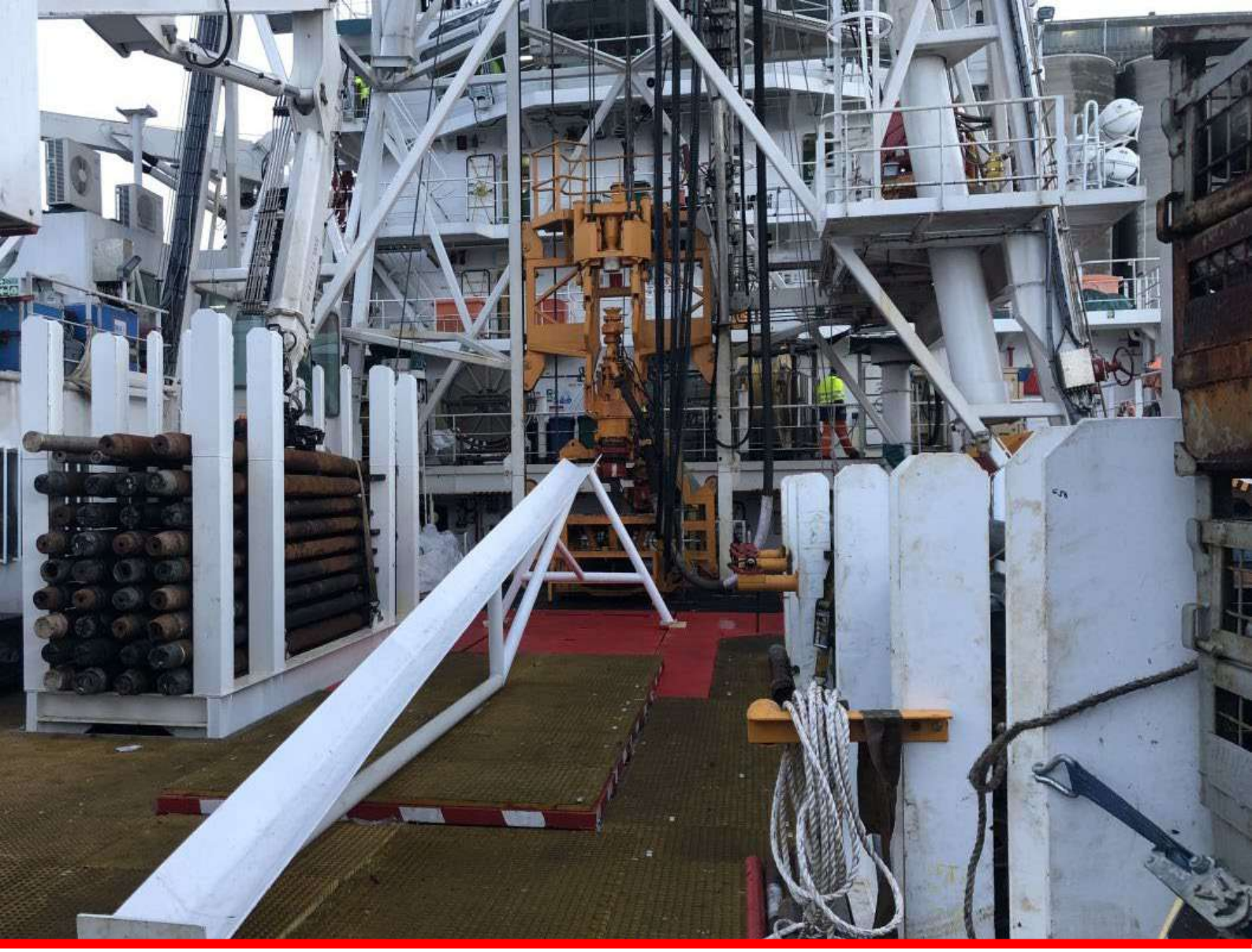
Appendix 11
Existing Environment in the Spill EMBA



APPENDIX 11

Existing Environment of the Spill EMBA

September 2024

Rev 1

eog resources

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11 Description of the Existing Environment of the Spill EMBA

In accordance with OPGGS(E) Regulation 21(2), the 'environment that may be affected' (EMBA) by the activity is described in this section, together with its values and sensitivities. While each hazard associated with the activity has its own unique EMBA, the largest one has been chosen for this chapter so as to describe all possible values and sensitivities, which is a surface release of crude oil from a loss of well control (LoWC). Spill modelling of this event used the NOPSEMA Bulletin #1 Oil Spill Modelling (NOPSEMA, 2019) hydrocarbon contact values of four oil phases (surface, dissolved, entrained and accumulated shoreline) that pose differing environmental risks to define the outer extent of the spill EMBA (see Table 5.1 in Section 5.1.2 of Chapter 5).

The low contact values used to inform the extent of the spill EMBA are useful for establishing scientific monitoring parameters and identifying potential socio-economic impacts (the socio-economic EMBA); however, they may not be at concentrations that are ecologically significant (NOPSEMA, 2019). Therefore, in addition to the socio-economic EMBA, an ecological EMBA has also been derived from the stochastic spill modelling using hydrocarbon thresholds that are identified by NOPSEMA Bulletin #1 (NOPSEMA, 2019) (see Table 5.1 in Section 5.1.2 of Chapter 5) as having the potential to cause impacts to ecological receptors. This is simply referred to as the 'spill EMBA' or interchangeably throughout this appendix as the 'EMBA' (Figure 11.1).

This spill EMBA has been established through hydrocarbon spill modelling (see Section 8.6 for MDO and Section 8.7 for crude oil). The spill EMBA is generated from stochastic modelling and therefore does not represent the possible outcome from a single spill scenario. The spill EMBA represents the compilation of possible outcomes and encompasses the area predicted to be affected from 100 simulations of the scenario per season (summer, winter, transition). Because of this, the spill EMBA is very large, covering areas that may not be affected by any single spill event.

The modelling also reports hydrocarbon contact for a given grid cell even if hydrocarbon concentrations reach this very low threshold for only one time step (2 hours) within the entire duration of the model run (6 hours for MDO and 77 days for crude oil). Because of this, the spill EMBA from a single spill event would be considerably smaller than the spill EMBA presented for the loss of MDO or a LoWC (which is an amalgamation of 100 simulations). Additionally, the spill EMBA does not consider mitigation measures that would be applied in the event of an MDO spill or LoWC, which would act the reduce the extent of the spill EMBA.

The 'environment' described in this EP is as per the definition in the OPGGS(E) regulations:

- Ecosystems and their constituent parts, including people and communities;
- Natural and physical resources;
- The qualities and characteristics of locations, places and areas;
- The heritage value of places; and
- The social, economic and cultural features of these matters.

The maps within this appendix contain the following note regarding the spill EMBA:

'The EMBA illustrated in this map represents the combined modelling results of 100 individual hydrocarbon spill simulations for each of three metocean seasons (summer, winter and transition), resulting in 300 spill simulations. Each individual spill simulates a loss of well control that releases 786,858 m^3 of crude oil over 77 days. Each spill simulation occurs is subject to various winds and ocean currents. The 300 individual spill simulations are then combined to identify the largest envelope in which a single spill could occur at any time. The EMBA is not representative of a single spill; an individual spill would affect a significantly smaller area. The modelled EMBA is based on the lowest reportable hydrocarbon thresholds.'

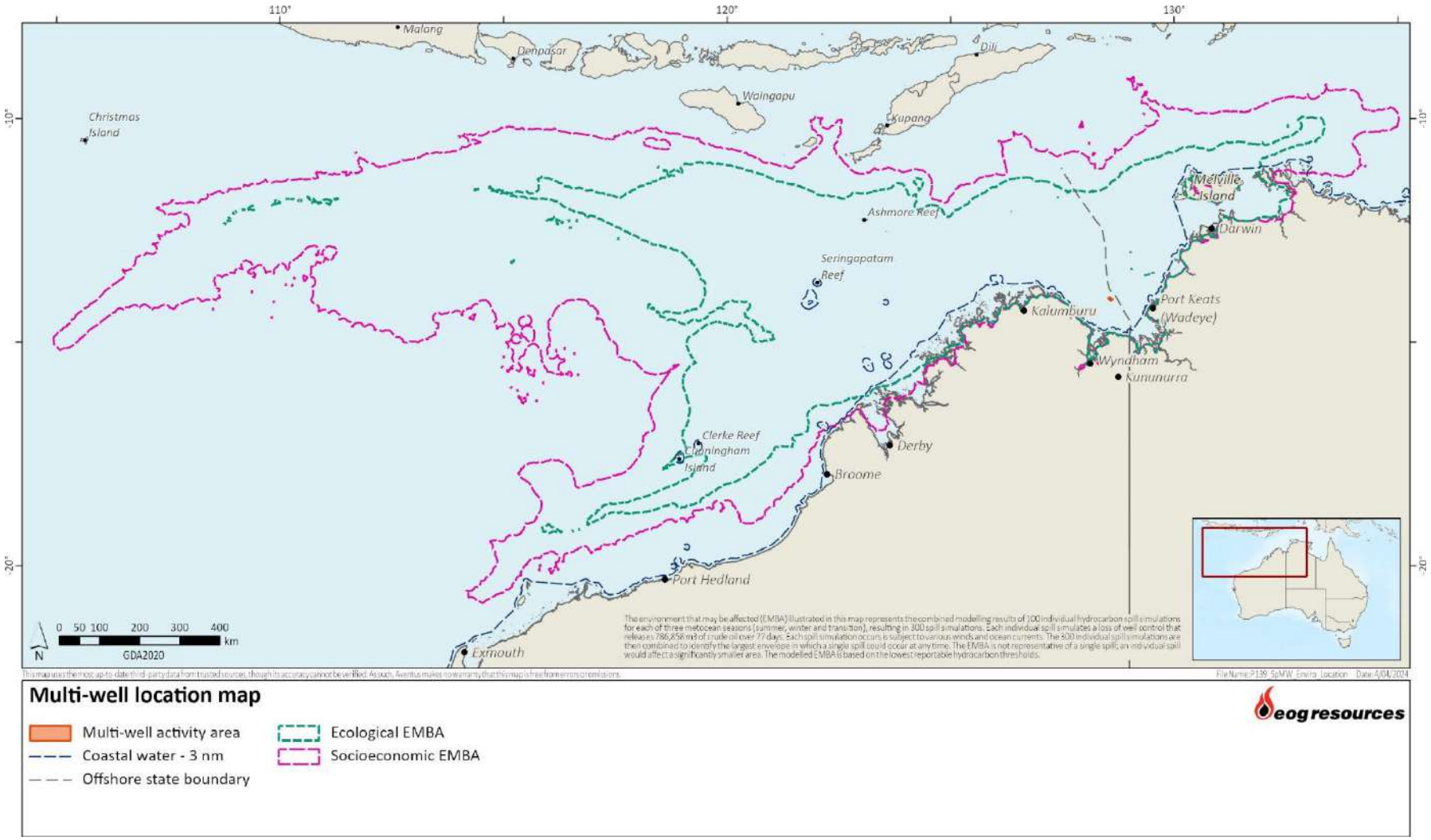


Figure 11.1 The LoWC spill EMBA

The key sources of information used in developing this chapter include the:

