthyofauna specialist
2024	**South Africa**	**Two Oceans Aquarium Foundation**	**Baseline survey of Marine Fauna and Flora, Granger Bay.** Scientific diver
2024	**South Africa**	**Zingce Environmental Solutions/ Transnet**	**Baseline survey of marine fauna, flora and antifouling contaminants, Port of Ngqura.** Marine ecology specialist, scientific diver, field scientist.
2024	**South Africa**	**CES/ Vopak/ Transnet**	**Estuarine specialist studies in support of an EIA for the development of a Liquified Natural Gas Import Terminal at the Port of Richards Bay, KwaZulu-Natal.** Co-author, ichthyofauna specialist, field scientist.
2023-2024	**Mozambique**	**ERM - Environmental Resources Management for DP World**	**Marine/estuarine specialist study for an Environmental and Social Impact Assessment (ESIA) application for proposed expansion of the Maputo container terminal in the Port of Maputo, Mozambique.** Marine/estuarine ecology specialist
2023	**South Africa**	**Gansbaai Marine**	**Water Quality and Marine Ecology Impact Assessment for Gansbaai Marine, Western Cape, in Fulfilment of awarded CWDP conditions.** Project manager, marine ecologist & field scientist
2023-2024	**South Africa**	**SANParks**	**Aerial survey of marine users of Table Mountain National Park Marine Protected Area and Subtidal surveys of commercially important invertebrates and indicator species within the Table Mountain Marine Protected Area.** Field scientist (helicopter survey) & scientific diver.
2023-2024	**South Africa**	**Nemai Consulting & Ugu District Municipality.**	**Estuarine offset/Compensation Plan: Assessment of the proposed development of the weir component of UBWSS in the uMzimkhulu Estuary** GIS specialist
2023	**Mozambique**	**Consultec – Consultores Associados, Lda.**	**Best Practicable Environmental Option (BPEO) and Marine Impact Assessment study of elevated phenol content in produced water discharge for Coral South FLNG, Mozambique.** Marine ecology specialist
2023	**Nigeria**	**ERM - Environmental Resources Management**	**Gap analysis and desktop estuarine component of Environmental and Social Impact Assessment (ESIA) for the MM Port FZE Project at the Federal Ocean Terminal, Onne Port Complex, Nigeria** Marine ecologist, lead author
2023	**South Africa**	**SANParks**	**Robben Island rocky shore survey** Field scientist
2023	**Mozambique**	**Consultec – Consultores Associados, Lda.**	**Best Practicable Environmental Option (BPEO) and Dispersion Modelling Study for Inshore Drilling Water Discharge, Pemba Bay Moçambique** Field scientist, marine ecology specialist
2023	**South Africa**	**Transnet**	**Port of Richards Bay estuary baseline ecological study, with focus on the fish community.** Ichthyofauna specialist, co-author
2023	**South Africa**	**Port Own Marina Authority**	**Assessment of invertebrate and fish fauna in the Berg Estuary channel and recommendations for disposal of dredge water** Field scientist
2023	**Guinea**	**Dynamic Mining/ SLR Consulting**	**Environmental assessment for a bauxite export facility in the prefecture of Boke, Republic of Guinea** In-country field scientist, marine/estuarine ecologist
2022-2023	**South Africa**	**Lucky Star Limited, Pioneer Fishing (WC) (Pty) Ltd**	**Dumping at Sea Permit application: marine environmental constraints analysis, site selection and impact statement.** Marine ecology specialist
2022-2023	**South Africa**	**Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)/ IWS**	**Economic, technical, legal, environmental, and social assessment of the suitability of desalination plants as water source for green hydrogen projects in South Africa** Primary author, marine ecology specialist
2022-2023	**South Africa**	**Total Energies/WSP**	**Marine and fisheries study as part of an ESHIA for an offshore production right and environmental authorisation applications for Block 11b/12b** Marine ecology specialist
2022-2024	**Sierra Leone**	**Iluka/ Sierra Rutile/ Digby Wells/ Jones & Wagener**	**Environmental, Safety and Health Impact Assessment (ESHIA) and environmental Flow Assessment studies for mining of the Sembehun group of deposits in the Southern Province of Sierra Leone.** Marine and estuarine specialist
2022-2023	**South Africa**	**SAMSA/ Impact Economix**	**Assessment of opportunities, challenges and risks associated with growing the maritime economy with off-shore Bunkering in St Helena Bay** Marine ecology and fisheries specialist
2022	**South Africa**	**Ugu District Municipality/ Nemai**	**Estuarine impact assessment and environmental flow assessment for the development of a weir on the uMzimkhulu estuary, KZN province** Marine/estuarine ecology specialist
2022	**South Africa**	**ECA Consulting**	**Estuarine Specialist Study for Development of Erf 578, uMzimkhulu Estuary** Marine/estuarine ecology specialist
2022	**South Africa**	**Impact Economix**	**Environmental Status Quo Report for Potential Ship-to-Ship Bunkering Operations in St Helena Bay** Marine ecology and fisheries specialist
2022-2024	**South Africa**	**Mhlathuze Water**	**Biannual Coastal Waters Discharge Permit effluent quality compliance audits** Data analyst, co-author
2022	**South Africa**	**Karpowership SA/ Triplo4**	**Marine, estuarine, fisheries and avifauna specialist studies for EIAs three power stations in the Port of Saldanha, Coega and Richards Bay** Marine ecology specialist

PUBLICATION RECORD

Winkler AC, **Bovim L**, Macena BC, Gandra M, Erzini K, Afonso P, Abecasis D. 2023. Depth and temperature preferences of meagre, *Argyrosomus regius*, as revealed by satellite telemetry. Plos one, 18(11):e0288706.

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THESES

Bovim LA. 2020. Depth and temperature preferences of satellite-tagged meagre, *Argyrosomus regius,* in the NE Atlantic. MSc Thesis, University of the Algarve, 43 pp.

Bovim LA. 2015. Stomatal response to smoke – could it prevent hydraulic death? BSc Hons. Thesis, University of Cape Town, 23 pp.

Bovim LA. 2015. Patterns of abundance and diversity among intertidal fishes of Struisbaai, South Africa. BSc Hons. Thesis, University of Cape Town, 34 pp.

CURRICULUM VITAE

AMY GRACE WRIGHT

ACADEMIC QUALIFICATIONS:

MSc Biological Sciences, 2017, University of Cape Town

BSc (Hons) Biological Sciences, 2013, University of Cape Town

BSc Marine Biology and Applied Biology, 2012, University of Cape Town

OTHER TRAINING:

Deltares Academy Delft3D Environmental Modelling, 2019, Deltares, Netherlands

First aid (Level 1)

COUNTRY EXPERIENCE: South Africa, Namibia, Mozambique, Mauritius, Nigeria, Kenya, Angola, Tanzania, Madagascar, Ghana

LANGUAGE PROFICIENCY: English (Excellent), Afrikaans (Basic)

POSTAL ADDRESS: 8 Steenberg House, Silverwood Close, Tokai 7945

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EMPLOYMENT HISTORY:

2026-current: Practice Manager Marine Systems and Hydrodynamics (Anchor Environmental Consultants Part of SLR)

2025-2026: Senior Associate: Marine Ecosystems & Resources (Anchor Environmental Consultants)

2021-2025: Senior Consultant (Anchor Environmental Consultants)

2017-2021: Marine Consultant (Anchor Environmental Consultants)

2014: Intern Consultant (Capricorn Marine Environmental)

SUMMARY PROFILE

Amy is Practise Manager: Coastal Processes & Water Quality at Anchor Environmental and a professionally registered Natural Scientist (SACNASP 131256). Her current role involves strategic leadership of coastal processes and hydrodynamic modelling team working to derive evidence-based solutions to improve sustainability and regulatory compliance. Her work involves marine and estuarine ecological and physical process specialist impact and sustainability assessments (ESIA), environmental law, environmental auditing and permitting requirements (including IFC Performance Standards), environmental monitoring program design and implementation. She has a background in ecology with an MSc degree in Biological Sciences and BSc. Hons. degrees in Marine Biology and Applied Biology from the University of Cape Town. Her areas of expertise include maritime and estuarine engineering; reverse osmosis/desalination operations; industrial and small-scale intake, discharge and cooling systems (including gas to power, green hydrogen and fisheries processing); offshore oil and gas operations; land- and sea-based mariculture; dredging and offshore mining operations; and shipping (ballast, antifoulants). She has worked extensively across temperate and tropical African systems with experience in South Africa, Namibia, Mozambique, Mauritius, Nigeria, Kenya, Angola, Tanzania, Madagascar and Ghana.

TECHNICAL SKILLS: Delft3D modelling suite (FLOW, SWAN, WAQ, PART), CorMIX, Delft3D FM, Deltares MAMPEC, Ancylus MOM, WRPLot, SEATerm, Statistica, SPSS, BGIS, BEAM-Visat, OceanView, MS Suite.

MEMBERSHIP OF PROFESSIONAL BODIES/ORGANISATIONS:

- Professional Natural Scientist, the South African Council for Natural Scientific Professions (Registration Number: 131256) (2021-)
- NF-POGO Alumni Network for the Ocean (2015-)
- Golden Key Honour Society (2011-)

SELECT PROJECT EXPERIENCE

Period	Country	Clients	Project, Tasks
2026	**South Africa**	**Rheinmetall Denel Munition**	**Team lead** Marine Impact Assessment, Coastal Waters Discharge Permit amendment application, and Delft3D Dispersion Modelling for Rheinmetall Denel Munition effluent discharges, Somerset West.
2026	**South Africa**	**SRK Consulting (South Africa) (Pty) Ltd**	**Team lead, marine ecologist** Coastal Water Discharge Permit Application for the Fishwater Flats Waste Water Treatment Works, Nelson Mandela Bay Municipality.
2026	**Ghana**	**SLR Consulting for Helios Capital**	**Hydrodynamic modelling team lead** Environmental and Social Due Diligence (ESDD) for a commercial Nile Tilapia aquaculture operation in Lake Volta, Ghana.
2025-2026	**South Africa**	**WSP Group Africa (Pty) Ltd**	**Marine ecology team lead** Thyspunt and Bantamsklip proposed Nuclear Power Plant Environmental and Social Impact Assessment (ESIA): Marine Ecology and Fisheries Impact Assessment Specialist Study
2025-2030	**South Africa**	**Eskom**	**Project manager** Provision of continuous marine engineering, monitoring and evaluation on an as and when required basis at Koeberg Nuclear Power Plant Operating Unit
2025	**South Africa**	**African Marine Solutions**	**Marine ecologist and permitting specialist** Preparation of an Environmental Management Plan (EMP) for ship-to-ship transfers required in terms of the Regulations for the Environmental Management of Offshore Ship-To-Ship Transfer (GN No. R. 6551, 28 August 2025).
2025	**South Africa**	**DNV South Africa (Pty)**	**Marine ecology team lead** Environmental screening (marine ecology and fisheries) of PetroSA offshore assets in Block 9 and 11a
2025	**South Africa**	**PRDW Africa**	**Hydrodynamic modelling team lead** Bed level change flood scenario analysis for the Milnerton Estuary under dredging scenarios. Included Delft3D sediment transport modelling.
2025	**South Africa**	**WML Coastal Engineering**	**Project manager, marine ecologist** Environmental Specialist Services in support of the Transnet National Ports Authority Foreshore Coastal Protection Project for the Port of Port Elizabeth.
2025	**South Africa**	**Guillaume Nel Environmental Consultants**	**Project manager, estuarine ecologist** Estuarine Constraints Analysis for the proposed Dreyersdal housing development, Zand estuary.

Period	Country	Clients	Project, Tasks
2025	South Africa	Savannah Environmental (Pty) Ltd	**Team lead** Marine Environmental Constraints Analysis and High-Level Impact Assessment for the Garden Route Gas to Power Project, Western Cape Province.
2025	South Africa	CES - Environmental and Social Advisory Services	**Estuarine ecologist, hydrodynamic modelling team lead** Estuarine specialist studies, inclusion avifauna impact assessment and Delft3D hydrodynamic modelling for the development of a Liquified Natural Gas Import Terminal at the Port of Richards Bay, Kwazulu-Natal.
2025	South Africa	CES - Environmental and Social Advisory Services	**Marine ecology specialist** Marine Impact Assessment and Dispersion Model studies for a CWDP Application for a Brackish Water Reverse Osmosis Desalination Plant Discharge at Port Alfred
2025	South Africa	Infinity Environmental/ City of Cape Town	**Team lead** Hydrodynamic modelling and estuarine impact assessment for the dredging of the Zandvlei Estuary, Cape Town
2025	South Africa	Guillaume Nel Environmental Consultants	**Team lead** Coastal Impact Assessment study (including marine assessment and coastal erosion study) for development of houses and erosion control measures at Schywershoek, Langebaan Lagoon
2025-2027	South Africa	uMngeni-uThukela Water	**Project manager, audit team lead** Bi-annual Coastal Waters Discharge Permit effluent quality compliance audit.
2025	South Africa	CSIR	**Reviewer** Strategic Environmental Assessment for a green hydrogen and port development in the Northern Cape.
2025	South Africa	WSP Group Africa (Pty) Ltd	**Biodiversity specialist team lead** Animal and terrestrial sensitivity specialist verification report for the proposed upgrade and deepening of the Maydon Wharf Berths 5-11 & 15 in the Port of Durban.
2025	Madagascar	ERM for Base Resources Limited	**Marine ecology specialist** IFC compliant marine coastal specialist studies for the Base Toliara Project ESIA, Madagascar.
2025	South Africa	Savannah Environmental (Pty) Ltd	**Team lead** Site selection assessment (Delft3D hydrodynamic dispersion modelling study) for the desalination infrastructure of a proposed green hydrogen and ammonia production plant in Saldanha Bay, Western Cape Province
2025	South Africa	Guillaume Nel Environmental Consultants	**Project manager, estuarine ecologist** Estuarine compliance statement for proposed bulk water pipeline crossing of the Jakkals River Estuary, Lambert's Bay
2025	South Africa	V&A Waterfront	**Marine ecology specialist** Basic Assessment Process for a Mixed-Use Development at the V&A Waterfront, Cape Town, Western Cape.
2025	Angola	HCV Africa	**Marine ecology team lead** Marine Biodiversity Assessment and Ecosystem Services Assessment (ESIA, IFC compliant) for deep-water exploratory drilling in Block 47, Lower Congo Basin, Angola

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2025	Zanzibar	ERM Consulting Tanzania Ltd	**Marine ecology specialist** Health, Safety, Environmental and Social Due Diligence Services for Zanzibar Ferry Terminal. IFC PS1 and PS6 compliance ESIA review
2025	South Africa	Infinity Environmental (Pty) Ltd / V&A Waterfront	**Marine ecology team lead** Marine Impact Assessment for and EIA Amendment process the proposed Granger Bay reclamation/revetment, V&A Waterfront, Cape Town
2024-2025	South Africa	Rheinmetall Denel Munition	**Team lead** Marine Impact Study and CorMix Dispersion Modelling for Rheinmetall Denel Munition effluent discharges, Somerset West
2025	South Africa	ECA Consulting	**Project lead, Marine/estuarine ecology team lead** Marine/Estuarine Impact Assessment for the proposed development of a Liquefied Petroleum Gas Terminal, Island View Precinct, Port of Durban
2025	South Africa	ECA Consulting/ Transnet	**Marine ecologist** Marine ecology, avifauna and water/sediment quality specialist studies for the proposed development of a Liquefied Natural Gas (LNG) Terminal at the Port of Ngqura
2025	South Africa	Enviroworks (Pty) Ltd	**Marine ecologist** Marine Ecology Impact Assessment for a Gas to Power Project at the Port of Ngqura
2025	South Africa	SLR Consulting (Africa)	**Marine ecology team lead** Block 11b/12b Environmental and Social Impact Assessment (ESIA): Marine Ecology Impact Assessment Specialist Study update
2025	South Africa	Lambert's Bay Foods (Pty) Ltd	**Project manager, environmental auditor, marine ecology and hydrodynamic modelling team lead** Environmental and effluent monitoring, audit and dispersion modelling in fulfilment of the awarded Coastal Water Discharge Permit
2024-2026	South Africa	WSP Group Africa (Pty) Ltd	**Marine ecology team lead** Port of Durban Point Container Terminal Reconfiguration Environmental and Social Impact Assessment (ESIA): Marine Ecology and Avifauna Impact Assessment Specialist Study
2024	South Africa	WSP Group Africa (Pty) Ltd	**Marine ecology team lead** Environmental screening (marine ecology and fisheries) of PetroSA offshore assets in Block 9 and 11a
2024	South Africa	Infinity Environmental (Pty) Ltd	**Project manager, estuarine ecologist, hydrodynamic modelling team lead** Estuarine Impact Assessment and Hydrodynamic Modelling (Delft3D) to assess impacts of the proposed dredging of Milnerton Lagoon on estuarine function and water quality
2024	South Africa	V&A Waterfront	**Marine systems team lead** Compilation of Marine Monitoring Plans in accordance with two awarded CWDPs (brine and cooling water) and compilation of the Operational Environmental Management Program (OEMPr) for the operational phase of the V&A Waterfront Desalination Plant
2024	South Africa	Pioneer Fishing (Pty) Ltd	**Project manager, marine ecologist, hydrodynamic modelling team lead** Dispersion model and marine assessment in support of a Dumping at Sea Permit Application for the disposal of fish bloodwater at sea in Algoa Bay