- EPBC Act Protected Matters Search Tool (PMST) database (DCCEEW, 2024a), conducted for the socio-economic and the ecological portion of the spill EMBA in on the 5th of April 2024 (**Appendix 10**);
    - The PMST search results of the socio-economic spill EMBA are split into 'east' and 'west' in **Appendix 10** because the PMST search does not allow for a search as large as the entire socio-economic spill EMBA.
    - The results of the PMST report have been screened against GIS data sets and current literature to remove any MNES identified in the PMST report that are outside the area of interest.
- Species Profile and Threats (SPRAT) Database (DCCEEW, 2024b);
- The Northwest Marine Bioregional Plan Bioregional Profile (DEWHA, 2008b);
- Marine bioregional plan for the North Marine Region (DSEWPC, 2012);
- Australian Marine Spatial Information System (AMSIS) (Geoscience Australia, 2024);
- Shoreline Ecological Assessments (Aerial & Ground Surveys) (PTTEP, 2009);
- Species recovery plans, conservation advice and scientific publications; and
- Seabed Habitats and Hazards of the JBG and Timor Sea, Northern Australia (Przeslawski *et al.,* 2011).

The relevant values and sensitivities considered in this chapter are inclusive of but not limited to the matters protected under Part 3 of the EPBC Act.

11.1 Regional Context

The spill EMBA occurs within both the NWMR and the NMR. The marine bioregional plans for the NWMR (DEWHA, 2008b) and NMR (DSEWPC, 2012) have been used in conjunction with other relevant management plans, reports, and published papers to inform the description of the existing environment.

11.1.1 Northwest Marine Region

The NWMR comprises Commonwealth waters from the Western Australia-Northern Territory (WA-NT) border to Kalbarri, south of Shark Bay, WA (DEWHA, 2008b).

The NWMR is characterised by the large area of continental shelf and continental slope, highly variable tidal regions and very high cyclone incidence (DEWHA, 2008b).

The NWMR is characterised by a wide continental shelf with water depths generally less than 70 metres, complex geomorphology with features including shelves, shoals, banks and terraces and valleys, currents driven largely by strong winds and tides and complex weather and a tropical monsoonal climate (DEWHA, 2008b).

11.1.2 North Marine Region

The NMR comprises Commonwealth waters from west Cape York Peninsula to the WA-NT border. The marine environment of the NMR is known for its high diversity of tropical species but relatively low endemism, in contrast to other bioregions. This region is highly influenced by tidal flows and less by ocean currents. The region is dominated by monsoonal climatic patterns characterised by a pronounced wet season and a generally dry season. Tropical cyclones are a dominant feature in the wet season (DEWHA 2008b).

11.1.3 Provincial Bioregions

Based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Version 4.0, the spill EMBA is situated within the Northern Shelf Province, Northwest Shelf Transition, Northwest Shelf Province, Timor Province and the Northwest Transition bioregions. The socio-economic EMBA intersects all the above bioregions as well as the Northwest Province, Christmas Island Province and the Timor Transition bioregions, which is illustrated in Figure 11.2**.**

Northwest Shelf Transition

The Northwest Shelf transition is a provincial bioregion situated within the NWMR and NMR extending from the Tiwi Islands in the NT to Cape Leveque in WA, covering an area of 305,463 km^2. The Indonesian Throughflow is the dominant oceanographic feature and dominates the majority of the water column. The strength of the Throughflow and its influence in the bioregion varies seasonally in association with the North-west Monsoon (DEWHA, 2008b).

The vast majority of the bioregion is located on the continental shelf with water depths generally in the range 10 to 100 m. The provincial bioregion has a complex seafloor topography with a diversity of features including submerged terraces, carbonate banks, pinnacles, reefs and sand banks. The carbonate banks and pinnacles of the Joseph Bonaparte Gulf are distinctly different in morphology and character to other parts of the region and are considered to support a high diversity of marine species (DEWHA, 2008b).

The biological communities of the North-west Shelf Transition are typical of Indo-west Pacific tropical flora and fauna and occur across a range of soft-bottom and harder substrate habitats. The inshore waters off the Kimberley are where the Western Australian population of humpback whales mate and

calve. The bioregion is important for commercial fisheries and supports both defence activities and the petroleum industry (DEWHA, 2008b).

Northwest Shelf Province

This provincial bioregion is located primarily on the continental shelf between Northwest Cape and Cape Bougainville. It varies in width from about 50 km at Exmouth Gulf to more than 250 km off Cape Leveque. Approximately half of the bioregion has water depths of only 50 to 100 m. The bioregion is a dynamic oceanographic environment, influenced by strong tides, cyclonic storms, long-period swells and internal tides. Its waters derive from the Indonesian Throughflow, are warm and oligotrophic, and circulate throughout the bioregion via branches of the South Equatorial and Eastern Gyral Currents (DEWHA, 2008b).

Fish communities are diverse and both benthic and pelagic fish communities appear to be closely associated with different depth ranges. Humpback whales migrate through the bioregion and Exmouth Gulf is an important resting area, particularly for mothers and calves on their southern migration. A number of important seabird breeding sites are located in the bioregion (but adjacent to Commonwealth waters), including Eighty Mile Beach, the Lacepede Islands (an Important Bird Area (IBA)), and Montebello and Barrow islands. The bioregion is important for the petroleum industry and the location of commercial fishing operations. The nationally significant ports of Dampier and Port Hedland operate in this bioregion (DEWHA, 2008b).

Northwest Transition

The Northwest Transition is a provincial bioregion located off the shelf between the Dampier Archipelago and Lacepede Islands covering a total area of 184 424 km2. The area includes shelf break and continental slope and the majority of the Argo Abyssal Plain included in the NWMR. Key topographic features include the Mermaid, Clerke and Imperieuse Reefs, all of which are marine reserves and together constitute the Rowley Shoals.

Surface circulation of Indonesian Throughflow waters occurs both via direct southward movement of the Throughflow itself, and recirculation of Throughflow waters via the South Equatorial Current. Cyclone incidence is high in this bioregion during summer months (DEWHA, 2008b).

Little is known about benthic biological communities in the deeper parts of the provincial bioregion, although high levels of species diversity and endemism have been identified among demersal fish communities on the continental slope. The Rowley Shoals are biodiversity hotspots in the bioregion and the steep change in slope around them attracts a range of pelagic migratory species including billfish, sharks, tuna and cetaceans. Commercial fishers operate within the bioregion and it may increase in importance for the petroleum industry in the future (DEWHA, 2008b).

Northwest Province

The Northwest Province is located on the continental shelf between Northwest Cape and Cape Bougainville, with half the bioregion located in water depths of 50 m to 100 m. It varies in width from approximately 50 km at Exmouth Gulf to more than 250 km off Cape Leveque in the Kimberley. The bioregion is a dynamic oceanographic environment, influenced by strong tides, cyclonic storms, long-period swells and internal tides. Waters derive from the Indonesian Throughflow, are warm and oligotrophic, and circulate throughout the bioregion via branches of the South Equatorial and Eastern Gyral Currents (DEWHA, 2008b).

Christmas Island Province

This provincial bioregion surrounds Christmas Island and covers a total area of 277,180 km^2. It contains the fourth largest abyssal plain/deep ocean floor area and smallest area of slope of all the bioregions (DEH, 2005). Water depths range from 0 m to 6,545 m and support a suite of marine species typical of

Indian Ocean tropical reefs. The recorded marine species diversity includes 88 coral species and over 600 fish species, including the whale shark and several other shark species, as well as hybrid fish. Green turtles and hawksbill turtles are found in offshore waters of the bioregion (DNP, 2014).

Northern Shelf Province

The Northern Shelf Province extends over the continental shelf from the eastern shore of Melville Island to West Cape York and is the largest of all the shelf provincial bioregions in the Region. It comprises the Gulf of Carpentaria in the east and the south-western Arafura Sea in the west, a covering a total area of 556,350 km^2. The provincial bioregion is characterised by relatively featureless sandy and muddy continental shelf and basin, turbid coastal waters, and submerged patch or barrier reefs around 30 m to 50 m water depth. Offshore features of the Arafura Shelf include canyons, terraces and the Arafura Sill (DEWHA, 2008b).

Of all the provincial bioregions of the Region, the Northern Shelf Province is the best sampled for demersal fish and invertebrates. Most data are associated with scientific studies and sampling of prawns and fish trawling. Localised upwellings offshore, around islands and offshore reefs, are also known to be hotspots for marine biodiversity in the provincial bioregion (DEWHA, 2008b).

Timor Province

This provincial bioregion covers almost 15% of the NWMR predominantly covering the continental slope and abyss between Broome and Cape Bougainville in WA. Water depth ranges from about 200 m near the shelf break to 5,920 m over the Argo Abyssal Plain. In addition to the Argo Abyssal Plain, the major geomorphic features are the Scott Plateau, the Ashmore Terrace, part of the Rowley Terrace and the Bowers Canyon. Important features of the bioregion include Ashmore Reef, Cartier Island, Seringapatam Reef and Scott Reef (DEWHA, 2008b).

The bioregion is dominated by warm, oligotrophic waters of the Indonesian Throughflow. In this bioregion the thermocline in the water column is pronounced and associated with the generation of internal tides. The variety of geomorphic features in the Timor Province, coupled with the variation in bathymetry, results in several distinct habitats and biological communities. The reefs and islands of the bioregion are regarded as particular hotspots for biodiversity. A high level of endemicity exists in demersal fish communities of the continental slope in the Timor Province and two distinct communities have been identified associated with the upper slope and mid slope (DEWHA, 2008b).

The bioregion supports commercial fisheries, and the petroleum industry (DEWHA, 2008b).

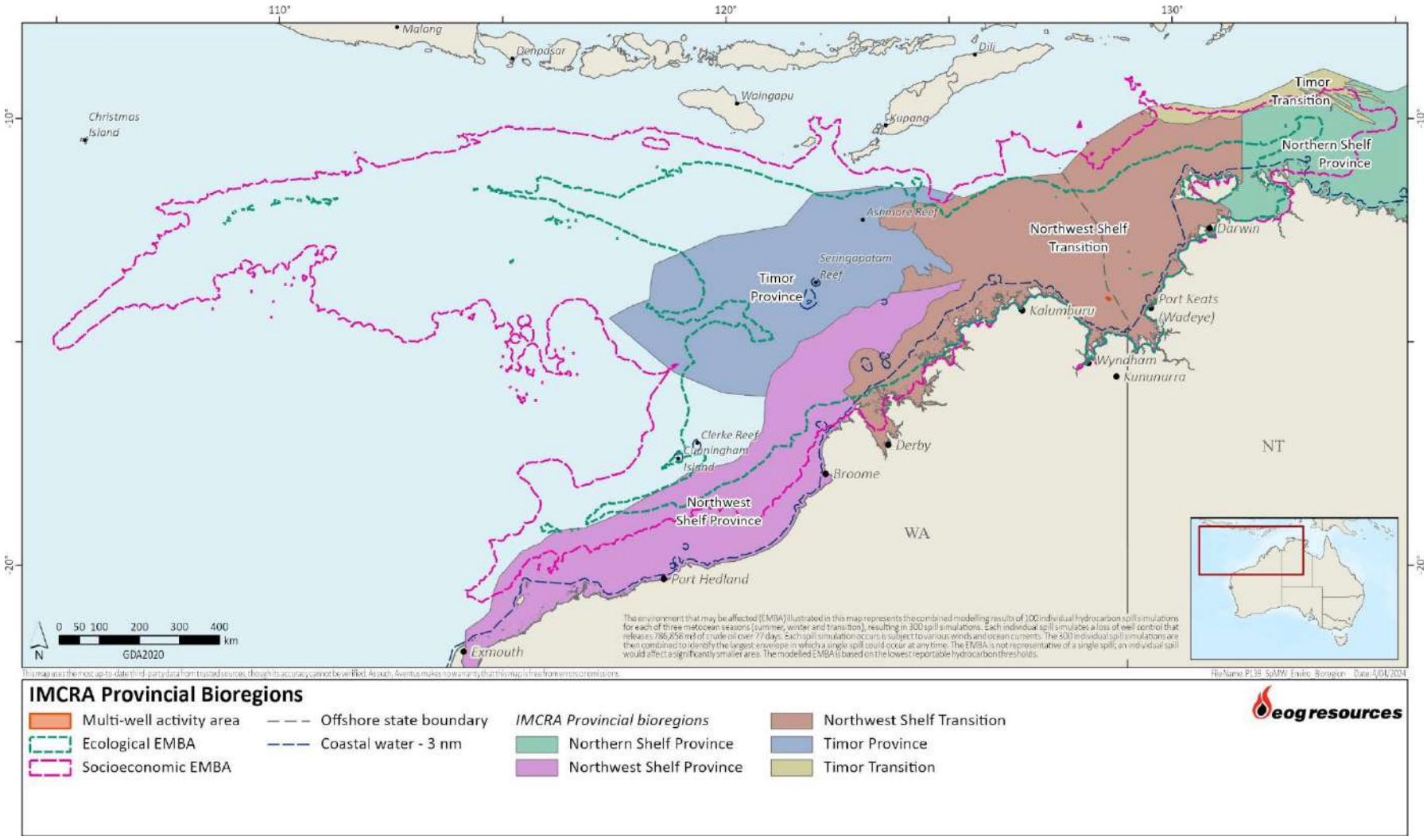


Figure 11.2 Provincial bioregions intersected by the spill EMBA

11.1.4 Mesoscale Bioregions

The following mesoscale bioregions are intersected by the spill EMBA and are presented in Figure 11.3:

- Anson Beagle;
- Arafura;
- Bonaparte Gulf;
- Cambridge-Bonaparte;
- Canning;
- Cobourg;
- Kimberley;
- King Sound;
- NorthWest Shelf;
- Oceanic Shoals;
- Tiwi; and
- Van Diemen's Gulf.

The socio-economic spill EMBA intersects all the above listed mesoscale bioregions, as well as Pilbara (offshore).

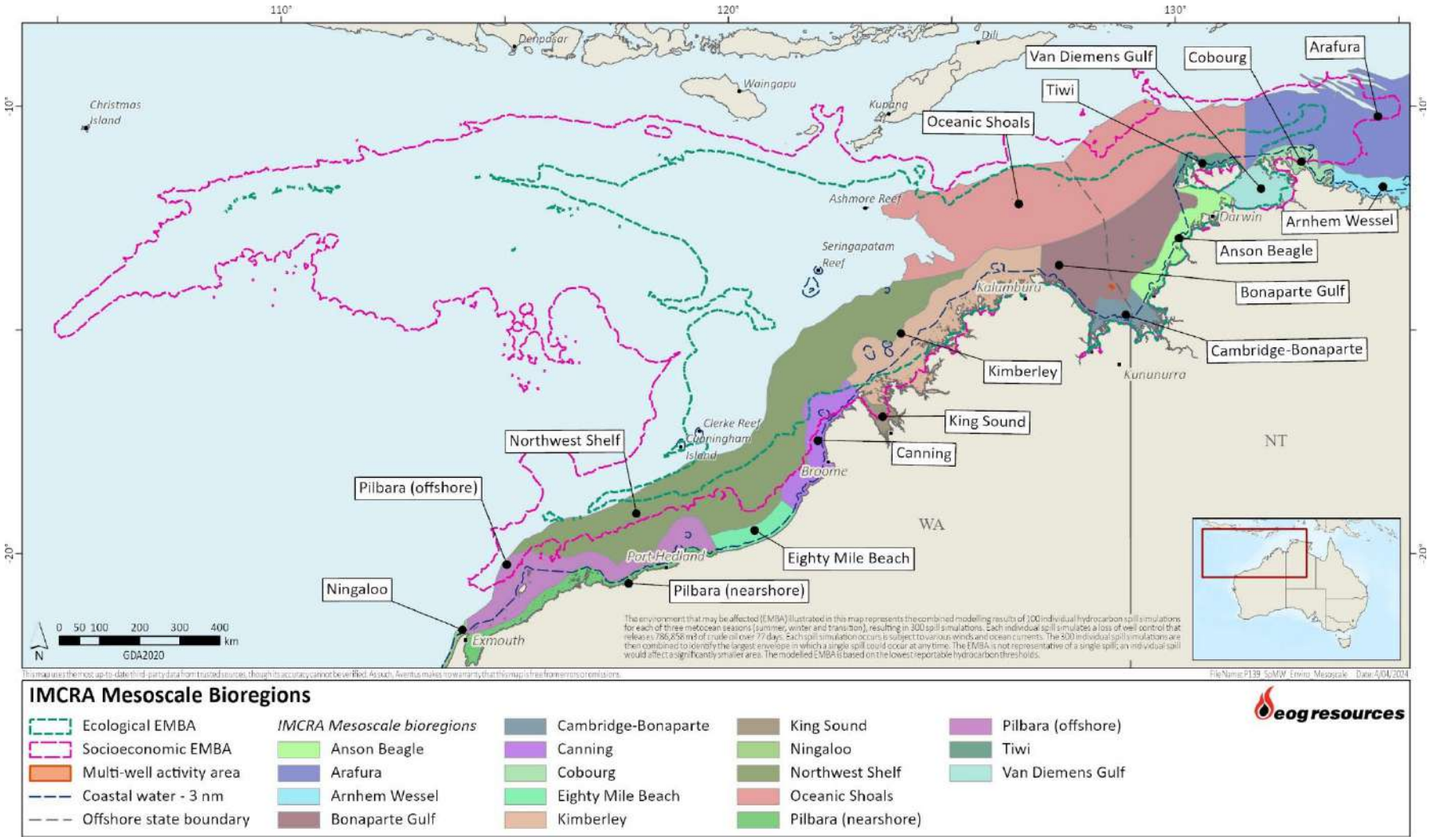


Figure 11.3 Mesoscale bioregions intersected by the spill EMBA

11.1.5 Climate

The northwest of Australia has a tropical climate with hot and humid summers and warm winters. There are two distinct seasons known as the northwest monsoon, which occurs from late October to mid-March ('wet season'); and the southeast monsoon, which occurs from May to mid-October ('dry season').

Air Temperature

Mean air temperatures range from a minimum of 11°C in winter to a maximum of 36°C in summer (Condie *et al.,* 2006). During summer, hot and dry wind from the north-east, which comes from the desert, can become really intense, with air temperatures reaching above 40°C.

Rainfall

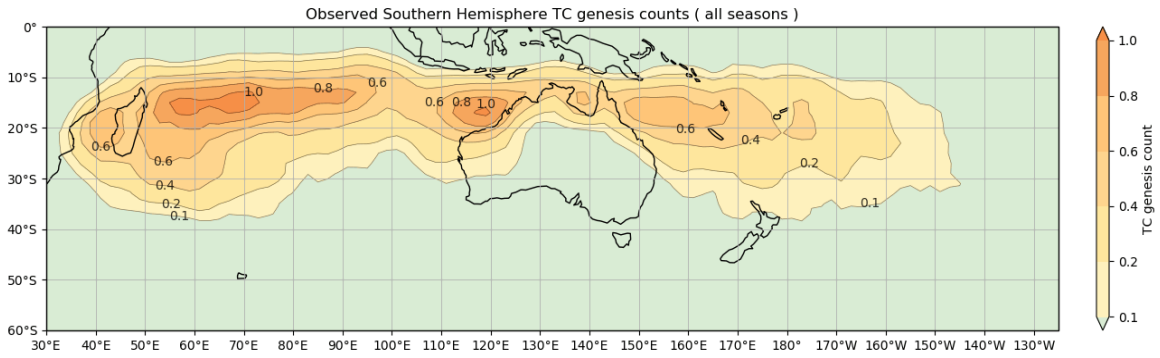
Regular and high rainfall is a characteristic of the northwest monsoon, mainly over coastal areas and during tropical cyclones. This is caused by large amounts of moisture being gathered as the monsoon crosses the sea from the Asian high-pressure belt on its way to the intertropical convergence zone, which drifts southward close to, or over, northern Australia. On the contrary, the southeast monsoon originates from the southern hemisphere high-pressure belt and is relatively dry and cool (DSEWPC, 2012). Low rainfall and humidity are associated with the southeast monsoon.