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2024	**South Africa**	**Zutari**	**Project manager** Aquatic ecology impact and risk assessment for the proposed Rooipoort renewable energy project, Klerkdorp, Northwest Province
2024	**South Africa**	**SLR Consulting (Africa)**	**Co-author and field scientist** Marine Baseline Study for WKN Benguela H2 Project, Doringbaai.
2024	**South Africa**	**Guillaume Nel Environmental Consultants**	**Project manager, estuarine ecologist** Estuarine constraints analysis and impact assessment for the proposed upgrading of the Onrus Main Pump Station, Hermanus
2024	**South Africa**	**GCS Water and Environmental Consultants**	**Project manager, estuarine ecologist** Compliance statement for the Transnet National Ports Authority 22 MW Dual Fuel Generator project, Richards Bay
2024	**South Africa**	**WSP Group Africa (Pty) Ltd**	**Project manager, marine ecologist** Compliance statements for various development sites within the Port of Cape Town (three separate appointments)
2024	**South Africa**	**Zutari**	**Project manager, water quality specialist, field scientist** Ambient water quality monitoring in Table Bay for the proposed City of Cape Town desalination project
2024	**South Africa**	**Gansbaai Marine**	**Senior environmental auditor** Gansbaai Marine Effluent Analysis Compliance Audit
2024	**South Africa**	**CES/Vopak/ Transnet**	**Estuarine ecologist, hydrodynamic modelling team lead** Estuarine specialist studies, inclusion dispersion modelling in support of an EIA for the development of a Liquified Natural Gas Import Terminal at the Port of Richards Bay, Kwazulu-Natal
2024	**South Africa**	**ECA Consulting/ Transnet**	**Project manager, marine ecologist** Marine and water quality specialist studies (monitoring and permit applications) for the construction of the marine infrastructure at the Port of Ngqura
2024	**South Africa**	**M2 Environmental Connections (Pty) Ltd/ Astron Energy**	**Project manager, marine ecologist, hydrodynamic modelling team lead** Marine specialist study, dispersion modelling and impact assessment a Coastal Waters Discharge Permit application for Astron Energy, Port Elizabeth
2024	**South Africa**	**Port Nolloth Sea Farms**	**Project manager, marine scientist** General Discharge Authorisation (GDA) application as per Section 69 of the National Environmental Management: Integrated Coastal Management Act (Act 24 of 2008)
2023	**South Africa**	**SANParks**	**Field scientist** Aerial survey of marine users of Table Mountain National Park Marine Protected Area
2023-2024	**South Africa**	**r3 Green/Afro Fishing (Pty) Ltd**	**Project manager, marine ecologist, hydrodynamic modelling team lead** Marine specialist study, dispersion modelling and impact assessment to inform a Coastal Waters Discharge Permit renewal application for the discharge fish processing water and cooling water in the Port of Mossel Bay

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2023-2024	**South Africa**	**De Beers Marine (Pty Ltd**	**Project manager, marine ecologist** Design and conduct Environmental Monitoring as per awarded Coastal Water Discharge Permit (CWDP) requirements for an outfall in the Port of Cape Town. Includes water quality (moored in situ instrumentation and CTD profiles), sediment quality and benthic macrofauna assessment
2023-2024	**Mozambique**	**ERM - Environmental Resources Management for DP World**	**Project manager, estuarine ecologist, hydrodynamic modelling team lead** Marine/estuarine specialist study and Delft-3D hydrodynamic dispersion modelling for an Environmental and Social Impact Assessment (ESIA) application for proposed expansion of the Maputo container terminal in the Port of Maputo, Mozambique
2023	**Nigeria**	**ERM - Environmental Resources Management**	**Project manager, estuarine ecologist** Gap analysis and desktop estuarine component of Environmental and Social Impact Assessment (ESIA) for the MM Port FZE Project at the Federal Ocean Terminal, Onne Port Complex, Nigeria
2023-2025	**South Africa**	**Zutari**	**Project manager, marine ecologist** Marine specialist for the EIA process for the Sea Water Desalination Project at the Cape Town Port Industrial Park (PIP)
2023	**South Africa**	**ECA Consulting**	**Project manager, marine ecologist** Maydon Wharf Channel Deepening in the Port of Durban- Update CSMP Berth 203 to 205
2023	**South Africa**	**SANParks**	**Field scientist** Robben Island Rocky Shore Survey
2023	**Mozambique**	**Consultec – Consultores Associados, Lda.**	**Project manager, marine ecologist, hydrodynamic modelling team lead** Best Practicable Environmental Option (BPEO) and dispersion modelling study for Coral South drilling water discharge/treatment options in Pemba Bay, Mozambique
2023	**Mozambique**	**Consultec – Consultores Associados, Lda.**	**Project manager, marine ecologist, hydrodynamic modelling team lead** Best Practicable Environmental Option (BPEO) and dispersion modelling study for EA amendment for the Coral South FLNG, Mozambique
2023	**Mozambique**	**Consultec – Consultores Associados, Lda.**	**Project manager, marine ecologist, hydrodynamic modelling team lead** International Association of Oil & Gas Producers (IOGP) Risk Based Assessment of offshore produced water discharge and Best Practicable Environmental Option (BPEO) for Coral South FLNG operations, Mozambique
2023	**South Africa**	**Guillaume Nel Environmental Consultants**	**Project manager, estuarine ecologist** Estuarine specialist study for the proposed upgrading of TR77/1 (R27), Velddrif
2023	**South Africa**	**West Point Processes**	**Project manager, marine ecologist, hydrodynamic modelling team lead** Update of marine specialist study and dispersion modelling for effluent discharge permits for the West Point fish meal processing plant, St Helena Bay. Liaison with marine engineers for pipe and diffuser design
2022-2023	**South Africa**	**Lucky Star Limited, Pioneer Fishing (WC) (Pty) Ltd**	**Project manager, marine ecologist** Dumping at Sea Permit application: marine environmental constraints analysis, site selection and impact statement

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2022-2023	South Africa	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Impact Water Solutions (Pty) Ltd	**Marine ecologist, hydrodynamic modelling team lead** GIZ Green Hydrogen Desalination Study to provide strategic information on the technoeconomic, legal, environmental, and social applicability of desalination plants as water source for green hydrogen projects in South Africa. Decision-support analyses for four locations. Review of ESIA report. CorMIX model to assess effluent dispersion for preferred ESIA scenario and inform outfall design
2022	South Africa	ECA Consulting	**Ecologist** Avifauna impact assessment for the Maydon Wharf Deepening and Widening Project, Port of Durban
2022	South Africa	WSP Group Africa (Pty) Ltd	**Marine ecologist** Marine ecological screening analysis for proposed green hydrogen project, Boegoebaai, Northern Cape
2022	South Africa	Infinity Environmental (Pty) Ltd.	**Estuarine ecologist** Zandvlei Dredge Assessment: Current Ecological Status
2022	South Africa	SLR Consulting	**Project manager, marine ecologist** Marine environmental early phase screening /constraints analysis for a proposed large scale desalination plant on the West Coast of South Africa
2022	South Africa	Lucky Star Limited, Pioneer Fishing (WC) (Pty) Ltd	**Project manager, marine ecologist, hydrodynamic modelling team lead** Marine Impact Assessments and associated Coastal Waters Discharge Permit applications for the offloading of fish processing water in the Port of Mossel Bay
2022	South Africa	Transnet National Ports Authority	**Marine ecologist** Marine baseline report Port of Durban, fauna, flora and antifoulant contaminants
2022	South Africa	Johan Neethling Environmental Services cc	**Project manager, estuarine ecologist** Estuarine Specialist site visit for Pre-Compliance Notice ground truthing
2022	South Africa	Guillaume Nel Environmental Consultants	**Project manager, estuarine ecologist** Estuarine Impact Assessment and Constraints Analysis study of the Berg River Estuary, Western Cape
2022-2024	Namibia	DebMarine Namibia/ Anglo American	**Hydrodynamic modelling team lead** Development of a predictive model and monitoring system to inform real-time operational and environmental risk assessment
2022	South Africa	PHS Consulting	**Project manager, marine ecologist, hydrodynamic modelling team lead** Marine specialist study and dispersion modelling for a proposed Reverse Osmosis plant operation and discharge at the West Point fish meal processing plant, St Helena Bay
2022-2024	South Africa	Marine Living Resources Fund, Department of Environment, Forestry and Fisheries	**Project manager** Independent Environmental Control Officer (ECO) for the Saldanha Bay sea-based Aquaculture Development Zone
2022	South Africa	WSP Africa/ DNG Energy (Pty) Ltd	**Project manager, ecologist** Marine Ecology and Terrestrial/Aquatic Impact Assessment for the proposed gas-to-power facility and associated infrastructure in Mosselbay, Western Cape Province

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2022-2023	South Africa	Lambert's Bay Foods (Pty) Ltd	**Project manager, environmental auditor, marine ecology and hydrodynamic modelling team lead** Environmental and effluent monitoring, audit and dispersion modelling in fulfilment of the awarded Coastal Water Discharge Permit, and permit renewal application
2022	South Africa	SRK Consulting (South Africa) (Pty) Ltd	**Project manager & marine ecology specialist** Marine Ecology Impact Statement for expansion of a sea water intake at Tronox Mineral Sands (Pty) Ltd
2021-2023	South Africa	Nemai Consulting	**Project manager & hydrodynamic modelling team lead** Delft-3D hydrodynamic dispersion modelling study of the Mzimkhulu Estuary (Kwa Zulu Natal) to assess salinity distributions and hydrodynamic impacts of a proposed weir development
2022	South Africa	Sea Harvest (Pty) Ltd	**Project manager, water quality specialist** Development and assessment of monitoring program to evaluate water quality in support of proposed Coastal Water Discharge Permit amendment
2022	South Africa	Guillaume Nel Environmental Consultants	**Project manager, estuarine ecologist** Estuarine Impact Assessment and Constraints Analysis study of the Goukou Estuary in Stilbaai, Western Cape
2021-2023	South Africa	WSP Group Africa (Pty) Ltd	**Project manager, marine ecologist** Total Energies Block 11b/12b Environmental and Social Impact Assessment (ESIA): Marine Ecology Impact Assessment Specialist Study
2021-2022	South Africa	Department of Environment, Forestry and Fisheries	**Co-author** Saldanha Bay Aquaculture Development Zone Environmental Monitoring: Inception report, Progress reports, Quarterly Monitoring reports
2021-2022	South Africa	Nemai Consulting	**Field scientist, water quality specialist** Ecological Water Requirements (EWR) update and estuarine impact assessment for the Mzimkhulu Estuary, Kwa Zulu Natal
2021-2022	South Africa	Exigent Engineering Consultants	**Project manager, marine ecologist & hydrodynamic modelling team lead** Marine Impact Assessments and hydrodynamic dispersion modelling for proposed FSRU facilities and associated infrastructure in Saldanha Bay
2021	South Africa	V&A Waterfront	**Co-author** Economic Assessment of Recreational Sailing in Cape Town
2021	South Africa	EcoMo Homes	**Project manager** Freshwater Assessment: Wetland Delineation for Erf 325, Franschhoek
2021	South Africa	Mossel Bay Municipality	**Co-author** Amendments to the Environmental Maintenance Management Plan (EMMP) for the Great Brak Estuary, Mossel Bay
2021-2023	South Africa	Mhlathuze Water	**Project manager, audit team lead** Annual Coastal Waters Discharge Permit effluent quality compliance audit
2021	South Africa	PHS Consulting	**Project manager, marine ecologist, hydrodynamic modelling team lead** Marine specialist study and dispersion modelling for the proposed expansion of the West Point fish meal processing plant, St Helena Bay

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2021	**South Africa**	**SLR Consulting (South Africa) (Pty) Ltd**	**Project manager, marine ecologist** Marine Ecology Specialist Assessment for the import and export of refined petroleum products at Berth 104 in Big Bay, Saldanha
2021	**South Africa**	**V&A Waterfront**	**Co-author** Economic impact analysis of the proposed Granger Bay Marina
2021	**South Africa**	**SRK Consulting (South Africa) (Pty) Ltd**	**Project manager** Olifants estuarine baseline and ephemeral system hydrological modelling study to inform sensitivity study for De Punt prospecting site
2021	**South Africa**	**Proxa Water (Pty) Ltd**	**Project manager, audit team lead** Coastal Waters Discharge Permit compliance audit as requested by the Department of Forestry, Fisheries and the Environment
2021	**South Africa**	**Bigen Africa Services (Pty) Ltd**	**Project manager** Bioassay toxicity testing in line with the requirements of the Caledon Waste Water Treatment Works Water Use License
2021	**Namibia**	**Benguela Current Commission**	**Project manager (South African team)** Drafting of national legislation for the effective implementation of the Ballast Water Convention in Namibia
2021	**South Africa**	**Nsovo Environmental Consulting**	**Project manager, marine ecologist** Marine Impact Assessments for proposed gas-to-power facilities (FSRU) and associated infrastructure development in Saldanha Bay, Mossel Bay and Coega
2021	**South Africa**	**Allan Gray (Pty) Ltd**	**Project manager, audit team lead** Coastal Waters Discharge Permit compliance audit
2021	**South Africa**	**PetroSA**	**Water quality specialist** Assessment of the inshore subtidal environment in the vicinity of the PetroSA Outfall at Vleesbaai, Mossel Bay
2020-2021	**South Africa**	**V&A Waterfront**	**Project manager & hydrodynamic modelling team lead** Marine specialist study and dispersion modelling for the East Pier District cooling plant outfall at the V&A Waterfront
2020-2021	**South Africa**	**De Beers Marine (Pty) Ltd**	**Project manager & hydrodynamic modelling team lead** Far field dispersion modelling (Delft 3D FLOW) and impact statement for proposed desalination outfalls in the Port of Cape Town. Amendment to CWDP
2020, 2023	**South Africa**	**St Helena Bay Water Quality Trust**	**Co-author** The State of St Helena Bay, ongoing physico-chemical and ecological monitoring of St Helena Bay
2020	**Kenya, Tanzania**	**Swedish Agency for Marine and Water Management**	**Specialist** Poverty and gender considerations in Marine Spatial Planning: review and conceptual framework
2020	**South Africa**	**Doug Jeffery Environmental Consultants**	**Project manager** Wetland Rehabilitation plan for the Stillbay arterial roadway, Western Cape, South Africa
2020-2021	**South Africa**	**CES - Environmental and Social Advisory Services**	**Project manager, marine ecologist** Marine Impact Assessment for the proposed marine pipeline servitude at the Coega Industrial Development Zone, Port of Ngqura, South Africa
2020	**South Africa**	**Guillaume Nel Environmental Consultants**	**Project manager, estuarine ecologist** Estuarine Impact Assessment study for the development 222 and 223 Weir Road Milnerton