Historical rainfall data in the region shows the highest mean monthly rainfall occurs from January to March (BoM, 2024b).

Cyclones

Cyclones are common in the region resulting in severe storms with gale force winds and a rapid rise in water levels. The cyclone season typically occurs between November and April (BoM, 2024c). Cyclones result in severe storms with gale force winds and a rapid rise in water levels. Cyclones in the Australian region are influenced by several factors, and in particular variations in the El Niño –Southern Oscillation, generally more tropical cyclones occur across the coast during La Niña years than during El Niño years. On average about eleven cyclones form in the Australian region (90-160° E) each cyclone season (BoM, 2024c).

The average number of tropical cyclones through the Australian region and surrounding waters in El Niño, La Niña, neutral years and using all years of data is presented in Figure 11.4. The data is based on a 48-year period from the 1969/70 to 2017/18 tropical cyclone season.



Source: BoM (2022)

Figure 11.4 Average number of tropical cyclones in Australia from 1969 to 2018

Wind

Winds typically vary seasonally, with a tendency for south-westerly winds during September–March and south-easterly from May–July (Condie *et al.,* 2006). Transitional wind periods, during which either pattern may predominate, can be experienced in April–May and September of each year. September–March winds are more variable and are driven by high pressure cells that pass from west to east over the Australian continent. During May–July the relative position of the high-pressure cells moves further north, leading to prevailing easterly winds blowing from the mainland (Pearce *et al.,* 2003).

Seasonally averaged winds in the NWMR at 10 m above sea level during January, March, May, July, September and November are presented in Figure 11.5.

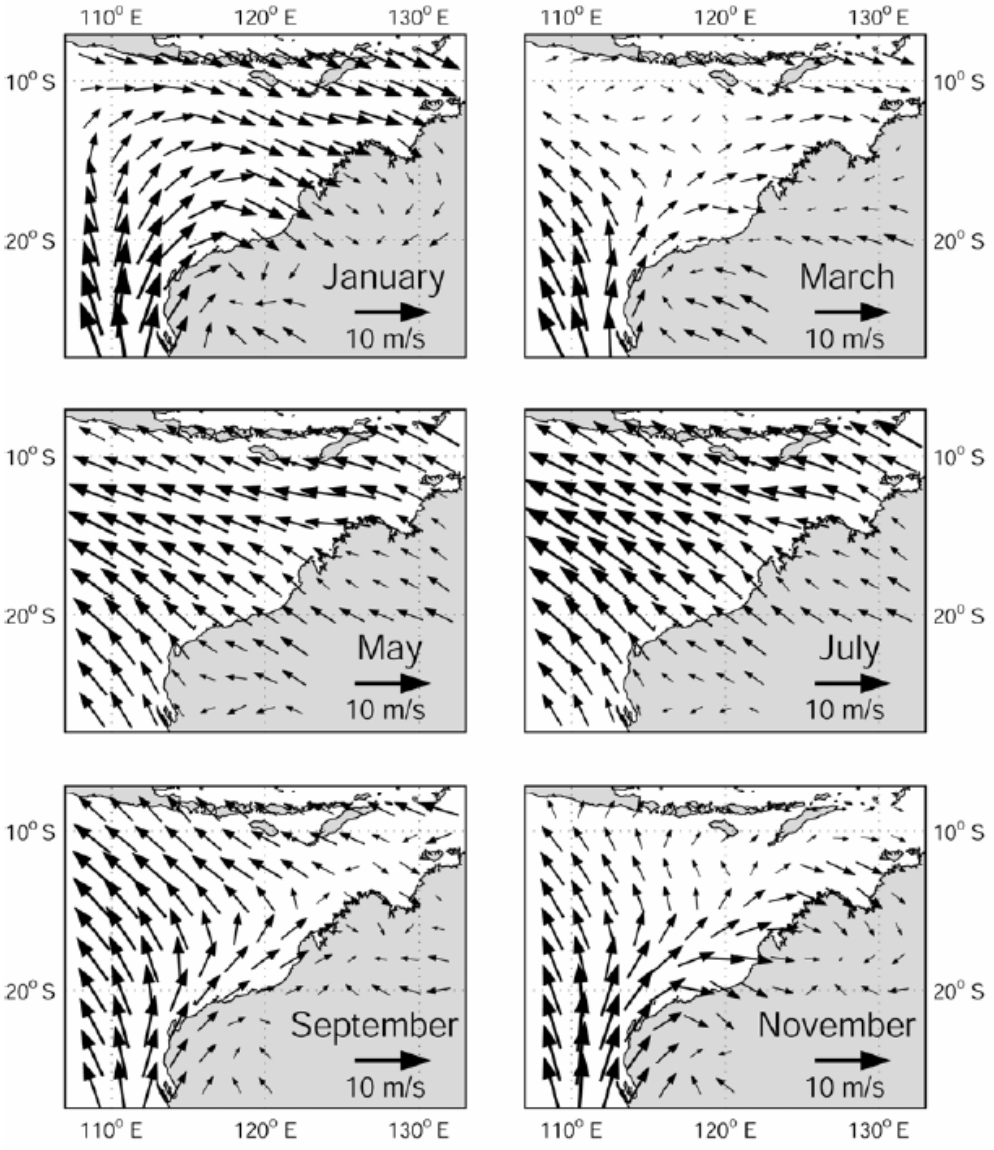


Figure 11.5 Seasonally averaged winds in the Northwest Marine Region

11.1.6 Oceanography

The oceanography of the spill EMBA is described within this section.

Currents

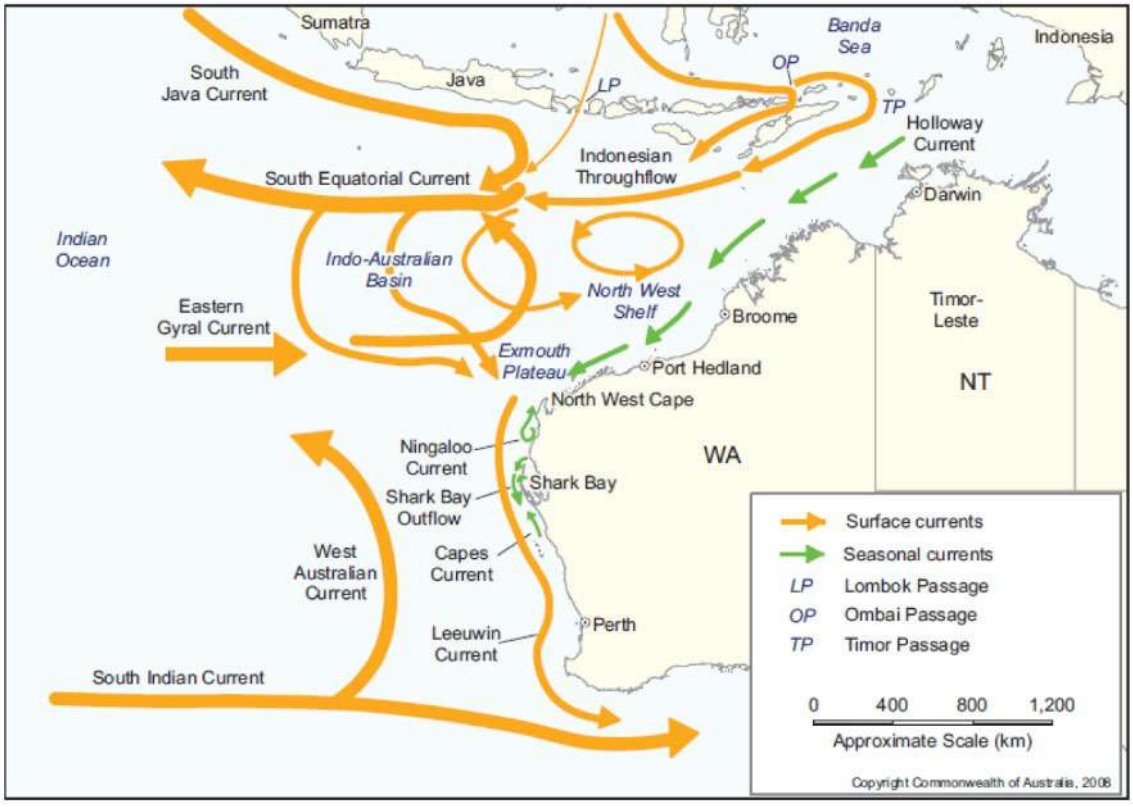
Broad-scale ocean circulation of the North Australian Shelf is dominated by the Indonesian Throughflow current system. The NWMR is influenced by a complex system of ocean currents that vary between seasons and years, which generally result in warm, nutrient-poor and low salinity surface waters (DEWHA, 2008b). Two ocean and coastal surface currents in the WA region are significant in shaping marine environmental conditions and climate. Forming on the NWS, the Leeuwin Current exerts a major influence on the distribution of marine life and WA's weather. The Indonesian Throughflow is a system of currents that carries water westward from the Pacific to the Indian Ocean through the deep passages and straits of the Indonesian Archipelago where warm, equatorial waters flow from one ocean to another, that influence the character of the Leeuwin Current (CSIRO, 2022).

During the wet season (December to March), monsoon winds push some of the waters of the Indonesian Throughflow eastwards, extending as far as the Gulf of Carpentaria. At the end of the Northwest monsoon (March-April), the pressure gradient is released, which releases a south-westerly flow of water across the shelf during autumn and winter, known as the Holloway Current (DEWHA, 2008b).

Currents in the NMR are driven largely by strong winds and tides, with only minor influences from oceanographic currents such as the Indonesian Throughflow and the South Equatorial Current. The net tidal flows that occur over time drive longer-term transport patterns through the region. The movement of tidal waters across the northern Australian marine environment is complex due to the barrier of islands and submerged reefs in the Torres Strait that hinder tidal energy entering from the Coral Sea (DSEWPC, 2012).

Surface currents that have some minor influence in the NMR include the Indonesian Throughflow and the South Equatorial Current. The Indonesian Throughflow brings warm water of lower salinity from the tropical western Pacific Ocean between the Indonesian islands to the Indo-Australian basin in the north-west of the region. The influence of the South Equatorial Current in the region is marginal, although the strength of its influence varies with the season (DSEWPC, 2012).

Figure 11.6 illustrates the major ocean currents in north-western Australian waters.



Source: DEWHA, 2008b

Figure 11.6 Ocean currents along the Northwest Australian continental shelf

Tides

The tides of the region are mixed and predominantly semi-diurnal (two high tides and two low tides per day), with well-developed spring to neap tidal variation (DEWHA, 2008b). The Kimberley region within the NWMR has some of the largest tides in Australia, along a coastline adjoining an open ocean. Tides increase in amplitude from with an increase in amplitude from south to north, which corresponds with the increasing width of the shelf (Holloway, 1983).

Tides and winds strongly influence water flow in the coastal zone and over the inner to mid-shelf, whereas flows over the outer-shelf, slope, rise and deeper waters are influenced by large scale regional circulation (DEWHA, 2008b).

Tides are semi-diurnal (two high tides and two low tides each day) and generally quite large; up to 10 m during spring tide and less than 3 m in the neap tides for the Kimberley region (DEWHA, 2008b). Water flows in the deeper waters are influenced more by large scale regional water circulation than tides and winds that influence the coastal regions. Tides contribute to the vertical mixing of surface water layers and sediments, but this is more evident in shallow waters than deep waters (DEWHA, 2008b).

The JBG is subject to semi-diurnal tides with two high and low tides per day, and has the largest tidal energy observed anywhere in the world (>7 m) (Rothlisberg *et al.,* 2005). Within the Bonaparte Gulf (situated in the Northwest Shelf Transition provincial bioregion), tides range from 2-3 m offshore (microtidal) rising to 3-4 m inshore (mesotidal).

Waves

In the JBG, the Southern Ocean swell is higher in winter than in summer as a result of northerly migration of swell-generating storms. The wave period and significant wave height generated by this swell is highly dependent on the exact location within the basin. For example, the JBG is protected from the Southern Ocean swell; therefore, swells affecting the area are limited to those generated by cyclones or prolonged storm winds (Maxwell *et al.,* 2004). The region is considered a moderate-energy environment except when influenced by tropical cyclones which generate short-term but major fluctuations in sea levels. Swells generated may have periods of 6-18 seconds and wave heights of 0.5-9 m and are dependent on the size, intensity, speed and relative location of the cyclone.

One of the most unique features of the NWMR is the occurrence of internal waves. Internal waves are dynamic, episodic events, which are strongly influenced by topography and generated by internal tides (DEWHA, 2008b). Internal tides occur at the thermocline, where the warm, low salinity waters of the Indonesian Throughflow overlay colder, more saline, deeper ocean waters. Internal tides are large in scale, frequently occurring across an ocean basin and forced by the gravitational pull of the moon and sun. An internal tide can rise and fall at a different rate to the surface tide but are typically occur semi-diurnal (twice daily) (Holloway *et al.,* 1997) and may travel either towards the shore, or away from the shore across the shelf and out into deeper water (DEWHA, 2008b).

Water Quality

The Indonesian Throughflow brings in oligotrophic waters (low in nutrients) from the western Pacific Ocean through to the Indian Ocean (DEWHA, 2008b). Exceptions in the region occur in the event of local or regional upwelling activity at the shelf break, where deeper, cooler nutrient-rich water is brought to the surface (DEWHA, 2008b). These upwelling activities include, but are not limited to, internal wave and tide regimes, horizontal shear due to strong tidal currents and tropical cyclones. However, understanding of the nature and spatial distribution of biological productivity in the region is limited (DEWHA, 2008b).

Major inputs of fine silt sediments from the Ord, Victoria and Keep River systems occur during the wet season, creating vast areas of high turbidity, particularly in the southern part of the Gulf. The sediments are deposited to form sand bars and mud flats which are themselves the source of high turbidity throughout the year as sediments are resuspended by tidal movements. Though there is only limited marine and nearshore water quality data available, as there are no major developments or population centres near the multi-well location, the potential for existing pollution is limited.

A study conducted by Holloway et al in 1985 into the mechanisms of nitrogen supply in the NWS indicated the NWMR is an oligotrophic (low in nutrients) environment. Nutrient enrichment of the shelf occurs through river runoff, tidal mixing, internal tides, low frequency circulation, upwelling, and tropical cyclones that induce oceanic mixing and further upwelling (Holloway *et al.,* 1985).

Ambient Ocean Sound

Physical and biological processes contribute to natural background sound. Physical processes include that of wind, waves, rain and earthquakes, whilst biological noise sources include vocalisations of marine mammals and other marine species.

Wind is a major contributor to noise between 100 Hz and 30 kHz and can reach 85-95 dB re 1µPa^2/Hz under extreme conditions (WDCS, 2004). Rain may produce short periods of high underwater sound with a flat frequency spectra to levels of 80 dB re 1µPa^2/Hz and magnitude 4 earthquakes have been reported to have spectral levels reaching 119 dB re 1µPa^2/Hz at frequency ranges of 5-15 Hz.

Turnpenny and Nedwell (1994) found that in sensitive species such as the cod, continuous ambient sound alone resulted in auditory masking, and that sound had to be 20 dB above ambient sound to be audible. A comparison of biological and anthropological sounds in the marine environment is provided in Table 5.5 of Section 5.2.2 of Chapter 5.

11.1.7 Physical Environment

The physical environment of the spill EMBA is described in this section.

Bathymetry

Water depths in the NWMR range from 0 to 5,980 m. The NWMR is relatively shallow, with greater than 40% of the total area in water depths of less than 200 m and greater than 50% in depths of less than 500 m (Baker *et al.,* 2008). Water depths in the spill EMBA range from 6,000 m (offshore) to <10 m (inshore).

Bathymetry in parts of the south of the JBG is strongly influenced by the strong tidal movement and channels of the Ord, Keep, Victoria and Fitzmaurice rivers. A series of extensive sandbars, known as the King Shoals and Medusa Banks, have been generated in the southwest by the strong outflows of sediment-laden water from the Cambridge Gulf. Similar sandbars can be found in the southeast of the JBG. Bathymetry of the spill EMBA is presented in Figure 11.7.

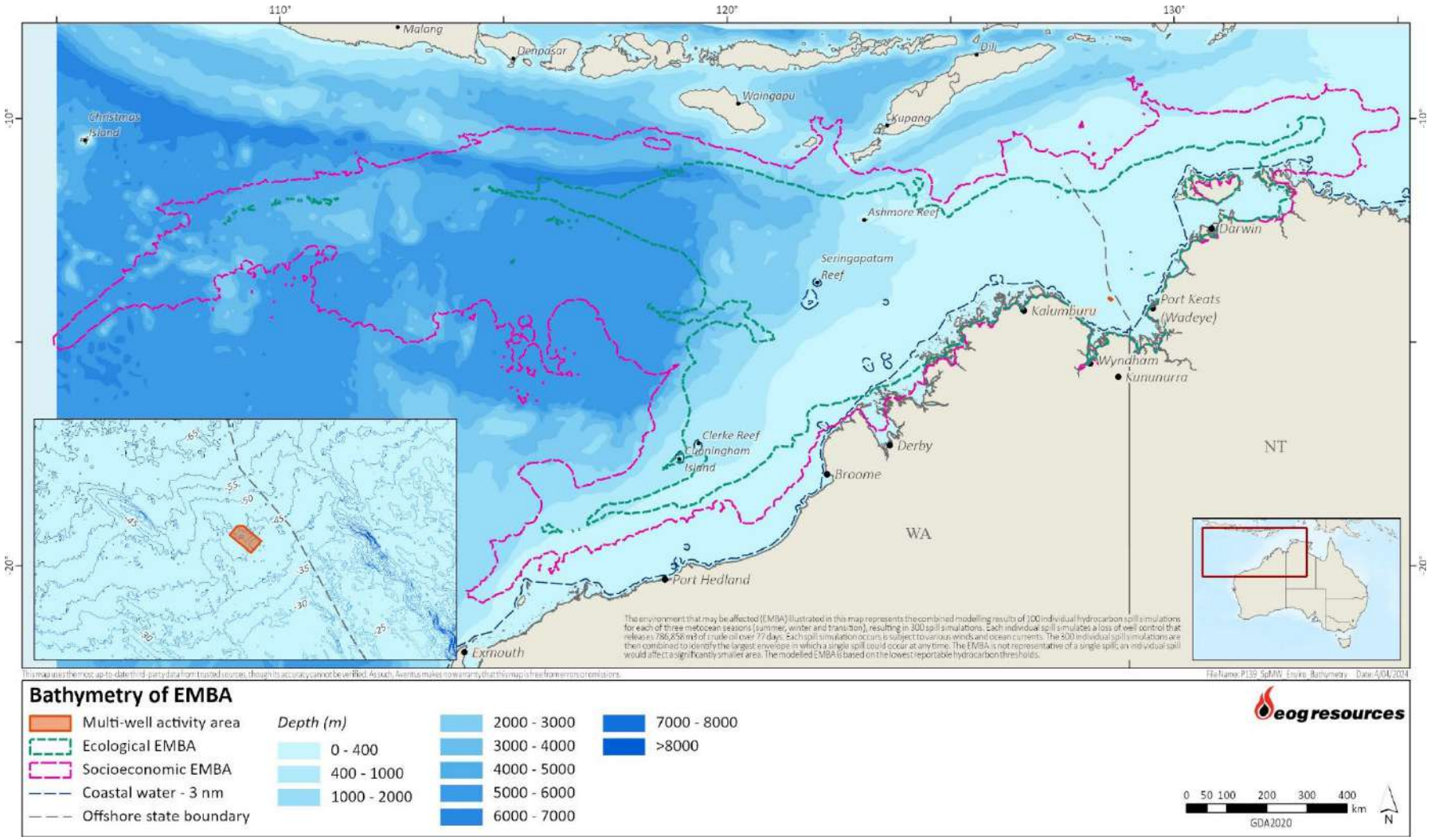


Figure 11.7 Bathymetry of the spill EMBA

Geomorphology

The seafloor of the NWMR comprises an extensive area of continental shelf, slope, rise and abyssal plain/deep ocean floor. Most of the region consists of continental slope (61%) or continental shelf (28%) and a range of features such as canyons, plateau, terraces, ridges, reefs, banks and shoals. Over half of the total area of banks and shoals in Australian marine jurisdiction occurs in the NWMR, including 39% of terraces and 56% of deeps, holes and valleys (DSEWPC, 2012).

Sediment texture and composition displays a zoning with depth, and sand and gravel dominatethe shelf area whilst mud dominates the lower slope and abyssal plain/deep ocean floor.

Calcium carbonate concentrations throughout the region are generally highest along the shelf to the shelf edge and are associated with reefs (Baker *et al.,* 2008).