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2020	**South Africa**	**Chand Environmental Consultants**	**Project manager, marine ecologist** Marine Specialist Study for the Proposed Transnet 2.5 Ml/D Reverse Osmosis Plant in the Port of Cape Town – Baseline Study and Impact Assessment Report
2020	**South Africa**	**Transnet National Ports Authority**	**Marine ecology team lead** Amendment to Environmental Authorisation of Transnet Berths 203-205 on the Port of Durban – Marine Ecology Impact Assessment of new proposed dredging activities
2020, 2022-2023, 2024	**South Africa**	**Rheinmetall Denel Munition**	**Project manager, marine ecologist** Coastal Waters Discharge Permit environmental monitoring and impact assessment (beach macrofauna, sediment, water quality)
2020	**South Africa**	**City of Cape Town**	**Project manager, marine ecologist** Marine ecology monitoring plans (MEMPs) for the Helderberg Marine Protected Area, Milnerton Lagoon and Zandvlei Estuary
2020	**South Africa**	**City of Cape Town**	**Marine ecology specialist** Biodiversity assessment/survey and public information programme for five tidal pools around the Cape Peninsula
2020, 2021	**South Africa**	**SRK Consulting (South Africa) (Pty) Ltd**	**Marine ecology specialist** Marine Ecology Impact Assessment for expansion of a sea water intake at Tronox Mineral Sands (Pty) Ltd
2020	**South Africa**	**ATKV**	**Marine ecology team lead** Hartenbos (Mossel Bay) dune stabilisation specialist study and impact assessment
2020	**South Africa**	**Lake Michelle Estate**	**Marine ecology specialist** Fish community survey of Lake Michelle, Noordhoek
2019-2020	**South Africa**	**Department of Environmental Affairs and Development Planning (DEA&DP)**	**Hydrodynamics, sediment dynamics and biota Specialist** Environmental flows and the health and value of the Berg River Estuary: Potential trade-offs between estuary value and regional water supply under a changing climate
2019-2022	**South Africa**	**Sea Harvest (Pty) Ltd**	**Project manager, hydrodynamic modelling team lead and marine ecologist** Development and undertaking of monitoring program (sediment, water quality and benthic macrofauna) to both fulfil CWDP conditions and validate the CorMIX hydrodynamic modelling study that informed the application
2019-2020	**South Africa**	**Bivalve Shellfish Farmers Association of South Africa — Saldanha Bay Chapter**	**Marine ecology team lead** Sanitary Survey Report for Saldanha Bay in accordance with guidelines stipulated in the South African Live Molluscan Shellfish Monitoring and Control Programme (2017)
2019-2020	**South Africa**	**ArcelorMittal Saldanha**	**Project manager, marine ecologist** Design and implementation of the environmental monitoring program in accordance with the CWDP
2019	**South Africa**	**De Beers Marine (Pty) Ltd**	**Project manager, hydrodynamic modelling team lead and marine ecologist** Dispersion modelling (CorMix) and specialist marine impact statement for a desalination discharge in the Port of Cape Town
2019	**South Africa**	**De Beers Marine (Pty) Ltd**	**Project manager** Review of environmental permitting requirements for the De Beers Port of Cape Town desalination plant

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2019	**South Africa**	**Doug Jeffery Environmental Consultants**	**Project manager, hydrodynamic modelling team lead and marine ecologist** Delft 3D (FLOW, WAQ) hydrodynamic modelling, CorMIX dispersion modelling and specialist marine impact studies for a proposed Atlantic Salmon farm the Port of Cape Town
2019-2021	**Mauritius**	**International Ocean Institute; Mauritius Oceanography Institute**	**Hydrodynamic modelling team lead and marine ecologist** Development of a Deltares MAMPEC dispersion model to capture marine pollutant dispersion resulting from in-water hull cleaning in Port Louis. Included training of the MOI staff in the use, set up and calibration of the model, as well as in collection, interpretation and implementation of the requisite oceanographic data
2019	**Mozambique**	**JG Afrika**	**Project manager, estuarine ecologist** Estuarine specialist report for proposed MOZAL Matola River pipeline
2018-2019	**South Africa**	**Planet Capital (Pty) Ltd**	**Project manager & hydrodynamic modelling team lead** Dispersion modelling of effluent outfall (CorMix), baseline study, impact assessment and CWDP application for the discharge of land-based aquaculture effluent
2018	**South Africa**	**NuLeaf Planning & Environmental**	**Estuarine ecology team lead** Marine impact assessment for the establishment of an aquaculture development zone in Amatikulu Estuary, Kwa-Zulu Natal
2018-2019	**South Africa**	**Lwandle Technologies (Pty) Ltd**	**Marine ecology specialist** City of Cape Town small scale desalination plant monitoring program marine ecology baseline, operational and post-operational monitoring report
2018	**South Africa**	**Marine Living Resources Fund, Department of Agriculture, Forestry and Fisheries**	**Team lead (Hydrodynamic modelling team lead)** Ancylus MOM dispersion modelling of finfish cage aquaculture in Algoa Bay to determine impacts and carrying capacity
2018	**South Africa**	**Marine Living Resources Fund, Department of Agriculture, Forestry and Fisheries**	**Hydrodynamics and marine ecology specialist** **Algoa Bay Sea-Based Aquaculture Development Zone:** Basic Assessment Process in Terms of the National Environmental Management Act, 1998 (Act No. 107 Of 1998) - Pre-Application Basic Assessment Report Appendix D: Marine Specialist Impact Assessment
2018, 2024	**South Africa**	**SeaVuna Fishing Company (Pty) Ltd**	**Project manager & hydrodynamic modelling team lead** Dispersion modelling of effluent outfall (CorMix), baseline study and impact assessment for the discharge of brine effluent into the Port of Mossel Bay as per the awarded CWDP
2018, 2023	**South Africa**	**V&A Waterfront**	**Project manager, marine ecologist** Development and implementation of an Environmental Monitoring in accordance with CWDP 2013/002/WC/Victoria & Alfred to both fulfil CWDP conditions and validate the hydrodynamic modelling study that informed the application
2018	**South Africa**	**Chand Environmental Consultants**	**Project manager, marine ecologist** Marine specialist study and impact assessment for a CWDP application for a reverse osmosis plant at the Cape Town International Convention Centre (CTICC)

Period	Country	Clients	Project, Tasks
2018-2019	**South Africa**	**Sea Harvest (Pty) Ltd**	**Project manager, hydrodynamic modelling team lead and marine ecologist** Dispersion modelling of effluent outfall (CorMix), baseline study, impact assessment and CWDP application for the discharge of brine effluent into Saldanha Bay
2018	**South Africa**	**City of uMhlathuze**	**Team lead (estuarine ecology)** Estuarine ecology impact assessment for construction of a new bridge over the Mzingazi Canal at the Richards Bay Waterfront
2018	**South Africa**	**Turnkey Water Solutions, Hessequa Local Municipality**	**Estuarine ecology specialist** Marine ecology impact assessment and dispersion modelling for the discharge of brine from a Reverse Osmosis Plant in the Breede River Estuary
2018	**South Africa**	**Khula Environmental Services**	**Team lead (marine ecology)** Marine ecology impact assessment for the maintenance management plan for the rock revetment at East Pier, Port of Cape Town
2018-2021	**South Africa**	**Mhlathuze Water**	**Marine ecology and effluent specialist** Marine Environment Impact Assessment for Mhlathuze Water Effluent Pipelines, in Richards Bay
2018	**South Africa**	**WSP, Environment & Energy, Africa**	**Project manager, marine ecologist** Marine ecology impact assessment for sea water cooling system intake discharge in the Port of Cape Town
2018	**Mozambique**	**JG Afrika**	**Project manager, hydrodynamic modelling team lead and estuarine ecologist** Dispersion modelling of effluent outfall (CorMix), baseline study and impact assessment for the discharge of brine effluent into Maputo Bay
2018	**South Africa**	**SRK Consulting (South Africa) (Pty) Ltd**	**Project manager, hydrodynamic modelling team lead and marine ecologist** Dispersion modelling of effluent outfall (CorMix), baseline study and impact assessment for the discharge of brine effluent into Saldanha Bay. Preparation of the Coastal Water Discharge Permit
2018	**South Africa**	**Sun International, Table Bay Hotel; GCX Analytics GCX Water**	**Project manager, hydrodynamic modelling team lead and marine ecologist** Dispersion modelling of effluent outfall (CorMix), baseline study and impact assessment for the discharge of brine effluent into Table Bay. Preparation of the Coastal Water Discharge Permit; registration as a Water Services Intermediately with the Department of Water and Sanitation; registration as a private sector water provision intervention under the City of Cape Town S30A Directive
2018	**South Africa**	**ArcelorMittal Saldanha**	**Project manager, hydrodynamic modelling team lead and marine ecologist** Dispersion modelling of effluent outfall (CorMix), baseline study and impact assessment for the discharge of brine effluent into Saldanha Bay. Preparation of Coastal Water Discharge Permit application
2018	**South Africa**	**Mainport Africa**	**Marine ecology specialist** Assessment of biofouling community collected from NM Cherry Blossom
2017	**South Africa**	**Viking Fisheries**	**Fisheries specialist** Socio-economic assessment of the impacts in a reduction of quota on a small commercial fishery

Period	Country	Clients	Project, Tasks
2017	**South Africa**	**SRK Consulting (South Africa) (Pty) Ltd**	**Marine ecology specialist** Tormin Mine EIA assessment, West Coast, South Africa; marine specialist report: baseline scoping report and marine environmental impact assessment
2017	**South Africa**	**GIBB**	**Marine ecology team lead** Marine specialist report for Table Bay and the Port of Cape Town; review of the known data regarding the oceanographic and ecological conditions of Table Bay and the Port of Cape Town
2017	**South Africa**	**GIBB**	**Marine ecology specialist** CorMIX modelling of effluent outfall for storm surge scenario for Cape Recife WWTW
2017	**South Africa**	**Oiltanking MOGS (Pty) Ltd and Advisian**	**Marine ecology team lead** Impact assessment for the proposed expansion of the crude oil jetty and construction of the associated pipeline system, Saldanha Bay, Western Cape; marine specialist report: baseline scoping report and marine environmental impact assessment
2017	**South Africa**	**Nsovo Environmental Consulting**	**Project manager** Impact assessment for the proposed design and construction of the IOT stormwater system Saldanha Bay, Western Cape; marine specialist report: baseline scoping report and marine environmental impact assessment
2017	**South Africa**	**Eco Impact Legal Consulting (Pty) Ltd.**	**Estuarine ecology team lead** Estuarine specialist study and impact assessment for the proposed expansion of Kliphoek Resort, Velddrif
2017	**South Africa**	**Advisian, City of Cape Town**	**Marine ecology specialist** Marine ecology impact assessments for eleven desalination plants for the Cape Town Emergency Water Resilience Project
2017, 2018, 2021-2025	**South Africa**	**Saldanha Bay Water Quality Forum Trust**	**Marine ecology specialist** The State of Saldanha Bay and Langebaan Lagoon; ongoing annual physico-chemical and ecological monitoring of Saldanha Bay and Langebaan Lagoon
2017	**Namibia**	**NAMDEB**	**Invertebrate taxonomy specialist** Annual benthic sampling campaign: NAMDEB's offshore environmental monitoring programme in the midwater mining license area
2017	**Namibia**	**De Beers Marine Namibia**	**Invertebrate taxonomy specialist** Annual benthic sampling campaign: De Beers Marine Namibia environmental monitoring programme in the Atlantic 1 mining license area for 2016
2017	**Namibia**	**De Beers Marine Namibia**	**Invertebrate taxonomy specialist** Annual benthic sampling campaign: De Beers Marine Namibia environmental monitoring programme in the Atlantic 1 mining license area for 2015

STUDENT CO-SUPERVISION

Year	Name	Institution	Degree	Thesis title
2017	Arno Botha	UCT	BSc (Hon)	Build or rent? Advantages and disadvantages of pseudo shells to two deep-water hermit crab species.

PUBLICATION RECORD

Wright, A.G., Griffiths, C.L. & Fairweather, T. 2020. Distribution and abundance patterns of two parapagurid hermit crabs (Crustacea: Decapoda: Anomura) along the west and south coasts of South Africa. *African Journal of Marine Science* 42(2): 177-183.

Wright, A.G., Botha, T.P.A. & Griffiths, C.L. 2019. Population structure and morphology of South African deep-water parapagurid hermit crabs. *Acta Zoologica*: 1–15.

Pillay, D., Moyo, R., **Wright, A.G.** 2018. Density- vs trait-mediated responses of a symbiont (Betaeus jucundus) to burrows of a burrowing crustacean (*Callichirus kraussi*). *Estuarine, Coastal and Shelf Science* 209: 183-190.

Wright, A.G., Perez-Portela, R., Griffiths, C.L. 2016. Determining the correct identity of South African Marthasterias (Echinodermata: Asteroidea). *African Journal of Marine Science* 8(3): 443-455.

THESES

Wright, A.G. (In process). *Dispersion modelling applications to inform management and assessment of anthropogenic discharges impacts to coastal marine systems*

Wright, A.G. 2017. *Deep water parapagurid hermit crabs: their distribution, abundance population structure and associations in the Southern Benguela*. MSc Thesis, University of Cape Town, 120 pp.

Wright, A.G. 2013. *Drivers of burrow symbiont distribution in a soft-sediment system: host abundance or burrow trophic environment?* BSc Hons. Thesis, University of Cape Town, 33 pp.

Wright, A.G. 2013. *Resolution of the Marthasterias Taxonomic "Disar-star".* BSc Hons. Thesis, University of Cape Town, 32 pp.

CONFERENCES

2025 Southern African Marine Science Symposium. Applicability of a near-field model to inform impacts to and management of land derived coastal discharges on coastal marine systems

2019 Deltares Delft Software Days. Hydrology and hydrodynamics; Coastal morphodynamics; Water quality and ecology.

2016 International Benguela Symposium. Long-term changes in distribution and population structure of deep water hermit crabs in the southern Benguela (awarded Best Poster)

2015 Zoological Society of South Africa (ZSSA). Deep water hermit crab–zoanthid associations

2014 Southern African Marine Science Symposium. The Marthasterias "disar-star"

CURRICULUM VITAE

TAHLIA TRISH HENRY

ACADEMIC QUALIFICATIONS:

MSc, Hydrography, 2020, Plymouth University

BTech, Oceanography, 2015, Cape Peninsula University of Technology

OTHER TRAINING:

Certified Commercial Diver (Class IV) – Course dates: 06 Nov 2017 – 04 December 2017, dive supervisor: Mr Pieter Truter. Registration number: SDS02/2156/256

Padi Open water Diver Level 2, 18 July 2011, dive instructor: Mr Iain Robertson. Diver number: 1108UK2850

First Aid Level 1, 2025

Personal Survival Techniques, 2027 - OPITO

Personal Safety and Social Responsibility, 2027 - OPTIO
Marine Firefighting, 2027 - OPTIO
Emergency Medical Care at Sea, 2027 - OPTIO

COUNTRY EXPERIENCE:

South Africa, Namibia, England, Antarctica (South African and German Base), Germany, Somaliland

LANGUAGE PROFICIENCY: English (Excellent), Te Reo Maori (Good), Afrikaans (Basic)

POSTAL ADDRESS: 8 Steenberg House, Silverwood Close, Tokai 7945

PHONE: +27-21-7013420 **E-MAIL:** tahlia@anchorenvironmental.co.za

EMPLOYMENT HISTORY:

2022- present: Environmental Consultant: Marine Ecosystems & Resources (Anchor Environmental Consultants)

2020 - 2022: Information Specialist (Antarctic Legacy of South Africa)

2017 - 2018: Marine Technician (Lwandle Marine Technologies)

2016 – present: SEAmester Co-ordinator (University of Cape Town)

SUMMARY PROFILE

Tahlia is a physical oceanographer with a background in operational oceanography and hydrographic survey. She completed her BTech in 2015 at Cape Peninsula University of Technology, where her work and studies focused on the physical oceanographic dynamics of the Prince Edward Island region and investigating connectivity between Sub-Antarctic islands using Lagrangian modelling techniques. She completed a taught MSc in Hydrography, University of Plymouth (2021) in which her dissertation focused on sediment and current dynamics in estuarine regions to best monitor and salvage sunken

wrecks using hydrographic survey techniques. These postgraduate studies have given Tahlia skills in remotely sensed and oceanographic data collection, data analysis, coding and research report writing and presenting. Tahlia has worked as an oceanographic technician serving onboard marine research vessels overseeing operation, maintenance and validation of oceanographic instruments. As part of her offshore work experience, she has had the opportunity to build skills in the fields of operational/physical oceanography and hydrography. Tahlia is currently an environmental consultant at Anchor Environmental Consultants. Her responsibilities include data collection (scientific diving), GIS mapping, data processing, report writing and assisting within the benthic monitoring team.

SKILLS: OceanParcels modelling package, GIS, ArcMap, SBE data processing, QPS QINSy, QPS Qimera, QPS FMGT, SonarWiz 7, Python, Matlab, MS Suite.

MEMBERSHIP OF PROFESSIONAL BODIES/ORGANISATIONS:

- Hydrographic Society of South Africa (HSSA) (2020-)
- Project Collaborator at Antarctic Legacy of South Africa (2020-)
- All-Atlantic Floating University Network (2019-)
- Lead Co-ordinator of SEAmester – South Africa's Class Afloat (2016-)

SELECT PROJECT EXPERIENCE

Period	Country	Clients	Project, Tasks
2025 - 2026	Namibia	De Beers Marine	**Shift lead and on-board technician (GoodWind):** Survey techniques include the use of a Van Veen grab, sediment and water quality instruments, manned submersible surveys, drop camera and benthic tow camera systems. Identify benthic invertebrate macrofauna, analysis of underwater video footage, statistical analyses and writing of report.
2025	South Africa	Sea Technology Services/ MFMR - Namibia	**Trainer, Ocean Technician** CTD training and oceanographic instrumentation
2025	Namibia	Hyphen Green Hydrogen Project	**Field scientist, team lead** Marine baseline study of green hydrogen project in Lüderitz and Prinzen Bucht.
2025	South Africa	Sea Harvest (Pty) Ltd	**Field scientist, data analyst** Monitoring program to evaluate water quality in support of proposed Coastal Water Discharge Permit amendment.
2025	Somaliland	DP World	**Commercial Diver, Fieldwork, Coral survey** Coral relocation and bio survey of established coral reef nursery and coral harvesting and planting on plinth structures.
2025	Namibia	NAMDEB	**Field scientist** Namdeb Coastal Monitoring Programme. Rocky shore and sandy beach surveys.
2025	South Africa	Trans Hex Group	**Shift lead and on-board technician** Benthic sampling in sea concessions 2C and 3C and reporting for Belton Park Trading 127 (PTY) LTD.

Period	Country	Clients	Project, Tasks
2025	**South Africa**	**City of Cape Town and Infinity Environmental**	**Commercial Diver, Field work, Identification** Receiving environment monitoring programme for City of Cape Town Marine Wastewater Outfalls.
2024 - 2025	**Namibia**	**De Beers Marine**	**Shift lead and on-board technician (DP Star):** Survey techniques include the use of a Van Veen grab, sediment and water quality instruments, manned submersible surveys, drop camera and benthic tow camera systems. Identify benthic invertebrate macrofauna, analysis of underwater video footage, statistical analyses and writing of report.
2024	**South Africa**	**Transnet – East London Port Survey**	**Commercial Diver, Field work, Identification, Report writing** Baseline survey of marine fauna, flora and ETP bird counts and deployment and retrieval of oceanographic equipment, Port of East London
2024	**South Africa**	**Two Oceans Aquarium – Granger Bay**	**Commercial Diver, Field work, Identification,** Video transects and quadrat surveys in Granger bay
2024	**South Africa**	**Saldanha Bay Water Quality Trust**	**Commercial Diver, Fieldwork** The State of Saldanha Bay and Langebaan Lagoon; ongoing annual ecological monitoring of Saldanha Bay and Langebaan Lagoon.
2024	**South Africa**	**Table Mountain National Park**	**Commercial Diver, Field work, Identification** Diving transect lines for Table Mountain National Park surveys collecting qualitative data on invertebrate fauna
2024	**South Africa**	**Transnet – Mossel Bay Port Survey**	**Commercial Diver, Field work, Identification, Report writing** Baseline survey of marine fauna, flora and antifouling contaminants, Port of Mossel Bay
2024	**South Africa**	**RV SA Agulhas II**	**SEAmester South Africa's Class Afloat, cruise co-ordinator** Served as the cruise coordinator for SEAmester VI Class Afloat and formed part of the on-board team of lecturers. Personal lectures focused on Hydrographic Survey and Oceanographic Instrumentation/Data analysis
2024	**South Africa**	**Zutari, CoCT**	**Commercial Diver, Fieldwork** Design and deploying four passive sampler moorings and housings for each chem-catcher, for ongoing survey of a proposed outfall pipeline for the City of Cape Town
2024	**South Africa**	**SLR Consulting/ WKN Windcurrent**	**Commercial Diver, Field survey** Marine baseline study for coastal water discharge permit.
2024	**South Africa**	**Transnet – Ngqura Port Survey**	**Commercial Diver, Field work, Identification, Report writing** Baseline survey of marine fauna, flora and antifouling contaminants, Port of Durban

Period	Country	Clients	Project, Tasks
2023 - 2024	**Namibia**	**De Beers Marine**	**Shift lead and on-board technician (DP Star):** Survey techniques include the use of a Van Veen grab, sediment and water quality instruments, manned submersible surveys, drop camera and benthic tow camera systems. Identify benthic invertebrate macrofauna, analysis of underwater video footage, statistical analyses and writing of report.
2023	**Somaliland**	**DP World**	**Commercial Diver, Fieldwork, Coral survey** Coral relocation and bio survey of newly established coral reef nursery and coral harvesting and planting on plinth structures.
2023	**South Africa**	**Saldanha Bay Water Quality Trust**	**Commercial Diver, Fieldwork** The State of Saldanha Bay and Langebaan Lagoon; ongoing annual ecological monitoring of Saldanha Bay and Langebaan Lagoon.
2023	**South Africa**	**Southern Estuarine Rehabilitation Action Group (SERAG)**	**Fieldwork, on site technician** Installation of AquaTroll 600 and Vulink (telemetry system) for continuation data uplink monitoring the state of Great Brak Estuary.
2023	**South Africa**	**Allan Gray (Pty) Ltd**	**Field technician, data quality management** Effluent Quality Audit of the Awarded Coastal Waters Discharge Permit for the seawater cooling system and desalination plant at No. 1 Silo Square, V&A Waterfront.
2023	**South Africa**	**South Africa National Parks (SANParks)**	**Commercial Diver, Fieldwork, Data analysis and GIS spatial mapping** Invertebrate survey and abundance count around Robben Island (MPA). Analysis of survey data and presenting GIS spatial map depicting the number of taxa for the MPA.
2022 - 2023	**South Africa**	**Department of Forestry, Fisheries and Environment (DFFE).**	**Commercial Diver, Fieldwork** Specialist monitoring programme and management recommendations for the Saldanha Bay Aquaculture Development Zone.
2023	**South Africa**	**RV SA Agulhas II**	**SEAmester South Africa's Class Afloat, cruise co-ordinator** Served as the cruise coordinator for SEAmester V Class Afloat and formed part of the on-board team of lecturers. Personal lectures focused on Hydrographic Survey and Oceanographic Instrumentation/Data analysis
2022	**South Africa**	**RV SA Agulhas II**	**SEAmester South Africa's Class Afloat, cruise co-ordinator** Served as the cruise coordinator for SEAmester V Class Afloat and formed part of the on-board team of lecturers. Personal lectures focused on Hydrographic Survey and Oceanographic Instrumentation/Data analysis
2019	**South Africa**	**RV SA Agulhas II**	**Technical Officer** Participated in the SCALE voyage (http://www.scale.org.za) aboard the SA Agulhas II, appointed as a Team Leader for the Oceanography group and Technical Officer. Main duties entailed CTD operations, data processing, TSG maintenance, ADCP operations and validation of CTD oxygen and salinity sensors.

Period	Country	Clients	Project, Tasks
2019	**South Africa**	**RV SA Agulhas II**	**SEAmester South Africa's Class Afloat, cruise co-ordinator** Served as the cruise coordinator for SEAmester IV Class Afloat and formed part of the on-board team of lecturers. Personal lectures focused on Hydrographic Survey and Oceanographic Instrumentation/Data analysis
2018-2019	**South Africa**	**RV SA Agulhas II**	**Oceanographic Technician** Served on board the SA Agulhas II for two back-to-back expeditions, SANAE 58 Antarctic relief voyage and the Weddell Sea expedition 2019: (https://weddellseaexpedition.org) (1 Jan 2019 – 22 February 2019). During the SANAE 58 component of the voyage served as the on board oceanographic technician, operating and maintaining ship based instrumentation (CTD, TSG, CPR and Scientific Data System). On the Weddell Sea Expedition served as the on board CTD technician/operator/data processor and winch driver for tethered oceanographic equipment (CTD, Bongo nets, Gravity corer and Multi-corer). Publication: (https://hal.archives-ouvertes.fr/hal-03017804)
2018	**South Africa**	**RV SA Agulhas II**	**SEAmester South Africa's Class Afloat, cruise co-ordinator** Served as the cruise coordinator for SEAmester III Class Afloat and formed part of the on board team of lecturers. Science on board: Sampling of the ASCA line, XBT deployments, CTD/winch operator and Salinometer operator.
2018	**South Africa**	**RV SA Agulhas II**	**Oceanographic Team Leader** SA Agulhas II relief voyage to Marion Island. Served as the Group Leader for the mooring operations and assisted with CTD ops, XBT deployments and winch operator for bio nets and dredge.
2018	**South Africa**	**City of Cape Town**	**Technical Manager** Technical manager (equipment prep, curation and technical assistance) for a water monitoring plan for a proposed Salt-Water Reverse Osmosis Plant for the City of Cape Town.
2018	**South Africa**	**PRDW**	**Diver, fieldwork and data analysis** Metocean data collection, service and co-management of long-term water quality monitoring programs in Table Bay and Cape St. Francis South Africa.
2018	**South Africa**	**Actimar (Operational Oceanography), Total**	**Field Technician** HF radar installation and collection of wave/current data using WERA ocean remote sensing system at three sites along the South African coastline.
2018	**South Africa**	**City of Cape Town**	**Diver, data analysis** Metocean data collection and service of instruments (ADCP, temperature recorders) in line with oceanographic survey conducted in Cape Town harbour.

Period	Country	Clients	Project, Tasks
2017	**South Africa**	**RV SA Agulhas II**	**Chief Scientist** SA Agulhas II relief voyage to Gough Island. Served as the DEA (Department of Environmental Affairs) appointed ship based Chief Scientist. Science on board: hydrographic continuous measurements, Euro-Argo float deployments, SOCCOM float deployments and calibration CTDs in collaboration with Scripps Institute of Oceanography - SOCCOM group. (https://soccom.princeton.edu/sites/default/files/imagesfiles/SOCCOM_2017-1_91AH20170907_Gough_.pdf)
2017	**South Africa**	**RV SA Agulhas II**	**SEAmester South Africa's Class Afloat, cruise co-ordinator, team leader** SA Agulhas II for SEAmester II Class Afloat. Served as the Co-ordinator for the program/cruise, lecturer for instrumentation module and group leader for the physical oceanographic team conducting work on the SAMBA monitoring line.
2017	**South Africa**	**RV SA Agulhas II**	**Chief Technician** SA Agulhas II Winter Cruise. Served as the Chief Technician, coordinating the physical oceanographic team, conducting hydrographic measurements and supervised UCT physical oceanography students on board.
2017	**South Africa**	**RV SA Agulhas II**	**Oceanography Team Leader** SA Agulhas II relief voyage to Marion Island. Served as the Group Leader for the mooring operations and assisted with CTD ops, XBT deployments and winch operator for bio nets and dredge.
2017	**Switzerland**	**RV Akademik Tryoshnikov/ EPFL – Swiss Polar Institute**	**Oceanographic Technician** RV Akademik Tryoshnikov for ACE Leg 3: Punta Arenas to Cape Town. Served as the CTD operator and on board technician. (https://spi-ace-expedition.ch/category/leg-3/)
2016	**Switzerland**	**RV Akademik Tryoshnikov/ EPFL – Swiss Polar Institute**	**Course Convenor, Oceanographic Technician** RV Akademik Tryoshnikov (Antarctic Circumpolar Expedition ACE Leg 0 – Class Afloat: Bremerhaven to Cape Town). Served as the course convenor and lecturer for the "Tools of the Trade" module covering physical oceanography principles and instrumentation. Assisted the science team on board by serving as the CTD operator and provided technical support. (https://spi-ace-expedition.ch/category/leg-0-ace-maritime-university/)
2016	**South Africa/Germany**	**RV SA Agulhas/Alfred Wagner Institute**	**Chief Scientist** Joined the SA Agulhas II (via flight to Antarctica) and took over as the DEA (Department of Environmental Affairs) appointed ship based Chief Scientist for the remaining two legs of the SANAE 56 Antarctic Relief Voyage. Science on board: conducting hydrographic measurements and physical oceanographic research along the GoodHope line, in-ice CTD operations and coordinated the retrieval of a tall mooring for the Alfred Wegner Institute (AWI).

Period	Country	Clients	Project, Tasks
2016	**South Africa**	**RV SA Agulhas II**	**Oceanographic Technician** SA Agulhas II Winter Cruise (Leg 2). Served as the group leader for the Physical Oceanographic team. Science on board: XBT deployments, Apex float deployments, CPR (continuous plankton recorder) operator, CTD/winch operator and salinometer operator.
2016	**South Africa**	**RV SA Agulhas II**	**SEAmester South Africa's Class Afloat, cruise co-ordinator** SA Agulhas II SEAmester I Cruise. Served as the cruise coordinator and formed part of the on board team of lecturers. Science on board: Sampling of the ASCA line, XBT deployments, CTD/winch operator and Salinometer operator
2016	**South Africa**	**RV SA Agulhas II**	**Oceanographic Technician** SA Agulhas II relief voyage to Marion Island and Prince Edward Island, conducted short mooring deployments and retrievals, sediment dredging (continuation of 2015 study), XBT deployments and CTD/winch operator.
2015-2016	**South Africa**	**RV SA Agulhas II**	**Oceanography Team Leader** SA Agulhas II SANAE 55 Antarctic Voyage. Served as the group leader for the University of Cape Town research team, conducting hydrographic measurements and physical oceanographic research along the GoodHope line.
2015	**South Africa**	**RV SA Agulhas II**	**Oceanographic Technician** SA Agulhas II relief voyage to Marion Island and Prince Edward Island, conducted short mooring deployments and retrievals, sediment dredging (for invertebrate samples) and bio optic float and XBT deployments.
2015	**South Africa**	**RV SA Agulhas II**	**Oceanographic Technician** SA Agulhas II relief voyage to Gough Island and Tristan de Cunha, conducted CTD operations, XBT deployments and Argo float deployments.
2015	**South Africa**	**RV Algoa**	**Oceanographic Technician, data analysis** RV Algoa conducting mooring deployments and biological research (bongo nets operations and on-board laboratory work)

PUBLICATION RECORD

Talley, L. D., Miller, M., **Henry, T**., Johnson, K., Riser, S., Boss, E., Dickson, A., and Key, R. 2017. SOCCOM biogeochemical profiling float deployments from SA Agulhas II AGAU027 (Gough Island). SOCCOM Tech. Rep. 2017-1.

Hutchinson, K., Deshayes, J., Sallee, J.B., Dowdeswell, J.A., de Lavergne, C., Ansorge, I., Luyt, H., **Henry, T**. and Fawcett, S.E., 2020. Water mass characteristics and distribution adjacent to Larsen C Ice Shelf, Antarctica. Journal of Geophysical Research: Oceans, 125(4), p.e2019JC015855.