Ten key geomorphic features have been identified in the JBG (Przeslawski *et al.,* 2011). The inner gulf comprises mostly shelf with sand banks and valleys. The outer gulf and Timor Sea mostly comprise of basin with banks/shoals, terraces and pinnacles separated by deep hole/valley features and escarpment.

The benthic environment of the JBG is linked to its geomorphic features, with the majority of the area characterised by infaunal plains, with some localised reefs and outcrops supporting sponge gardens. Seabed morphology in parts of the JBG is influenced by the strong tidal movement and channels of the Ord, Keep, Victoria and Fitzmaurice rivers. A series of extensive sandbars, known as the King Shoals and Medusa Banks (approximately 70 km and 65 km south respectively of the multi-well location), have been generated by the strong outflows of sediment-laden water from Cambridge Gulf. Similar sandbars can be found in the south-east of the JBG. The multi-well location is located entirely within the ‘shelf’ geomorphic feature, which is typically characterised by extensive sediment plains and high sediment deposition from the coastal rivers to the south (Figure 11.8).

The NMR seafloor comprises a wide continental shelf with water depths generally less than 70 m although water depths range from approximately 10 m to a maximum known depth of 357 m (DSEWPC, 2012). It contains the Van Diemen Rise, characterised by complex geomorphology with features including shelves, shoals, banks, terraces and valleys like the Malita Shelf Valley, which provides a significant connection between the Joseph Bonaparte Gulf and the Timor Trough. In addition, numerous limestone pinnacles up to tens of kilometres in length and width, lie within the Bonaparte Basin (DSEWPC, 2012).

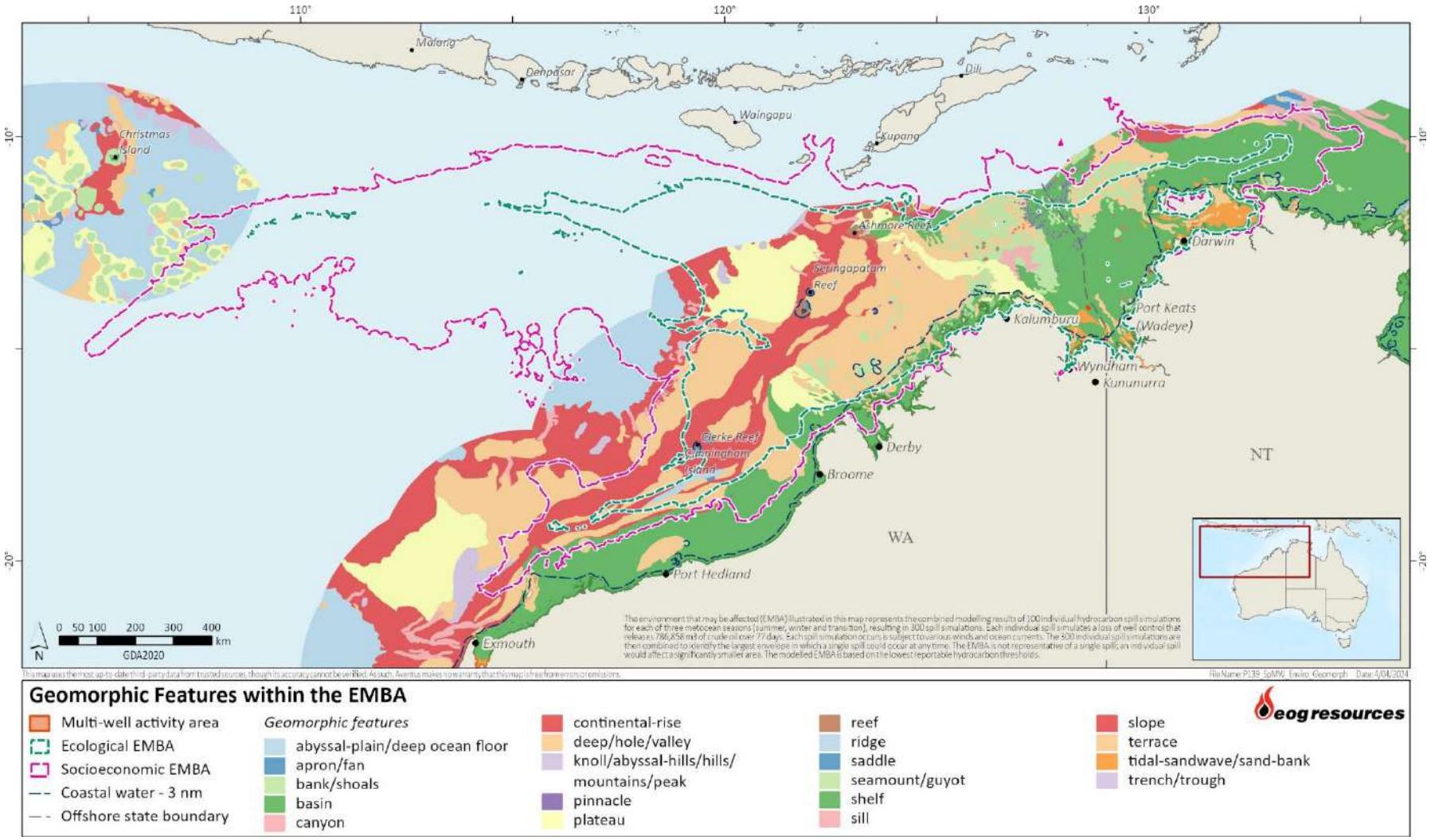


Figure 11.8 Geomorphic features of the spill EMBA

Sedimentology

The sedimentology of the NWMR is varied due to the diversity of physical features from coral reefs to major canyons that act as conduits for sediment and nutrient transport (DSEWPC, 2012). The region is made up of a tropical carbonate shelf dominated by sand and gravel to 15° latitude, while the outer shelf/ slope zone is dominated by mud (Baker *et al.,* 2008). It has a relatively homogenous rise and abyssal plain/ deep ocean floor that is dominated by non-carbonate mud because it occurs below the carbonate compensation depth (Baker *et al.,* 2008).

Major contributors to sediment mobilisation in the NWMR include storm events, tropical cyclones; internal tides; and ocean currents, including the Leeuwin current (Baker *et al.,* 2008). Sediments of the middle shelf region are predominantly influenced by tidal processes, including internal tides (Baker *et al.,* 2008).

Sedimentology in the NMR is also varied, with physical features including shallow canyons, which mainly consist of calcium carbonate, based sediments, as well as limestone pinnacles and reefs (DEWHA, 2008b).

The continental shelf in the JBG is the widest in Australia, extending up to 400 km from the shore. The sedimentology of the JBG is unique, with most of the inner shelf being characterised by relatively flat expanses of soft sediment seabed with localised rocky outcrops, gravel deposits and sands banks. The soft sediments in the region typically consist of sandy and muddy substrate, occasionally made up of patches of coarser sediments (Baker *et al*., 2008). The inner shelf section of the JBG receives significant loads of sediments from several large rivers including the Daly and Victoria rivers (Przeslawski *et al*., 2011).

The distribution of seabed sediments in the JBG, and in particular within the Sahul Shelf, reflects the present-day oceanographic condition and displays a distinct seaward fining pattern (Lees 1992, in Baker *et al*., 2008). Sediment sampling undertaken by ERM) in 2010 and 2011 (within WA-6-R and NT/RL1, more than 100 km north of the multi-well location location) confirms that the area is mainly dominated by sand, with similar proportions of smaller gravel, silt and clay (ERM, 2011).The top layer of sediment in the JBG from ~3 km to 35 km offshore is expected to be greater than 1 m in depth and consists of sand and gravel with variable proportions of clay. This material is primarily alluvium, derived from sedimentary sandstones and basal conglomerate. Sonar images indicate some minor paleochannels in this area containing mega-ripple or sand waves. These sediments are generally unconsolidated coarse sand, fine gravel interspersed with areas of flat and featureless seabed containing very soft to firm gravelly clays (Woodside, 2004).

The main drainage channels for the Victoria River System occur from approximately 35 km to 58 km offshore. This area is dynamic as currents and tidal influence are constantly changing the seabed features in the area. Due to the dynamic nature of the channels, the thickness of the top layer of sediment is expected to be variable. A top layer greater than one metre in depth and consisting of sands and gravels with variable proportions of clay is expected from 59 km to 65 km offshore, with some minor paleochannels occurring. The influence of alluvial inputs diminishes from around 60 km offshore to the Blacktip Wellhead Platform (WHP), which is located approximately 20 km northwest of the multi-well location. This top layer increases to greater than two metres in depth from 66 km offshore and the sediments range from loose silty/clayey sands from 66 km to 75 km and very soft clayey silt and silty clay from 75 km offshore to the Blacktip WHP location (Woodside, 2004). Again, the seabed alternates between flat and featureless seabed containing very soft to firm silty clay and an area of hummocky seabed containing mega-ripple or sand waves, though the seabed is generally flat to gently sloping from about 66 km offshore to the Blacktip WHP location (Woodside, 2004).

11.2 Coastal Environments

The physical coastal environment described in this section is defined by the potential extent of dispersion of low threshold entrained hydrocarbons predicted under the LoWC spill scenario (i.e., the socio-economic EMBA), as illustrated in Figure 11.1.

Shoreline habitats are defined as those habitats that are adjacent to the water along the mainland and islands that occur above the Lowest Astronomical Tide (LAT), and most often in the intertidal zone. Table 11.1 provides a description of the shoreline types according to shoreline receptors (areas defined in this EP to inform oil spill response planning purposes and are referred to as 'sectors') that are intersected by the socio-economic EMBA. Descriptions of the shoreline habitats for each sector are derived from the Australian Coastal Geomorphology Smartline database.

In general, these coastlines and islands (excluding Darwin) are very remote and sparsely populated. Levels of human development and disturbance are correspondingly low around most of the coast (Chatto and Parks, 2006).

Maps of the coastal habitats of the shoreline sectors intersected by the spill EMBA are provided in Figure 11.9 to Figure 11.23. These maps note the maximum probability of shoreline loading from a LoWC.

The following section broadly categorises shoreline habitats as the following biological communities that were identified to occur within the socio-economic EMBA: sandy beaches, rocky shorelines, tidal flats, mangroves and islands.

11.2.1 Sandy Beaches

Sandy beaches are the dominant shoreline type on the eastern coast of the JBG with only occasional rocky headlands and river estuaries leading to the ocean. These environments are remote and have had limited anthropogenic presence (Christiansen *et al.,* 2010). The beaches provide roosting and nesting habitat for sand nesting birds and turtles, such as plovers and flatback turtles, respectively.