Henry, T., Robinson, C., Haumann, F.A., Thomas, J., Hutchings, J., Schuback, N., Tsukernik, M. and Leonard, K., 2019. Physical and biogeochemical oceanography data from Conductivity,

Temperature, Depth (CTD) rosette deployments during the Antarctic Circumnavigation Expedition (ACE). (1.0) [Data set]. Zenondo. https://doi.org./10.5281/zenodo.3247384

CONSULTING REPORTS

Biccard, A., Rees, A., Ho. Y., Gammon, EJ., Malan, A., Le Gall, L., Payne, R., **Henry, T**. Cook, J., Schmidt, KM., Nkwentsha, O., Malgas, M., Joja, E., Haihambo, W., Januarie, D., Kanyemba, J., Gazeau, B., Clark, B. & Wright, A.G. 2026. De Beers Marine Namibia Benthic Environmental Monitoring Programme: Atlantic 1 Mining Licence Area 2024 Sampling Campaign. Report no. 2210/2 prepared by Anchor Environmental Consultants (Pty) Ltd for De Beers Marine Namibia (Pty) Ltd. 209 pp.

Biccard A, Payne RP, **Henry T**, Ho Y, Malan A, Gammon E, Rees A, Schmidt KM, Wright A, Rajeev H, Nashima P, Nkwentsha O, Malgas M, Joja E, Januarie D, Kanyemba J, Bovim LA and Clark BM. 2025. De Beers Marine Namibia Benthic Environmental Monitoring Programme: Atlantic 1 Mining Licence Area 2023 Sampling Campaign. Report prepared for De Beers Marine Namibia (Pty) Ltd by Anchor Environmental Consultants (Pty) Ltd. Report no. AEC2137.

Biccard A, Payne RP, **Henry T**, Ho Y, Malan A, Schmidt KM, Nashima P, Januarie D and J Kanyemba. 2024. Namdeb Environmental Monitoring Program in the Midwater Mining Licence Area: 2023 Benthic sampling Campaign. Report prepared for Namdeb Diamond Corporation (Pty) Ltd. by Anchor Environmental Consultants (Pty) Ltd. Report no. AEC2141

Biccard A, Hutchings K, Payne R, Malan A, Nashima P, Gammon E, **Henry T**, Schmidt K, Wright A and BM Clark. 2024. Marine Baseline Study for WKN Benguela H2 Project, Doringbaai. Report no. 2164/3 prepared by Anchor Environmental Consultants (Pty) Ltd for SLR Consulting (Africa). 113 pp.

Biccard A, Payne RP, Ho Y, Malan A, Hutchings K, Clark BMC, Schmidt KM, **Henry TT** and S Mtsokoba. 2024. De Beers Marine Namibia Benthic Environmental Monitoring Programme: Atlantic 1 Mining Licence Area 2022 Sampling Campaign. Report prepared for De Beers Marine Namibia (Pty) Ltd by Anchor Environmental Consultants (Pty) Ltd. Report no. AEC205

CONFERENCES

2021 Southern oCean seAsonaL Experiment Symposium (SCALE): Presented on cruise data and technical reporting

2018 South African National Antarctic Program Symposium (SANAP): Presented on data management onboard the SA Agulhas II (poster)

2014 Southern African Marine Science Symposium. Project title: "Real-time Underwater Acoustic Relay Network" (poster)

2023 Subsurface Mooring Training Course on mooring design, recovery and deployment: Presented by Institute of Oceanology, Chinese Academy of Sciences (IOCAS), Qingdao, China.

CURRICULUM VITAE

MICHAEL PHILIP ANTHONY ARMITAGE

DATE OF BIRTH: 9 September 1996

NATIONALITY: South African

ACADEMIC QUALIFICATIONS, UNIVERSITY OF CAPE TOWN (UCT):

MSc Environmental and Geographical Science (EGS), 2022—with Distinction.
BSc (Hons) EGS, 2018—First Class Pass (with Distinction).
BSc EGS and Archaeology, 2017.

OTHER TRAINING:

Environmental Impact Assessments Training Course, Cape Town, 2024. Business Success Solutions In association with Janice Tooley Attorneys. SACNASP and EAPASA accredited.

Practical Implementation of Environmental Auditing and Monitoring Training Course, Cape Town, 2024. Business Success Solutions in association with Umhlaba Environmental Consulting. SACNASP and EAPASA accredited.

PCSWMM and EPA SWMM5 Modelling Short Course, 2019. Computational Hydraulics International (CHI).

First Aid Level 1

MEMBERSHIP OF PROFESSIONAL BODIES/ORGANISATIONS:

EAPASA: Candidate EAP, Registration Number: 2024/7978
IAIAsa: Full Member, Registration Number: 7619

COUNTRY EXPERIENCE: South Africa, People's Republic of China

LANGUAGE PROFICIENCY: English (Excellent), Afrikaans (Basic)

POSTAL ADDRESS: 8 Steenberg House, Silverwood Close, Tokai 7945

PHONE: +27-21-701 3420 **E-MAIL:** michael@anchorenvironmental.co.za

EMPLOYMENT HISTORY:

2022-Present: Environmental Consultant: Marine Ecosystems and Resources (Anchor Environmental Consultants)

2021: Research Assistant (South African National Biodiversity Institute and Breede-Gouritz Catchment Management Agency); and University Demonstrator.

2015: Mathematics and Physical Science Tutor (Mastermaths)

SUMMARY PROFILE

Michael holds MSc and BSc (Hons) degrees in Environmental and Geographical Science (EGS), as well as a BSc in EGS and Archaeology, all from the University of Cape Town. His expertise lies in integrated environmental and water resources management—with a focus on coastal, estuarine, and freshwater systems, as well as nature-based management solutions. He thrives on unpacking the complexities of dynamic systems to develop integrated, practical, and effective management solutions. Michael works as an Environmental Assessment Practitioner (EAP) and Environmental Management Specialist, undertaking Environmental Impact Assessments (EIAs) and preparing a range of environmental management plans. He also has experience in estuarine studies, sediment quality assessment, and GIS mapping. He is a registered Candidate EAP (EAPASA: 2024/7978) and a member of the International Association for Impact Assessment South Africa (IAIAsa: 7619).

SELECT PROJECT EXPERIENCE

Environmental Impact Assessments and Related Projects

Period	Country	Client	Project, Tasks
2026	**South Africa**	**Trans Atlantic Diamonds**	**Environmental Assessment Practitioner:** Resubmission Basic Assessment Process and prospecting rights application for Offshore Sea Concession 11C in the Western Cape.
2024-Ongoing	**South Africa**	**Sunwater East London**	**Environmental Assessment Practitioner and Estuarine Specialist** Scoping and Environmental Impact Assessment (S&EIA) for Transnet Ports Authority (TNPAs) Proposed Solar Powered Desalination Plant in the Port of East London.
2024-Ongoing	**South Africa**	**V&A Waterfront**	**Environmental Assessment Practitioner and Socio-Economic Specialist** Basic Assessment Process for a Mixed-Use Development within the Breakwater Precinct of the, V&A Waterfront, Cape Town.
2024-Ongoing	**South Africa**	**National Sea Rescue Institute (NSRI)**	**Environmental Assessment Practitioner** Environmental Impact Assessment (EIA) for the Proposed Upgrades the NSRI Bakoven Rescue Base.
2024-2025	**South Africa**	**Port Nolloth Sea Farms Ranching (Pty) Ltd**	**Environmental Assessment Practitioner** Off Road Vehicle Driving Permit and Vessel Launching Permit Applications for the PNSF Abalone Ranching Concession Area.
2024-2025	**South Africa**	**Port Nolloth Sea Farms Ranching (Pty) Ltd**	**Environmental Scientist and GIS Specialist** Amendment of the Environmental Authorisation for the Port Nolloth Sea Farms ranching abalone holding and processing facility, south of Kleinzee.
2025	**South Africa**	**Netelek**	**Environmental Assessment Practitioner** Screening study for a proposed Solar-Power Desalination Plant, Ammonium Production Plant, and Associated Infrastructure, Jacobsbaai & Saldanha Area, Western Cape.
2023-2024	**South Africa**	**Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) for the City of Cape Town**	**GIS and Environmental Governance Specialist** Green infrastructure options for improved waterway and catchment management for the City of Cape Town. Contributions included: conducting extensive spatial mapping of key socio-economic metrics—and contributing to the interpretation of these results. Was also the lead contributor on the Governance and Regulatory Framework Report pertaining to Cape Town's waterways (and associated green spaces)—which linked closely with the Socio-Economic report, and dealt in depth with topics such as land zoning, local legislative context, etc.
2023	**South Africa**	**Impact Water Solutions (IWS) for Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)**	**Environmental Scientist and GIS Specialist (Lead Author)** Green Hydrogen Desalination Study Task 7: Environmental and Social Impact Assessment (ESIA) scoping Report. The report formed the basis for the guideline document for Green Hydrogen developments in South Africa.

Period	Country	Client	Project, Tasks
2022	**South Africa**	**Trans Atlantic Diamonds**	**Co Author of Marine & Fisheries and Socio-Economic Specialist Reports and Contributor to Basic Assessment (BAR) Report.** Basic Assessment Process and Application for Prospecting Rights in Offshore Sea Concession 10B in the Northern Cape.
2022	**South Africa**	**Trans Atlantic Diamonds**	**Co Author of Marine & Fisheries and Socio-Economic Specialist Reports and Contributor to Basic Assessment (BAR) Report.** Basic Assessment Process and Application for Prospecting Rights in Offshore Sea Concession 7C in the Northern Cape.
2022	**South Africa**	**Matzikama Kaolin**	**Environmental Scientist and GIS Specialist** Scoping & Environmental Impact Assessment and Application for Prospecting Rights for Kaolin Prospecting in the Western Cape: Preparation of EIA Scoping Report.
2022	**South Africa**	**Xwena Kaolin**	**Environmental Scientist and GIS Specialist** Scoping Report for Prospecting Rights for Kaolin and Silica Prospecting in the Western Cape: Preparation of EIA Scoping Report.

Environmental Management Plans and Processes

Period	Country	Client	Project, Tasks
2024-Ongoing	**South Africa**	**Overstrand Local Municipality and United National Environmental Programme (UNEP**	**Estuarine Specialist and Environmental Assessment Practitioner** <u>Onrus Catchment to Coast (C2C) Programme</u>: Preparing Estuarine Ecological Health Assessment (EHA) and Maintenance Management Plan (MMP) Reports for the proposed dredging and future maintenance of the Onrus Estuary; Acquiring approval to rehabilitate the Main Onrus palmiet peat wetland under the Department of Agriculture's Landcare EMPr; Conducting a Water Use License (WULA) Application for both the dredging and rehabilitation work. Future works will include the compilation of additional MMPs, an EIA process, and an additional WULA for catchment rehabilitation further upstream.
2025-Ongoing	**South Africa**	**African Marine Solutions (AMSOL)**	**Environmental Management Specialist** Development of an Environmental Management Plan (EMP) for the offshore ship-to-ship bunkering activities in Algoa Bay.
2024-2025	**South Africa**	**Mossel Bay Local Municipality and Southern Estuarine Rehabilitation Action Group (SERAG)**	**Estuarine Specialist and Environmental Assessment Practitioner** Preparing a Maintenance Management Plan (MMP) for the Groot Brak Estuary.
2024	**South Africa**	**Department of Forestry, Fisheries and the Environment (DFFE)**	**Environmental Assessment Practitioner and Stakeholder Engagement Support** Development of management plans for the South-East Atlantic and South-West Indian Seamounts Marine Protected Areas (Ongoing).

Period	Country	Client	Project, Tasks
2022-2023	**South Africa**	**Infinity Environmental for the City of Cape Town**	**Estuarine Specialist and Co-Lead Author** Situation Assessment and Estuarine Management Plan Reports for the Zandvlei Estuary.
2022-2023	**South Africa**	**Lukhozi Consulting Engineers**	**Estuarine Specialist (Lead Author)** Mouth Management Plan for the Zandvlei Estuary.

Estuarine, Sediment Quality, and other Scientific Specialist Work

Period	Country	Clients	Project, Tasks
2025	**South Africa**	**Saldanha Bay Water Quality Trust**	**Sediment Quality Specialist and Chapter Author** 2025 State of Saldanha Bay (SOB) Annual Environmental Monitoring Report.
2024	**South Africa**	**Infinity Environmental for the City of Cape Town**	**Estuarine and Ichthyofaunal Specialist (Lead Author) and GIS Specialist** Estuarine and Ichthyofaunal Specialist Impact Assessment for the Proposed Fish Ladder Construction and Alterations of Existing Weir and Bridge Infrastructure in the Zeekoevlei Estuary.
2024-Ongoing	**South Africa**	**The City of Cape Town (CCT) and Infinity Environmental**	**Field Scientist** Marine microplastics and water quality sampling and compliance monitoring for the City of Cape Town's marine outfalls surrounding the Cape Peninsula.
2023-2024	**South Africa**	**Dube Tradeport Corporation**	**Estuarine Specialist and Lead Author** Estuarine Specialist Impact Assessment for the Proposed Automotive Supply Park Sewer Line Passing through the aManzimtoti Estuary.
2024	**South Africa**	**ECA Consulting**	**Field Scientist** Updated Marine Specialist Study and Dumping at Sea Permit Application for the Berth 100A Application in the Port of Ngqura.
2023	**South Africa**	**Sharples Environmental Services**	**Estuarine and GIS Specialist (Lead Author)** Assessment of the Impacts of Building a Residential House in the Knysna Estuary, Garden Route Municipality, Western Cape.
2023	**South Africa**	**Enviroworks**	**Estuarine Specialist and Lead Author** Estuarine and Coastal Impact Assessment for the Proposed SANParks Developments in the West Coast National Park, Langebaan.
2023	**South Africa**	**Guillaume Nel Environmental Consultants**	**Estuarine Specialist and Lead Author** Estuarine Specialist Assessment for the proposed upgrade of the TR77/1 (R27), Velddrif.
2023	**South Africa**	**Saldanha Bay Water Quality Forum Trust**	**Sediment and GIS Specialist and Sediment Chapter Lead Author** The State of Saldanha Bay and Langebaan Lagoon; ongoing annual ecological monitoring of Saldanha Bay and Langebaan Lagoon.
2023	**South Africa**	**St. Helena Bay Water Quality Trust**	**Sediment and GIS Specialist and Sediment Chapter Lead Author** The State of St Helena Bay: ongoing semi-annual ecological monitoring of St Helena Bay and the lower Berg Estuary.
2023	**South Africa**	**WSP Group Africa (Pty) Ltd**	**Marine Ecologist** Total Energies Block 11b/12b Environmental and Social Impact Assessment (ESIA): Marine Ecology Impact Study.

Period	Country	Clients	Project, Tasks
2023	**South Africa**	**Infinity Environmental for the City of Cape Town (CCT)**	**Estuarine Specialist** Estuarine Specialist Impact Assessment for the Proposed Dredging of the Milnerton Lagoon by the City of Cape Town.
2023	**South Africa**	**Infinity Environmental for the City of Cape Town**	**Estuarine Ecologist** Remediation Plan for the Milnerton Lagoon: Ecological Risks and Benefits associated with the Proposed Remediation Options.
2023	**South Africa**	**Doug Jeffery Environmental Consultants**	**GIS Specialist** Marine Specialist Study for the Residential Development in Oudekraal, Camps Bay: Site sensitivity and Constraints Report.
2022	**South Africa**	**KSEMS Environmental Consulting**	**Estuarine Specialist and Lead Author** Assessment of Impacts of Proposed Upgrade of the N2 Section 25 between the Isipingo Interchange and Umlaas Canal, and Construction of a New Drainage Canal, in the Ethekwini Municipality, Kwazulu-Natal.
2022	**South Africa**	**Nemai Consulting**	**Estuarine Ecologist and Field Scientist** Ecological Water Requirements (EWR) Update and Estuarine Impact Assessment for the uMzimkhulu Estuary, Kwa Zulu Natal.
2022	**South Africa**	**Lukhozi Consulting Engineers for the City of Cape Town**	**Estuarine Specialist and Lead Author** Zandvlei Estuary: Ecological Context and Recommendations Pertaining to Mouth Management.
2022	**South Africa**	**Infinity Environmental for the City of Cape Town**	**Estuarine Specialist and Lead Author** Zandvlei Dredge Assessment: Current Ecological Status Report

THESES

Armitage M.P.A. 2022. An Assessment of the Heavy Metal Concentrations in Surface Sediments from the Knysna Estuary. MSc Thesis, The University of Cape Town, 172 pp.

Armitage M.P.A. 2018. A Current Analysis of the Heavy Metal Load in the Ashmead Channel (Knysna Lagoon) Sediments. BSc (Hons) Thesis, University of Cape Town, 39 pp.