For the purposes of this description, sandy beaches include areas of mixed sandy shore/mixed sandy sediments on bedrock, sand beach/alluvium/shore/dune/foredunes (Table 11.1).

Sandy beaches provide habitat to a variety of burrowing invertebrates and subsequently provide foraging grounds for shorebirds (Garnet and Crowley, 2000). The number of species and densities of benthic macroinvertebrates that occur in the sand are typically inversely correlated with sediment grain-size and exposure to wave action, and positively correlated with sedimentary organic content and the amount of detached and attached macrophytes (Wildsmith *et al.,* 2005). However, the distributions of these fauna among habitats will also reflect differences in the suite of environmental variables that characterize those habitats (Wildsmith *et al.,* 2005).

Sandy beaches are found scattered throughout the coastline of northwest WA and the NT with large areas on the western side of the Dampier Archipelago, north and south of Broome (approximately 140 km in length) (Figure 11.10), Derby-West Kimberley (10.6 km) (Figure 11.11), Mitchell River (23.9 km) (Figure 11.12), Wyndham-East Kimberley sector (150 km) (Figure 11.13), Ashmore Reef/Cartier Island (14.5 km) (Figure 11.14), Scott Reef/Browse Island (~2 km) (Figure 11.15), north of Cox-Finniss (25.8 km) (Figure 11.19) and Litchfield (4.8 km) (Figure 11.20).

11.2.2 Rocky Shorelines

Rocky shores can include pebbles/cobbles, boulders and rocky limestone cliffs (often at the landward edge of reef platforms). Rocky outcrops typically consist of hard bedrock, but some of the coastline has characteristic limestone karsted cliffs with an undercut notch. Rocky shorelines can vary from habitats where there is bedrock protruding from soft sediments to cliff like structures that form

headlands. Rocky shorelines are an important foraging area for seabirds and habitat for invertebrates found in the intertidal splash zone (Morton and Britton cited in Jones, 2004). For the purposes of this description, rocky shorelines include areas of hard bedrock/cliff (> 5 m)/hard rocky shore, rocky shore and soft bedrock (Table 11.1).

Rocky shorelines are the dominant shoreline type on the western coast of the JBG that is intersected by the socio-economic EMBA. Hard bedrock shorelines are also found in all of the shoreline sectors except for Ashmore Reef/Cartier Island (Figure 11.14), Scott Reef/Browse Island (Figure 11.15) and Victoria-Daly (Figure 11.16). The longest length of coastline consisting of hard bedrock cliffs and shore are found in the following shoreline sectors: Derby-West Kimberley (2,261 km) (Figure 11.11) and Mitchell River (3,837 km) (Figure 11.12).

While there are some stretches of sandy beaches on the west coast of the JBG, they are confined to the sheltered bays and inlets. The exposed rocky shores would be exposed to wave action from the surrounding gulfs and as such are likely to provide habitat for intertidal algae and shell species.

11.2.3 Tidal Flats

Tidal flats (also referred to as mudflats) are comprised of layers of fine mud due to the ongoing deposition of estuarine silts, which combines with deposition of fine sands by tidal movements. For the purposes of this description, tidal flats include areas of tidal flats (sand, mud, sediments)/mangroves, marshy sediment flats/marshy saline sediment flats, saline mudflats and muddy sediments /alluvium/sediment flats (Table 11.1).

These areas provide important habitat for mud and sand-dwelling invertebrates such as crabs, prawns, shells and worms and sheltered habitat for larval and juvenile fishes. Due to the diversity of infauna, they are also an important foraging habitat for various shorebird species including egrets, plovers and oystercatchers.

the spill EMBA intersects tidal flats (sand, mud, sediment) which are found in all of the shoreline sectors except for Ashmore Reef/Cartier Island (Figure 11.14) and Scott Reef/Browse Island (Figure 11.15). The longest length of coastline consisting of tidal flats are found in the following shoreline sectors: Derby-West Kimberley (100 km) (Figure 11.11), Mitchell River (55 km) (Figure 11.12), and Wyndham-East Kimberley (1,062 km) (Figure 11.13).

Tidal sediments flats (inferred from mangroves) are predominantly found in the NT from the Victoria-Daly coastline extending up to and including West Arnhem (Figure 11.16 to Figure 11.22).

Marshy sediment flats including marshy saline sediment flats are commonly found along the Cox-Finniss sector (Figure 11.19) toward and including the West Arnhem sector (NT) (Figure 11.22).

11.2.4 Mangroves

Mangroves commonly occur in sheltered coastal areas in tropical and sub-tropical latitudes (Kathiresan and Bingham, 2001). Mangroves are found wherever suitable conditions are present including wave-dominated settings of deltas, beach/dune coasts, limestone barrier islands and ria/archipelago shores (Semeniuk, 1993). For the purposes of this description, mangroves include areas of tidal flats (sand, mud, sediments)/mangroves and marshy sediment flats/marshy saline sediment flats (Table 11.1).

Mangroves are important primary producers and have a number of ecological and economic values, including reducing coastal erosion and providing habitat for a variety of epibenthic, infaunal and meiofaunal invertebrates (Kathiresan and Bingham, 2001). Crustaceans known to inhabit the mud in mangrove systems include fiddler crabs, mud crabs, shrimps and barnacles, while water channels of the system support various finfish. Mangroves and their associated invertebrate-rich mudflats are also

an important habitat for migratory shorebirds from the northern hemisphere, as well as some avifauna that are restricted to mangroves as their sole habitat (Garnet and Crowley, 2000).

Mangrove habitat intersected by the socio-economic EMBA typically occur along the banks of the major rivers and estuarine environments of the southern JBG including at Quoin Island (126 km southeast of the multi-well location) and Clump Island (133 km southeast) and along the southern coastline of Dorcherty Island (95 km east), including the Tiwi Islands and Vernon Islands (located 345 km in the most north-easterly extent of the spill EMBA) (see Figure 11.23).

Shoreline ecological aerial and ground surveys were conducted from Darwin in the NT to Broome in WA in response to the Montara oil spill during 2009 (Pearce & Duke, 2013). A distance of approximately 5,100 km of shoreline was surveyed, analysed and mapped to quantitatively characterise coastal ecological features. Mangroves were found to grow along 63% of the surveyed shoreline and salt marshes occurred over 24% of the shoreline.

11.2.5 Islands

Several rocky and sandy islands are located within the socio-economic EMBA that provide intertidal and shoreline habitats for a variety of marine fauna and ecological communities, including many small islands along the north Kimberley coast, Browse Island, including sand islands at Ashmore Reef and Cartier Island (as described in Sections 11.3.1 and 11.4.7), the Tiwi Islands (including Melville and Bathurst Islands (Figure 11.23) and Vernon Islands, as described in Sections 11.3.1). For the purposes of this description, islands include reef/coral outer with sandy shore (Table 11.1).

Table 11.1 Description of shoreline receptors by type in the spill EMBA

EMBA shoreline sector	Description of shoreline by type														
	Alluvial sediment/plain	Beach sediment/ridges	Colluvium	Tidal flats (sand, mud, sediment)/Mangroves	Hard bedrock/Cliff (>5 m)/Hard rocky shore	Marshy sediment flats/Marshy saline sediment flats	Mixed sandy shore/Mixed sandy sediments on bedrock	Muddy sediments/alluvium/sediment flats	Reef/Coral outer with sandy shore	Rocky shore	Saltpans/saline mudflats	Sandy beach/alluvium/shore/dune/foredune	Sediment plain/sediment deposits	Soft bedrock	Unclassified
Broome		X		X	X		X		X		X	X			X
Derby-West Kimberley		X		X	X				X		X				X
Mitchell River	X	X		X	X						X	X		X	X
Wyndham-East Kimberley	X	X		X	X						X	X	X	X	X
Victoria-Daly		X		X							X	X	X		X
Thamarrurr		X		X	X							X	X	X	
Daly	X			X	X							X	X	X	
Cox-Finniss	X	X		X	X	X	X	X		X	X	X	X	X	X
Litchfield				X	X	X	X	X		X	X	X		X	X
South Alligator				X	X	X	X	X			X	X	X	X	
West Arnhem	X		X	X	X	X		X			X	X	X	X	X
Bathurst and Melville Islands	X		X	X	X	X	X	X			X	X	X	X	

EMBA shoreline sector	Description of shoreline by type														
	Alluvial sediment/plain	Beach sediment/ridges	Colluvium	Tidal flats (sand, mud, sediment)/Mangroves	Hard bedrock/Cliff (>5 m)/Hard rocky shore	Marshy sediment flats/Marshy saline sediment flats	Mixed sandy shore/Mixed sandy sediments on bedrock	Muddy sediments/alluvium/sediment flats	Reef/Coral outer with sandy shore	Rocky shore	Saltpans/saline mudflats	Sandy beach/alluvium/shore/dune/foredune	Sediment plain/sediment deposits	Soft bedrock	Unclassified
Scott Reef/Browse Island									X			X			
Ashmore Reef/Cartier Island									X			X			

Key:
X = shoreline type present.
Unclassified is defined as the 13,045 km of shoreline of the spill EMBA that has no known coastal geomorphological classification.
Source: Australian Coastal Geomorphology Smartline. Note GoogleEarth Pro imagery was used in the absence of GIS data for unclassified areas.

Note: a detailed list of receptors mapped against the Western Australia Marine Oil Pollution Risk Assessment (WAMOPRA) sectors is presented in table E.2 in appendix E of the OPEP.