CONFERENCES

2021 Joint Society of South African Geographers-Southern African Association of Geomorphologists Conference (Presentation)

2021 International Association for Impact Assessment South Africa: Re-Thinking IEM (Integrated Environmental Management) in Pursuit of the Sustainable Development Goals (Attendee)

2021 National Research Fund-National Natural Sciences Foundation of China Collaborative Research Closing Symposium with academics from East China Normal University (Presentation)

2019 National Research Fund-National Natural Sciences Foundation of China Collaborative Research Symposium hosted in Shanghai with academics from East China Normal University and the University of Cape Town (Presentation)

2019 Pollution State of the Knysna Estuary Symposium with members of the Knysna Municipality, Town Council, and stakeholders (Presentation)

2018 National Research Fund-National Natural Sciences Foundation of China Collaborative Research Symposium hosted in Shanghai with academics from East China Normal University and the University of Cape Town (Presentation)

2018 International Urban Biodiversity & Food Security conference, held in Cape Town (Volunteer & Attendee).

CURRICULUM VITAE

KENNETH HUTCHINGS

Born:	15 June 1972, South Africa
Nationality:	South African
Languages:	English excellent/Afrikaans good/ Xhosa fair
Present occupation:	Practise Leader Marine Science at Anchor Environmental
Work address:	8, Steenberg House, Silverwood Close, Tokai 7945 South Africa
Drivers licence:	Code 08, 30/07/1990
Commercial dive qualifications:	Class III scientific, Supervisor
Commercial skippers ticket:	Category B (< 9m, 40 NM, Dive, and night operations)
Email:	ken@anchorenvironmental.co.za

SUMMARY PROFILE

Dr Hutchings has more than 30 years of research and consulting experience in the fields of fisheries management, mariculture, estuarine research and management, marine and estuarine spatial planning, marine impact assessment, research and conservation strategy development, fishery socio-economic surveys and analyses, biological sampling and life-history analyses of fish (age and growth, reproduction, mortality, migration, diet, ecology), taxonomic methodology, population genetics, fisheries modelling, marine ecotoxicity trials, trace metal pollution and physico-chemical, ecological and biodiversity surveys of marine, estuarine and freshwater habitats. Dr Hutchings is experienced in developing estuarine and coastal management plans and in conducting public participation processes. Dr Hutchings is a research associate of the University of Cape Town's Biological Science Department. He has excellent verbal and writing communication skills, is competent with software packages used in scientific research and consulting projects. He has published 20 scientific papers and compiled more than 100 consulting reports. Dr Hutchings is comfortable working as part of a team in both a leadership and mentoring position or as a team member. Dr Hutchings has participated in international collaborative studies in Angola, Mozambique, Tanzania, Namibia, Sierra Leone, Republic of Congo, Somalia and Mauritius. He has practical and research experience of most commercial fishing methods (hand, line, spear, pole, gill net, trammel, net, beach seine net, trap, longline, trawl and purse-seine). He has personally collected scientific data for the demersal trawl and longline hake fisheries, designed, implemented and managed multi-year fishery observer programmes for line, longline, lobster trap and demersal trawl fisheries in South Africa. He has project managed several long-term fishery and mariculture research and monitoring projects for the South African Department of Forestry, Fisheries and the Environment and numerous other consulting projects for state, NGO and private sector clients.

TERTIARY EDUCATION:

PhD Zoology – Fish taxonomy, life history, ecology and management, UCT (2005)

M.Sc. Zoology (with distinction) – Fisheries management, UCT (2000)

B.Sc. (Honours - First Class) Marine Biology, UCT (1997)

B.Sc. Zoology & Environmental and Geographical Science, University of Cape Town (1994)

Distinction in Zoology

RELEVANT WORK AND PROJECT EXPERIENCE

- Anchor Environmental Consultants (1999-present)
- PhD student, Line-fish research (under contract to MCM) (2001-2005)
- Research officer, Zoology Department, University of Cape Town (1998-2000)
- Demersal Trawl Fishery, scientific observer, University of Cape Town (1995)
- Commercial squid (freezer vessel), line-fish crew (deck boat), ski boat crew/skipper, Beach-seine fishing crew, boat-skipper, shore skipper, B &K fishing CC. Messrs. G. William, M. Johnson & B. Docke (1986-2006)

MEMBERSHIP OF PROFESSIONAL BODIES/ORGANISATIONS

- Professional Natural Scientist, the South African Council for Natural Scientific Professions (2014-present)
- Research Associate Marine Research Institute, Department of Biological Science, University of Cape Town (2006-present)
- Associate Technical Consultant, Marine Stewardship Council (2019-present)
- Linefish Scientific Working Group (1999-2001, 2025)

SCIENTIFIC PUBLICATIONS

HUTCHINGS K, REES A, PULFRICH A, CLARK BM 2025: Effects of diamond mining on southern Namibian sandy beaches—the use of the oniscid isopod, *Tylos granulatus*, as an indicator species. Afr J Mar Sci. 47:3, 281-294,

MALAN A, BICCARD A, DAWSON J, PAYNE R, SCHMIDT K, GIHWALA K N, **HUTCHINGS K**, LOUW D, SHIKEVA J, KAMWI B, KAIMBI L, VUMAZONKE J, MUTALENI M, SHANNON T, CHORDEKAR S, & V ROSS-GILLESPIE 2024: Diversity, distribution and knowledge gaps of Polychaeta on the continental shelf of southern Namibia, African Zoology, DOI: 10.1080/15627020.2024.2349648

ASCHE F, GARLOCK TM, AKPALU W, AMAECHINA EB, BOTTA R, CHUKWUONE NA, EGGERT H, **HUTCHINGS K**, LOKINA R, TIBESIGWA B & J K TURPIE 2020. Fisheries performance in Africa: An analysis based on data from 14 countries. *Marine Policy, 125, 104263. doi:10.1016/j.marpol.2020.104263*.

HORTON M, KERWATH S, PARKER D, WINKER H, LAMBERTH S, & **K. HUTCHINGS** 2019 Age, growth and per-recruit stock-assessment of *Chelon richardsonii* in Saldanha Bay and Langebaan Lagoon, South Africa. *African Journal of Marine Science*, 41: 313-324

PARKER D, SE KERWATH, TF NÆSJE, CJ ARENDSE, FJ KEULDER-STENEVIK, **K HUTCHINGS**, BM CLARK, H WINKER, PD COWLEY & CG ATTWOOD 2017. When plenty is not enough: an assessment of the white stumpnose (*Rhabdosargus globiceps*) fishery of Saldanha Bay, South Africa, *African Journal of Marine Science*, **39**:2, 153-166

HUTCHINGS, K & C.G ATTWOOD 2013 Belman (*Umbrina robinsoni*) In: Mann BQ. (Ed). Southern African Marine Linefish Species Profiles. Special publication, Oceanographic Research Institute, Durban 9:165-166.

HUTCHINGS, K. and M. H. GRIFFITHS 2010 - Life-history strategies of *Umbrina robinsoni* (Sciaenidae) in warm-temperate and sub-tropical South African marine reserves *African Journal of Marine Science* **32(1):**37-53

HUTCHINGS, K. and M. H. GRIFFITHS 2010 – Assessment of South African *Umbrina robinsoni* based on per-recruit models *African Journal of Marine Science* **32(3):** 511–523

HUTCHINGS, K. GRIFFITHS M. H. and S.J LAMBERTH 2010 - An investigation of the effect of temporal variation in growth rate of *Umbrina robinsoni* on biological reference point estimates calculated using per-recruit models. *African Journal of Marine Science 32(3): 633–636*

CLARK, B.M., **HUTCHINGS, K.**, and S.J. LAMBERTH 2009. Long-term variations in the composition and abundance of fish in the Berg estuary, South Africa. *Transactions of the Royal Society of south Africa* **64(2)**: 238-258

LAMBERTH, S.J., VAN NIEKERK, L and **K HUTCHINGS** 2008 Comparison of, and the effects of altered freshwater inflow on, fish assemblages of two contrasting South African estuaries: the cool-temperate Olifants and the warm-temperate Breede. *African Journal of Marine Science* **30(2**): 311–336.

HUTCHINGS, K., CLARK, B.M., ATKINSON, L.J. and C. G. ATTWOOD 2008 - Evidence of recovery of the linefishery in the Berg River Estuary (Western Cape, South Africa) subsequent to closure of commercial gill netting. *African Journal of Marine Science*. **30(3):** 507–517.

HUTCHINGS, K., GRIFFITHS, M. H. and J. G. FIELD 2006 – Regional variation in the life history of the canary drum *Umbrina canariensis* (Sciaenidae), in South African waters. *Fisheries Research* **77**:312-325.

GRIFFITHS, C. L., VAN SITTERT, L., BEST, P. B., BROWN, A. C., CLARK, B. M., COOK, P. A., CRAWFORD, R. J. M., DAVID, J. H. M., DAVIES, B. R., GRIFFITHS, M. H., **HUTCHINGS, K.**, JERARDINO, A., KRUGER, N., LAMBERTH, S., LESLIE, R. W., MELVILLE-SMITH, R., TARR, R. and C. D. VAN DER LINGEN 2004 – Impacts of human activities on marine animal life in the Benguela: A historical overview. *Oceanogr. Mar. Biol. Ann. Rev*. **42**: 303-392.

HUTCHINGS, K. and M. H. GRIFFITHS 2005 - Identity and distribution of southern African sciaenid fish species of the genus *Umbrina. African Journal of Marine Science* **27**(1): 1-22.

HUTCHINGS, K. and S. J. LAMBERTH 2003 - The likely impacts of an eastward expansion of the gill-net fishery in the Western Cape, South Africa; Implications for Management. *Maine and Freshwater Research* **54**: 39-56.

HUTCHINGS, K. and S. J. LAMBERTH 2002 – Catch and effort estimates for the gill and beach-seine net fisheries in the Western Cape, South Africa. *S. Afr. J. mar. Sci*. **24**: 205-225

HUTCHINGS, K. and S. J. LAMBERTH 2002 - By-catch in the gill and beach-seine net fisheries in the Western Cape, South Africa, with implications for management. *S. Afr. J. mar. Sci*. **24**: 227-241

HUTCHINGS, K., LAMBERTH, S. J. and J. K. TURPIE 2002 – Socio-economic characteristics of gill and beach-seine net fishers in the Western Cape, South Africa. *S. Afr. J. mar. Sci*. **24**: 243-262

VAN TETS, I. G., **HUTCHINGS, K**. and S.W. NICHOLSON 2000 – Relative merits of using purified proteins and natural foods in studies of wildlife nutrition: the nitrogen requirements of a rodent pollinator. *African Zoololgy* **35(2)**: 207-215.

HUTCHINGS, K., LAMBERTH, S. J. and C. L. GRIFFITHS 1999 – Gill nets and line-fish, what is the catch? *SANCOR Occasional Report* **5**: 77-84

PROJECT EXPERIENCE

Period	Country	Client	Project, Tasks
2025/26	**Somaliland**	**DP World**	Marine and coastal specialist Environmental, Health and Social Impact Assessment for proposed Berbera Port expansion.
2025-26	**DRC**	**DP World**	Turtle Nest Monitoring and beach habitat assessment at Port Banana
2026	**Ghana**	**SLR/Helios Investment partners**	Carrying capacity estimation component of Due Diligence study of Tropo Farms Ghana
2025	**South Africa**	**WNel Environmental Consulting Services**	Marine specialist impact assessment for mining activities in the Buffels marine mining area, Kleinzee
2025	**South Africa**	**WWF SA**	Deployment of a hydrophone to mitigate mariculture impacts in Saldanha Bay.
2025	**South Africa**	**WEC Consult**	Marine ecological monitoring report for Hermanus wastewater treatment works
2025	**Mozambique**	**Acer Africa**	Ecological and Fisheries monitoring for the Kenmare Moma mineral sands mine.
2025-26	**South Africa**	**City of Cape Town**	End of Pipe Environmental Assessment and Monitoring Programme for the City's designated wastewater Marine Outfalls.
2024	**South Africa**	**SLR Consulting (Africa)**	Marine baseline study for the Wkn Windcurrent Benguela H2 Project, Doringbaai
2024	**South Africa**	**Transnet National Ports Authority**	Baseline survey for marine fauna and flora and antifouling contaminants, Port of Mossel Bay.
2024	**South Africa**	**Kleinzee Holdings**	Marine and Coastal Impact Assessment for mining activities in the Buffels Marine Mining Area, Kleinzee, Northern Cape
2024-25	**South Africa**	**CES/Vopak/Transnet**	Estuarine specialist studies, including dispersion modelling in support of an EIA for the development of a Liquified Natural Gas Import Terminal at the Port of Richards Bay, Kwazulu-Natal
2023-2024	**Mozambique**	**ERM South Africa**	Estuarine impact assessment for quay wall and yard expansion works, Maputo DP World Terminal, Maputo
2023-2024	**South Africa**	**The Nature Conservancy**	Marine invertebrate diving surveys and marine resource use assessment within the Table Mountain National Park Marine Protected Area. Project leader
2024	**South Africa**	**WWF South Africa**	Development of a management strategy

Period	Country	Client	Project, Tasks
			for endangered, threatened or protected species encountered in the Saldanha Bay rope grown mussel fishery, South Africa.
2024	**South Africa**	**WWF South Africa**	Development of a management strategy for endangered, threatened or protected species encountered in the albacore tuna pole and line fishery, South Africa.
2023-2025	**Namibia**	**De Beers Marine Namibia**	De Beers Marine Namibia Benthic Environmental Monitoring Programme Atlantic 1 Mining License Area. 2022 Report Review.
2023-2024	**South Africa**	**Zingce Environmental Solutions**	Baseline Marine fauna and flora survey, Port of Ngqura. Project lead.
2023	**South Africa**	**ECA Consulting**	Deepening, lengthening and widening of berth 203 to 205, pier 2, container terminal, port of Durban — central sandbank mitigation plan.
2023	**South Africa**	**African Tuna (Pty) Ltd**	Feasibility study for the commercial harvesting of periwinkles and limpets on the west coast of South Africa.
2023	**South Africa**	**St Helena Bay Water Quality Trust**	The State of St Helena Bay Reporting.
2022-2023, 2025	**Mozambique**	**Acer Africa & Kenmare**	Long-term coral reef monitoring programme at Caldeira and Njovo islands, Mozambique. Fish specialist, project management.
2022-2023	**South Africa**	**Irvin and Johnson Aquaculture Pty (Ltd)**	Application for an abalone ranching concession. Project management and execution.
2022-2023	**South Africa**	**Hake Longline Association**	Ad-hoc scientific advisory services.
2022-2023	**Namibia and South Africa**	**Creocean and Total Energies E&P South Africa**	Environmental baseline studies of five offshore blocks. Benthic ecological specialist studies. Responsible for project management and review.
2023	**South Africa**	**WWF South Africa**	Diving surveys of key invertebrate fauna in the Robben Island MPA. Project management and execution.
2022-2023	**South Africa**	**Wild Oceans**	An assessment of the Inshore Trawl Fishery in South Africa. Responsible for project management and review.
2022-2024	**Sierra Leone**	**Iluka/Sierra Rutile/Digby Wells/Jones & Wagener**	Environmental, Safety and Health Impact Assessment (ESHIA) and environmental Flow Assessment studies for mining of the Sembehun group of deposits in the Southern Province of Sierra Leone. Marine and Estuarine specialist.
2022	**South Africa**	**Transnet National Ports Authority**	Baseline survey marine fauna, flora and antifouling contaminants Port of Durban.

Period	Country	Client	Project, Tasks
			Principal consultant responsible for project management and implementation.
2021-2025	**South Africa**	**Diamond Coast Abalone**	Environmental Monitoring and stock assessment for abalone ranching concession Area NC4, Northern Cape. Principal consultant responsible for project management and implementation.
2021-2026	**South Africa**	**Department of Forestry, Fisheries and Environment (DFFE).**	Specialist monitoring programme and management recommendations for the Saldanha Bay Aquaculture Development Zone. Principal consultant responsible for project management and implementation.
2021-2023	**South Africa**	**Department of Forestry, Fisheries and Environment (DFFE).**	Review of independent stock assessment abalone ranching concession area EC1. Principal consultant responsible for review of stock assessment report, diving verification surveys and recommendations for sustainable future harvest quantities.
2021-2022	**South Africa**	**Trans Atlantic Diamonds**	Marine Specialist Studies and Basic Assessment Processes for offshore concession Areas 14A and 11C. Principal Consultant responsible for marine specialist reporting, basic assessment report review and oversight (EAP).
2021	**South Africa**	**Nsovo Environmental Consulting**	Marine ecology impact assessment for proposed DNG Energy (Pty) Ltd Busisiwe (Coega 1) and Cheyeza (Coega 2) Gas to Power facilities and associated infrastructure. Principal Consultant responsible for project review.
2021	**South Africa**	**V&A Waterfront, Cape Town**	Marine specialist study and dispersion modelling for the East Pier District cooling plant outfall at the V&A Waterfront. Principal Consultant responsible for project review.
2021	**South Africa**	**Allan Gray (Pty) Ltd**	Effluent Quality Audit of the Awarded Coastal Waters Discharge Permit (2013/002/WC/VICTORIA & ALFRED) for the seawater cooling system and desalination plant at No. 1 Silo Square, V&A Waterfront. Principal Consultant responsible for project review.
2021	**South Africa**	**Guillaume Nel Environmental Consultants**	Estuarine constraints analysis for the proposed development on the remaining extent 37 of farm 23 (Uitkomst), Paternoster. Principal Consultant responsible for project review and oversight.
2021	**South Africa**	**Habitat Link Consulting.**	Marina Martinique pipeline repair and maintenance. Marine Specialist Report:

Period	Country	Client	Project, Tasks
			Assessment of impacts on intertidal and sub-tidal environment. Principal Consultant responsible for project review and oversight.
2021	**South Africa**	**Nomalungelo Faku**	Feasibility study for a pearl farm in the greater Nelson Mandela Metropolitan Area. Principal consultant responsible for project design, review and oversight.
2021	**Somalia**	**Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) (Kenya)**	Training on data analysis and introduction to electronic data collection for fishery data collection officers at MoFMR, Kismayo. International fisheries expert responsible for project implementation.
2021	**South Africa**	**Guillaume Nel Environmental Consultants**	Estuarine Impact Assessment for Development of Erf 222 and 223, Weir Road, Milnerton. Principal consultant responsible for project review and oversight.
2021	**South Africa**	**PHS Consulting**	Marine specialist study and dispersion modelling for the proposed expansion of the West Point fish meal processing plant, St Helena Bay. Principal consultant responsible for project review and oversight.
2021 & 2023	**South Africa**	**WWF-South Africa**	Environmental Specialist Benthic Monitoring programme for the Saldanha Bay Aquaculture Development Zone. Principal consultant responsible for project review and oversight.
2021-2022	**South Africa**	**Sea Harvest Corporation**	Coastal waters discharge permit Environmental monitoring. Principal consultant responsible for project review and oversight.
2020-2021	**South Africa**	**EDTEA KZN**	Development of an Estuary Management Plan for the Uthongathi Estuary, KzwaZulu-Natal. Project review.
2020-2021	**Sierra Leone**	**Iluka/Sierra Rutile/Digby Wells**	Environmental, Safety and Health Impact Assessment (ESHIA) review for mining of the Sembehun group of deposits in the Southern Province of Sierra Leone. Estuarine specialist.
2020	**South Africa**	**Western Cape Government**	Value of the Berg Estuary and Importance of Management Interventions. Biodiversity team leader and fisheries expert responsible for research and reporting.
2020-2021	**South Africa**	**City of Cape Town Metropolitan**	Effluent Pipelines Biomonitoring Principal consultant responsible for project review and oversight.

Period	Country	Client	Project, Tasks
2020	**South Africa**	**Department of Environment Forestry and Fisheries (DEFF)**	Fishery Independent Abalone Surveys. Principal consultant responsible for project implementation and oversight.
2020	**South Africa**	**Department of Environment Forestry and Fisheries (DEFF)**	Environmental Specialist Monitoring of the Saldanha Bay Aquaculture Development Zone. Principal consultant responsible for project review and oversight.
2019	**Mauritius**	**International Ocean Institute — African Region.**	Biofouling project in Port Louis harbour, Mauritius Phase III – dispersion modelling, BDI determination and sediment contamination. Principal consultant responsible for project review and oversight.
2019	**South Africa**	**Environment for Development Initiative, University of Gothenberg**	Completion of Fishery Performance Indicators (see Anderson et al 2015) for South African small pelagic, hake deep-sea trawl, west coast rock lobster and hake longline sectors. Principal consultant who undertook the research, consultation with industry completion of FPI spreadsheets and summary profiles.
2019	**South Africa**	**Doringbaai Abalone**	Risk and environmental assessment and public participation process to support a Phase 2 application to undertake abalone ranching. Project leader.
2019-2020	**South Africa**	**South African National Parks**	Subtidal surveys of commercially important and indicator invertebrate and fish species within the Table Mountain Marine Protected Area. Project leader.
2019	**Mozambique**	**Golder Mozambique/ Sasol Petroleum Mozambique Exploration Limitada**	Marine specialist impact assessment for proposed offshore explorations in shallow water portions of blocks 16 & 19, Inhambane and Sofala provinces, Mozambique. Project leader responsible for study design, implementation and reporting.
2018-2026	**Namibia**	**Namibian DeBeers**	Sandy beach, rocky intertidal and subtidal monitoring programme. Studies on the effects of mining activities and mitigation measures to avoid or minimise impacts on the affected environment. Sandy beach team leader, survey design, implementation, analysis and reporting.
2018-2020	**South Africa**	**Umhlathuze Water**	Environmental monitoring of the Richards Bay Pipelines. Project leader, physical oceanography and fish specialist.
2018-2019	**South Africa**	**Department of Agriculture, Forestry and Fisheries**	Marine specialist impact assessment study for the declaration of proposed bivalve and finfish aquaculture development

Period	Country	Client	Project, Tasks
			zones in Algoa Bay. Principal consultant responsible for marine ecological assessment, review of EIA, public presentation and stakeholder engagement.
2018	**South Africa**	**Diamond Coast Aquaculture**	Basic Assessment Process for proposed upgrades to the diamond coast aquaculture facility Kleinzee, Northern Cape.
2018	**South Africa**	**Port Nolloth Sea Farms Ranching (Pty) Ltd**	Basic Assessment process for a proposed abalone holding and processing facility.
2018	**Somaliland**	**WSP, DP World**	Marine and coastal specialist Environmental, Health and Social Impact Assessment for proposed Berbera Port expansion.
2018	**Namibia**	**Ministry of Mines and Energy**	Marine benthic baseline study of intertidal and subtidal habitats in vicinity of new oil and gas terminal. Fish, sandy beach invertebrate and sea bird specialist.
2018	**Republic of Congo**	**The Biodiversity Company, Kola Potash**	Oceanographic and benthic surveys and ecotoxicity trials to assess potential impacts of proposed potash processing discharge, jetty construction and transhipment of product. Project leader.
2017	**South Africa**	**Viking Fishing Group**	Socio-economic assessment of a 60% reduction in Viking Fishing Group's allocation in the inshore demersal trawl fishery. Fisheries expert responsible for project supervision and review.
2017-2018	**Sierra Leone**	**Sierra Rutile PTY Ltd**	Fish and fisheries expert assess downstream impacts of rutile mining operation on downstream estuarine and marine habitats.
2017	**South Africa**	**Southern Cross Salmon Pty Ltd.**	On-site oceanographic monitoring and environmental impact assessment for proposed salmon sea cage farm, Saldanha Bay
2017, 2021	**South Africa**	**National Nuclear Regulator**	Marine and fisheries expert review of Thyspunt site safety report submitted by Eskom.
2016-2017	**South Africa**	**Royal Society for the Protection of Birds**	Design and conduct a feeding trial experiment to assess the uptake of the rodenticide brodifacoum by Tristan Rock lobsters *Jasus paulensis*. Principal consultant responsible for all aspects of the study, including permitting, experimental design and setup, data analysis and reporting.
2016-	**South Africa**	**Department of Water**	Classification of and resource quality

Period	Country	Client	Project, Tasks
2017		**and Sanitation**	objectives for the water resources of the Berg and Breede water management areas. Senior consultant responsible for status quo descriptions of estuaries in the two study areas and fish specialist for ecological reserve determination studies on nine estuaries.
2016	**South Africa**	**WorleyParsons RSA (Pty) Ltd and Oiltanking MOGS (Pty)**	Marine Impact Assessment for sea water intake and discharge facility at Saldanha Bay. Senior consultant responsible for report.
2016	**South Africa**	**MOGS (Pty) Ltd**	Marine baseline report for import facility for natural gas in Saldanha Bay.
2016	**South Africa**	**Port Owen Marina Authority**	ADCP measurement and analysis of current velocity in relation to tidal phase in the Berg River Estuary. Development of a timetable for disposal of dredge spoil that is compliant with conditions stipulated in the environmental authorization. Senior consultant responsible for survey and reporting.
2016-2024	**South Africa**	**DeBeers Marine Namibia**	Collaboration on survey design and statistical analysis of data collected as part of a long-term benthic monitoring programme. Scientific review of reporting.
2016	**South Africa**	**SE Solutions (Pty) Ltd and South32 Aluminium SA Limited**	Prepare marine and estuarine specialist study for EIA for a desalination plant in Richards Bay to supply Hillside Aluminium with process water. Study leader, field investigation and report compilation.
2016	**South Africa**	**City of Cape Town**	Preparation of estuary maintenance plan impact assessment reports for eight estuaries within the megacity boundaries. Study leader undertook site visits, liaised with city staff and compiled reports.
2016	**South Africa**	**Atlantic Salmon Pty Ltd.**	Deploy and retrieve an acoustic Doppler current profiler to measure currents at a proposed salmon farm site in St Helena Bay. Analyse and present data.
2015-2016	**South Africa**	**Mossel Bay Municipality**	Preparation an estuary management plan for the Hartenbos Estuary. Supervisory role in development of plans, presentation and chairing of public meeting.
2014-2016	**South Africa**	**Transnet National Ports Authority**	Field survey team leader for the implementation of a water, sediment quality and biological monitoring programme in the Port of Durban. Supervision of analysis and reporting.
2014-	**South Africa**	**Coega Development**	Assessment of impacts of wastewater

Period	Country	Client	Project, Tasks
2016		**Corporation**	discharge from Coega Industrial Development Zone, Algoa Bay. Conduct oceanographic data analysis, marine and marine baseline study.
2014-2016	**South Africa**	**Nelson Mandela Bay Metro, GIBB**	Assessment of impacts of wastewater discharge from a new WWTW at Cape Recife, Algoa Bay. Oceanographic, bathymetry and ecological survey team leader, data analysis and reporting.
2006-2024	**Namibia**	**NamDeb Namibia**	Sandy beach macrofauna and sediment quality monitoring programme for the Bogenfels and MA1 Mining Licence Areas, Namibia. Studies reported on the effects of mining activities and mitigation measures to avoid or minimise impacts on the affected environment. Sandy beach team leader, survey design, implementation, analysis and reporting.
2015	**South Africa**	**NWJ Environmental**	Impact assessment for a proposed sand mining operation on the Umzumbe Estuary, KwaZulu-Natal. Ecological and physic-chemical estuarine survey design, implementation and reporting.
2015	**South Africa**	**Marutleng SHE Services**	Marine Impact Assessment Simonstown-Glencairn Railway Rehabilitation and Maintenance Work. Sandy beach and rocky shore survey design, implementation and reporting.
2015	**South Africa**	**AquaTech**	Risk assessment for in-water hull cleaning operations in the Port of Durban, South Africa. Contribution to methodology, supervision of sampling protocol, review of report.
2015	**Namibia**	**Pisces Environmental Services**	Gecko Namibia Vision Industrial Park Development. Compilation of baseline field survey ichthyofauna report.
2014-2015	**South Africa**	**South African Pelagic Fishing Industry Association**	Assessment of the socio-economic impacts of a reduction in the sardine minimum Total Allowable Catch (TAC). Project leader responsible for design, data collection by means of interviews with industry and fishery scientists, socio-economic analysis and reporting.
2014	**South Africa**	**Molapong Aquaculture**	Risk Assessment for culture of King and Coho salmon in South Africa. Reporting and review.
2014	**South Africa**	**Transnet National Ports Authority**	Assessment of potential impacts of the proposed Durban Dig Out Port of the annual sardine migration up the East coast of South Africa. Research and reporting.

Period	Country	Client	Project, Tasks
2014	**South Africa**	**WWF-SA**	Assist with the development of a Fisheries Improvement Project for Small Scale Fisheries in the Kogelberg. Undertaking fisheries assessments using the Marine Stewardship Council benchmarking tool, workshops and reporting.
2014	**South Africa**	**Tronnox Namaqua Sands, Matzikamma Municipality, SRK**	Environmental impact assessment for an aquaculture facility at Doringbaai, Northern Cape. Assessment of sites for intake and discharge infrastructure and potential environmental impacts of proposed abalone and finfish aquaculture discharges on the marine environment.
2014	**South Africa**	**Cape Nature**	Rezoning and realignment of borders for Betty's Bay, Goukamma and Robberg marine protected areas in South Africa. Fisheries impacts, advice and review.
2014-2025	**South Africa**	**Port Nolloth Sea Farms Ranching (PTY) LTD. Diamond Coast Aquaculture. Diamond Coast Abalone**	Baseline survey and monitoring for abalone ranching concession areas NC2, NC3 and NC4. Team leader responsible for sub tidal ecological survey design, implementation and reporting.
2013-2014	**South Africa**	**iSimangaliso Wetland Park Authority**	Assessment of the hydrological, hydrodynamic and ecological functioning of the Lake St Lucia Estuarine System and formulation of recommendations for rehabilitation and improved management of the system. Responsible for an assessment of marine fishery impacts under past, present and future management scenarios.
2013	**South Africa**	**Cape Nature, Department of Environmental Affairs**	Assessment of impacts of an oil spill on sandy beach and rocky intertidal communities in the Goukamma MPA. Project leader responsible for field survey design and implementation.
2013	**South Africa**	**Department of Agriculture, Forestry & Fisheries (DAFF)**	Development of a Strategy for Research in the Fisheries Sector. Principal consultant responsible for consultation, data acquisition and reporting.
2013	**South Africa**	**Transnet National Ports Authority**	Marine specialist study as part of an EIA for upgrading the General Maintenance Quay (GMQ) in the Port of Saldanha Bay. Field survey leader.
2013	**South Africa**	**Sea Harvest**	Assessment of fish factory effluent water quality. Sampling, analysis and reporting.
2013, 2015-2016	**South Africa**	**Department of Agriculture, Forestry & Fisheries (DAFF)**	Diving Surveys of the Eastern Cape Abalone Resource. Study leader responsible for planning, implementation

Period	Country	Client	Project, Tasks
			and reporting.
2012	**South Africa**	**South African National Parks**	Fisheries consultant for a study of the potential impacts of the Addo Elephant National Park Marine Protected Area on commercial fisheries and their value. Tasks included collection of data by means of interviews with fishing industry representatives and government scientists, data analysis and reporting.
2012	**Mauritius**	**Mauritius Oceanography Institute**	Diving team leader for alien species, and water and sediment quality assessment of Port Louis, Mauritius.
2012	**South Africa**	**Transnet National Ports Authority**	Marine specialist appointed to assess potential impacts of iron ore oxide (Fe2O3) on the marine flora and fauna of Saldanha Bay. Analysis of storm water runoff.
2012	**South Africa**	**Amathole Water Board**	Marine specialist appointed to assess the suitability of different sites and the impacts of reverse osmosis desalination plant discharge on the marine environment.
2010-2013	**South Africa**	**Department of Agriculture, Forestry & Fisheries (DAFF)**	Principal consultant as marine ecology and aquaculture specialist on an EIA for four Marine Aquaculture Development Zones (MADZs) in the Eastern Cape, South Africa. Project tasks included reviewing available technology and its suitability for use at each of the selected sites, identifying key risks and impacts that could arise from the culture of selected species on the sites including impacts on existing beneficial uses, and developing an Environmental Management and Monitoring Plan for each site as a whole as well as individual concession areas within each site.
2011	**South Africa**	**Department of Agriculture, Forestry & Fisheries (DAFF)**	Principal consultant on a Strategic Environmental Assessment (SEA) to identify potential sea-based finfish aquaculture development zones (ADZ) off the South African coastline. The study entailed identifying and applying a suite of quantitative site selection criteria in a geographical information system (GIS) framework to identify suitable sites for sea based finfish culture in South Africa, taking account of environmental suitability, environmental sensitivity, and user conflict considerations.
2011	**South Africa**	**Element Consulting**	Marine specialist baseline report for a

Period	Country	Client	Project, Tasks
		Engineers	reverse osmosis desalination plant at Lamberts Bay. Responsible for sub-tidal ecological survey design, implementation, analysis and reporting.
2011	**South Africa**	**Really Useful Investments no 72 (PTY) LTD**	Environmental assessment for the abalone (*Haliotis midae*) ranching right application (phase 2) in the Northern Cape (area NC2). Desktop research and reporting.
2011	**South Africa**	**Council for Scientific and Industrial Research (CSIR)**	Benthic macrofauna and fish baseline survey for a reverse osmosis desalination plant at Saldanha. Survey team leader responsible for design, implementation analysis and reporting.
2010	**South Africa**	**Department of Environmental Affairs & Development Planning, Western Cape Government**	Assessment of the effects of heavy metal accumulation from land based sources on the Diep River Estuary. Principal consultant on a study assessing trace metal pollution in the Diep estuary in the City of Cape Town, to investigate potential sources of pollution and to prepare management recommendations for addressing principal sources of pollution.
2010	**South Africa**	**Port Owen Marina Authority**	Assessment of Port Owen marina dredging activities on the Berg River estuarine fish and macrobethos communities. Senior consultant responsible for survey and reporting.
2010	**South Africa**	**Chand Environmental**	Marine and coastal specialist appointed to assess the status and sensitivity of the coastal marine environment off Partridge Point on the Cape Peninsula, and likely impacts that would arise from development of the site.
2009-2019	**South Africa**	**Various companies**	Consultant on a series of environmental impact assessments for desalination plants at Sedgefield, Plettenberg Bay, Witsands, Saldanha Bay, Mossel Bay and Port Nolloth, and Cape Town. (7 separate appointments).
2009-2011	**South Africa**	**Cape Action Plan for People & the Environment (C.A.P.E.)/Cape Nature/Marine & Coastal Management (MCM)**	Consultant appointed to develop a management plans for the Olifants, Berg, and Uilkraals Estuaries, South Africa. (Three separate appointments). Projects entailed preparing situation assessments and strategic management plans for the Olifants, Berg and Uilkraals estuaries that included recommendations for establishment of a new marine protected area, terrestrial protected area, zonation

Period	Country	Client	Project, Tasks
			plans for each of these elements, visitor management plans, and recommendations for institutional development. Consultant appointed for the implementation of the Verloerenvlei estuary management plan. All projects included presentation of plans and consultation with stakeholder leading to the establishment of estuary management forums comprising management agency representatives and local stakeholders.
2009-2011	**South Africa**	**WWF-SA, Lotto Programme**	Scientific advisor on a shore-based fisheries monitoring programme coordinating a team of 20 fisheries monitors at six sites on the South and East coasts of South Africa. Tasks included on-going training, quality control and report reviews.
2009-2010	**South Africa**	**WWF-SA/Cape Action for People and the Environment (C.A.P.E.)**	Fisheries consultant for the preparation of marine and coastal spatial plans and socio-economic assessments for the Kogelberg Biosphere Reserve and Garden Route Initiative. The project involved mapping biodiversity pattern and processes in the marine and coastal environment, spatial mapping of economic value, good and services, and of threats to these ecosystems.
2009	**South Africa**	**West Coast District Municipality, Jeffares & Green (Pty) Ltd**	Principal consultant on an assessment of the Jakkalsvlei estuary, the purpose of which was to describe and assess the ecological impacts of illegal excavation and infilling activities that took place during July 2008, and to draft rehabilitation plan to mitigate any impacts.
2009	**South Africa**	**City of Cape Town**	Consultant on project to prepare a situation assessment for the Coastal Monitoring Programme for the City of Cape Town (City of Cape Town). Preparation of an overview report on the conservation status and sensitivity of the City of Cape Town Coast including estuaries.
2009	**South Africa**	**Doug Jeffery Environmental Consultants**	Senior consultant on an assessment of the status and sensitivity of the coastal marine environment off Oudekraal on the Cape Peninsula with an assessment of potential constraints relating to impacts to the marine environment on the development

Period	Country	Client	Project, Tasks
			of the site.
2002, 2009, 2015-2018	**South Africa**	**Department of Environmental Affairs & Tourism: Marine and Coastal Management (DEAT: MCM**	Estimation of west coast rock lobster catch and effort by the recreational fishery sector. Responsible for telephone survey data analysis and reporting. Project included a series of workshops aimed at resolving inconsistencies in previous surveys and developing improved methodology for future surveys.
2009	**South Africa**	**Chand Environmental Consulting**	Marine and coastal specialist appointed to assess the status and sensitivity of the coastal marine environment off Oudekraal on the Cape Peninsula, and likely impacts that would arise from development of the site.
2008-2011	**South Africa**	**Century City Property Owners Association**	Principal consultant on a study to assess the effectiveness of a fish eradication programme conducted in the Century City wetlands and canals using the ichthyocide rotenone, and for development of recommendation for future management of the system
2007-2011	**South Africa**	**Resource Ballast Technology (Pty) Ltd**	Consultant appointed as independent assessor of efficacy of a newly developed ballast water treatment system and evaluation (risk assessment) of the residual toxicity of ballast water treated with the system. Project entailed verifying the efficacy of the ballast water treatment system as well as literature survey and laboratory toxicity testing to assess the residual acute and chronic toxicity of the treated ballast water to a variety of different organisms and potential risks posed by the treated ballast water to the environment and human health.
2007-2011	**South Africa**	**Department of Environmental Affairs & Tourism: Marine and Coastal Management (DEAT: MCM)**	Scientific advisor of a fisheries monitoring programme designed to assess levels of fishing mortality, stock abundance indices and to evaluate the effectiveness of management measures for the commercial and recreational linefishery, tuna pole, hake longline, west coast rock lobster, Inshore demersal trawl and hake handline fishing in South African waters. Scientific advisor was responsible for recruiting and training a team of fishery observers who were deployed on-board vessels and at strategic landing sites

Period	Country	Client	Project, Tasks
			around the country, quality control of all data collected and review of data reports.
2007-2010	**Ghana**	**Tullow Oil Plc**	Consultant responsible for preparation of Environmental Impact Assessment, Environmental Overview and identification of Environmental Best Management Practise (BMP) required for seismic surveying and exploratory drilling for offshore oil and gas resources in the Tano shallow water and Deep water blocks in Ghana. (Three separate EIA studies).
2006-2011	**Tanzania**	**International Conservation Union (IUCN)/Pangani Water Basin Office, Tanzania**	International mentor of the Estuary Team for a project entitled "Flows for People and the Environment: Supporting Sustainable Land Management in the Pangani Basin (Tanzania)". The estuary component of the project included conducting a health assessment of the Pangani estuary with the Tanzanian national team and the development of a flow assessment tool to guide allocation of freshwater flow in the system.
2006	**South Africa**	**Department of Science and Technology**	Investigation of stakeholder requirements and potential host institutions for the South African National Antarctic Programme (SANAP).
2005-2007	**Angola**	**BCLME Programme/ United Nation Development Programme (UNDP)/ UNOPS/Global Environment Facility (GEF)**	Consultant on a project aimed at assessing the status of biodiversity along the Angola coastline. The project entailed completing a series of field surveys at selected localities at approximately 100 km spacing along the Angolan coastline at which inshore fish, rock intertidal and sandy beach biota were surveyed. Data were analysed with a view to identifying biogeographic patterns in Angolan coastal fauna and flora.
2005-2007	**South Africa**	**Cape Action Plan for People & the Environment (C.A.P.E.), Cape Nature, and Department of Environmental Affairs & Tourism: Marine and Coastal Management (DEAT: MCM)**	Consultant on a biodiversity and economic assessment and development of an integrated conservation plan for CAPE estuaries. The project comprised filling estuary biodiversity data gaps (collection and collation of new botanical, fish and bird data for temperate South African estuaries).

Period	Country	Client	Project, Tasks
2007, 2005	**South Africa**	**Transnet-National Ports Authority (Transnet NPA)**	Consultant on ballast water, flora and fauna survey in the Ports of Durban and Port Elizabeth. Surveys were conducted in representative examples of all habitat types present in the Port of Durban and Port Elizabeth to identify all species present in the port, including all alien and potentially cryptogenic species. Responsible for sampling and reporting.
2005	**South Africa**	**National Empowerment Fund (NEF)**	Principal consultant on a due diligence (feasibility) study to assess the feasibility of a proposed eel aquaculture and processing operation in the Eastern cape, South Africa, focussing on biological, ecological, logistic and legislative considerations of the proposed project.
2001-2005	**South Africa**	**Department of Environmental Affairs & Tourism: Marine and Coastal Management (DEAT: MCM)**	Project leader on a research programme that investigated the taxonomy, biology and management of South African Sciaenid fish of the genus *Umbrina*. Responsible for project design, sampling strategy, biological sampling and processing of samples to provide data on taxonomy, age and growth, reproduction and population genetics. Analysis and use of these data in stock assessments and management recommendations.
2005	**South Africa**	**Emross Consulting CC.**	Marine specialist for the assessment of the potential impacts of a boat launching site on the marine environment at Mbotyi River Mouth.
2004-2024	**South Africa**	**Saldanha Bay Water Quality Forum Trust (SBWQMFT)**	Senior consultant on a team appointed to develop a series of "State of the Bay" Monitoring Programme and Reports for Saldanha Bay and Langebaan Lagoon in 2004, and annually between 2008 and 2024. The project involved collation and analysis of historic data from a wide range of disciplines, identification of key indicators for the reporting system, as well as initiating new data collection and survey programmes, and the production of annual monitoring reports and yearly State of the Bay Reports.
2003-2005	**South Africa**	**Department of Water Affairs & Forestry (DWAF)**	Estuarine and fisheries consultant on the Berg River Baseline Monitoring Programme prior to the construction of the Skuifraam Dam. The study spanned a period of three years and required a multidisciplinary approach. Duties

Period	Country	Client	Project, Tasks
			included assisting specialists from a wide range of disciplines including water quality, sociology, macro invertebrates, fish, avifauna, vegetation and algae.
2001-2003	**South Africa**	**Department of Environmental Affairs & Tourism/ Rhodes University**	Fisheries specialist contracted to assist with an Economic Sectoral Study of the South African Fishing Industry. The consultant was responsible for collecting requisite data on the linefish, sector.
2001	**South Africa**	**GEF/UNDP/IMO Globallast Programme**	Fish scientist on a ballast water surveys in the Port of Saldanha. The objective of the study was to survey representative examples of all habitat types present in the ports with a view to developing a full list of all species including all alien and potential cryptogenic species in the port.
1999-2000	**South Africa**	**Foundation for Research Development**	Researcher on a project to assess the impacts of exploitation of wonderworm *Marphysa sanginea* on bouldershore habitats on the Cape Peninsula, South Africa. The project included field surveys, literature review, statistical analysis of data and report production.
1998-2000, 2007-2011	**South Africa**	**Department of Environmental Affairs & Tourism: Marine and Coastal Management (DEAT: MCM)**	Scientific advisor and operations manager of an offshore, boat-based fisheries monitoring programme designed to supply and deploy scientific observers aboard fishing vessels for the inshore trawl, hake longline and west coast rock lobster fisheries. Responsibilities of the scientific advisor included ensuring that observers were trained to collect accurate data on the nature of fisheries operations, catch composition, by-catch mortality, fish biology, quantity and size range of discarded target species, and biological samples as required. Data were captured electronically and submitted to the client for use in stock assessment and resource management programme.
1998-2000	**South Africa**	**Department of Environmental Affairs & Tourism: Marine and Coastal Management (DEAT: MCM)**	Lead researcher on a 3-year project that assessed the catch, effort and socioeconomic status of the Western Cape gill and beach-seine net fisheries. Responsible for project design and implementation. Included sampling of commercial fish catches, conducting detailed socio-economic interviews with industry participants, experimental netting and interpretation of the findings

Period	Country	Client	Project, Tasks
			into management recommendations.

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Kenneth Hutchings

Registration Number: 400039/17

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule 1 of the Act)

Environmental Science (Professional Natural Scientist)

Effective **25 January 2017** Expires **31 March 2027**

President of Council

Chief Executive Officer

To verify this certificate scan this code

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Lily Astrid Bovim

Registration Number: 172158

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003 (Act 27 of 2003)
in the following field(s) of practice (Schedule 1 of the Act)

Aquatic Science (Professional Natural Scientist)

Effective **22 January 2025** Expires **31 March 2027**

President of Council

Chief Executive Officer

To verify this certificate scan this code

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Amy Grace Wright

Registration Number: 131256

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule 1 of the Act)

Biological Science (Professional Natural Scientist)

Effective **3 November 2021** Expires **31 March 2027**

President of Council

Chief Executive Officer

To verify this certificate scan this code

forestry, fisheries & the environment

Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

Private Bag X447, Pretoria, 0001, Environment House, 473 Steve Biko Road, Pretoria, 0002 Tel: +27 12 399 9000, Fax: +27 86 625 1042

SPECIALIST DECLARATION FORM – AUGUST 2023

Specialist Declaration form for assessments undertaken for application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

REPORT TITLE
Scoping & Environmental Impact Assessment (S&EIA) for the Proposed 2MLD Solar Powered Seawater Desalination Plant in the Port of East London, Buffalo City Metropolitan Municipality, Eastern Cape Province, by Transnet National Ports Authority

Kindly note the following:

1. This form must always be used for assessment that are in support of applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting, where this Department is the Competent Authority.
2. This form is current as of August 2023. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.dffe.gov.za/documents/forms.
3. An electronic copy of the signed declaration form must be appended to all Draft and Final Reports submitted to the department for consideration.
4. The specialist must be aware of and comply with '*the Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the act, when applying for environmental authorisation - GN 320/2020)*', where applicable.

1. SPECIALIST INFORMATION

Title of Specialist Assessment	Marine and Estuarine Ecology Impact Assessment
Specialist Company Name	Anchor Environmental Consultants
Specialist Name	Amy Wright
Specialist Identity Number	91 11 11 0094 089
Specialist Qualifications:	
Professional affiliation/registration:	SACNASP 131256
Physical address:	Suite 8, Steenberg House, Silverwood Close, Steenberg Office Park, Tokai
Postal address:	Same as above
Postal address	Click or tap here to enter text.
Telephone	021 701 3420
Cell phone	--
E-mail	amy@anchorenvironmental.co.za

2. DECLARATION BY THE SPECIALIST

I, Amy G. Wright declare that –

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. "the Protocols") and in Government Notice No. 1150 of 30 October 2020.
- I will perform 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;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I 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;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my 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 myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the NEMA Act.

____
Signature of the Specialist

Anchor Environmental Consultants
____
Name of Company:

Click or tap to enter a date. 2026/06/29
____
Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, ________Amy G. Wright____________________________, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Anchor Environmental Consultants

Name of Company

2026/06/29

Date

Signature of the Commissioner of Oaths

29. 06. 2026

Date

I certify that the deponent has acknowledged that he/she knows and understands the contents of this affidavit, that he/she does not have any objection to taking the oath, and that he/she considers it to be binding on his/hers conscience and which was sworn to and signed before me at Cape Town on this the 29th day of June 2026 and that the administering oath complied with the regulations contained in government gazette No. R1258 of 21 July 1972, as amended.	**COMMISSIONER OF OATHS** Janine van Graan (PA) SA SAIPA Membership No. 7380 Minter House, 1 Otto Close Westlake 7945 Cape Town

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Amy Grace Wright

Registration Number: 131256

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule 1 of the Act)

Biological Science (Professional Natural Scientist)

Effective **3 November 2021** Expires **31 March 2027**

President of Council

Chief Executive Officer

To verify this certificate scan this code