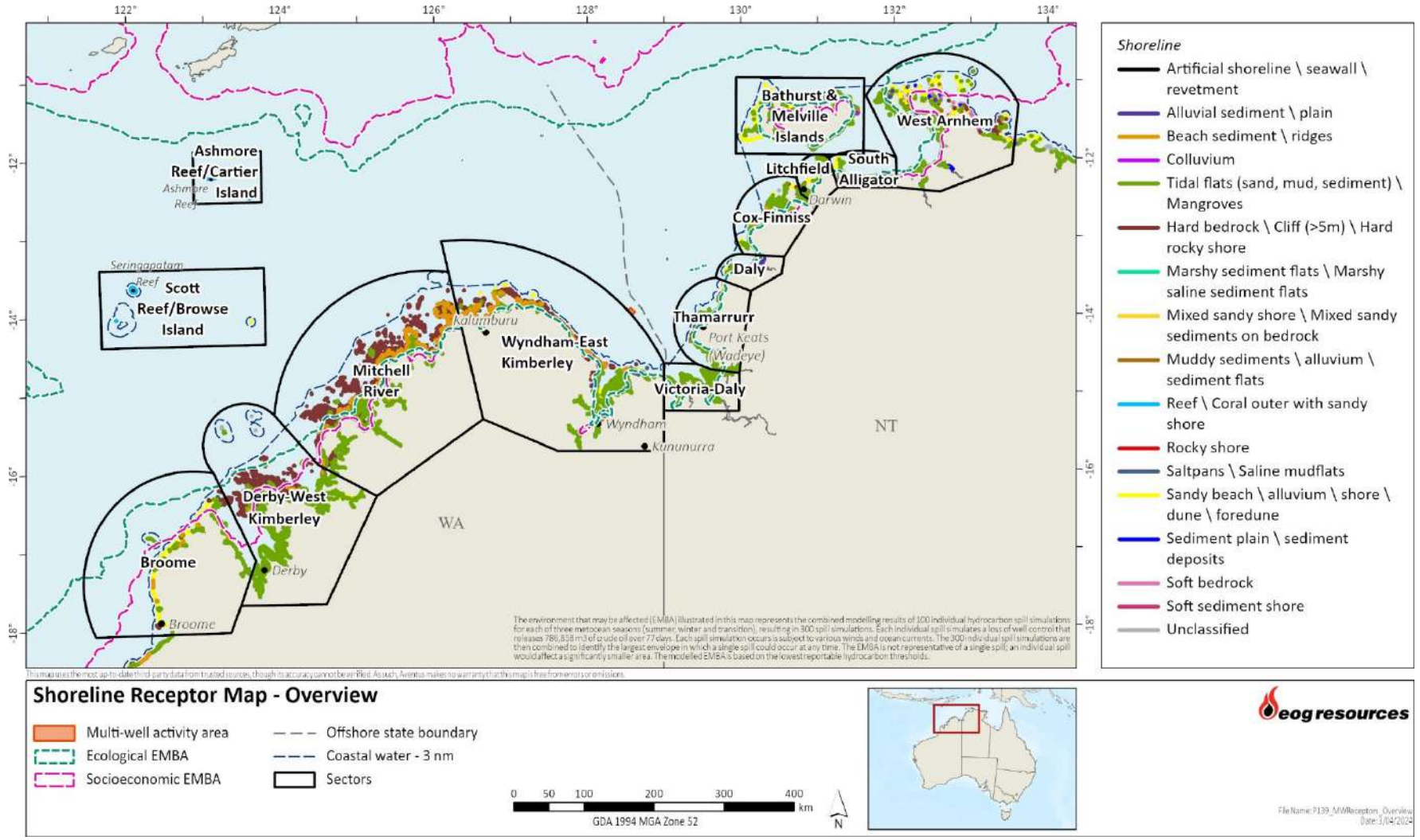
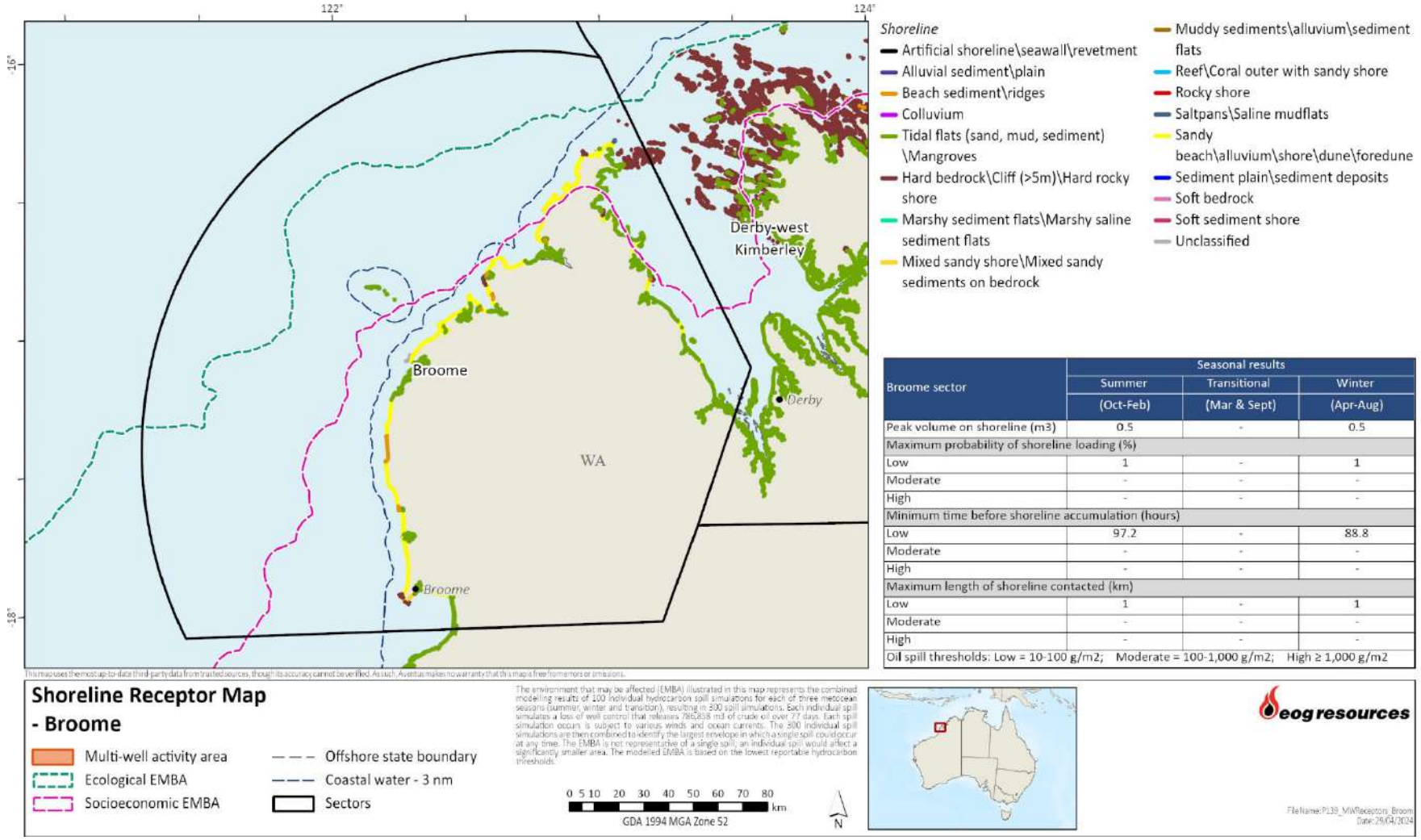
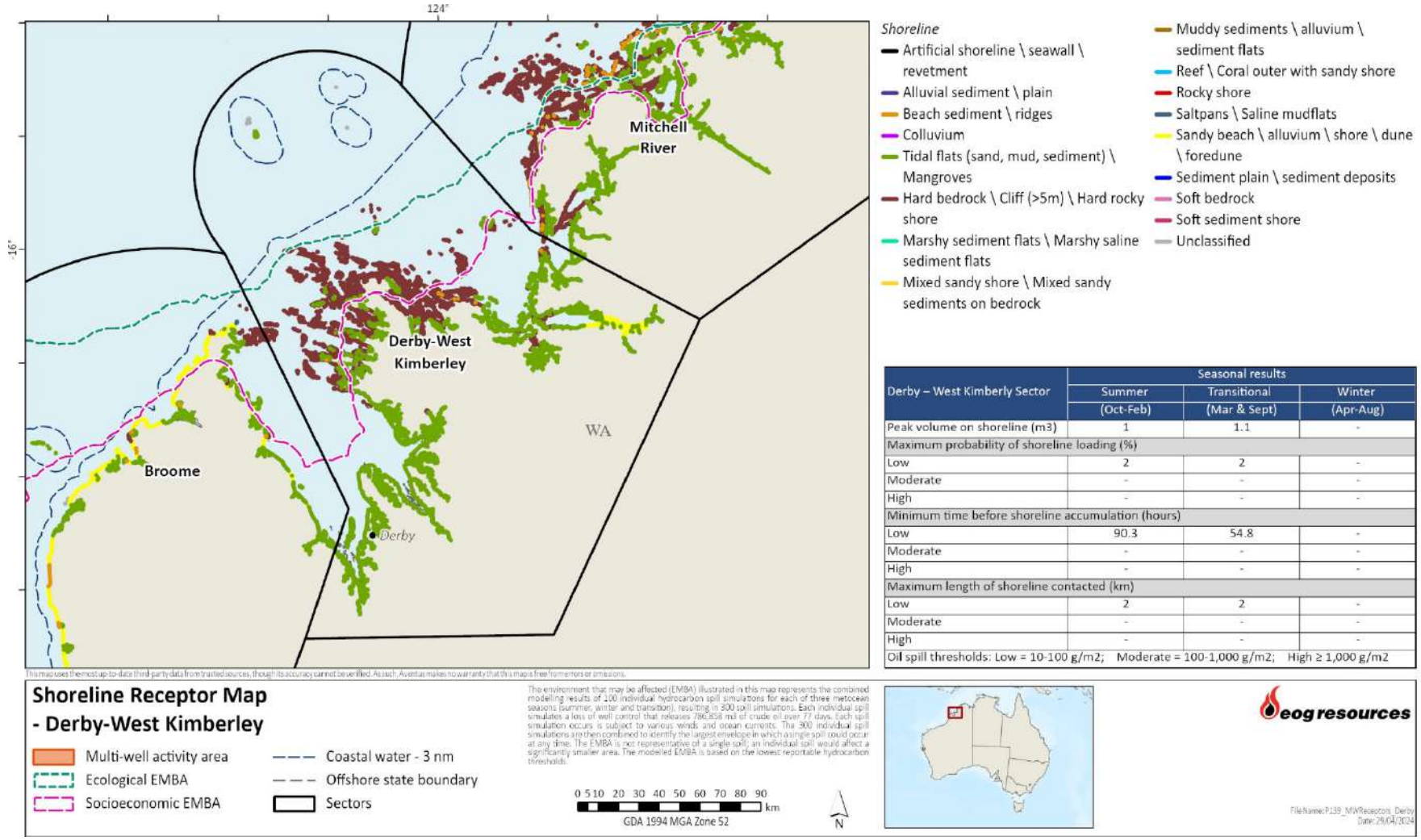


Figure 11.9 Overview of the shoreline receptors intersected by the spill EMBA



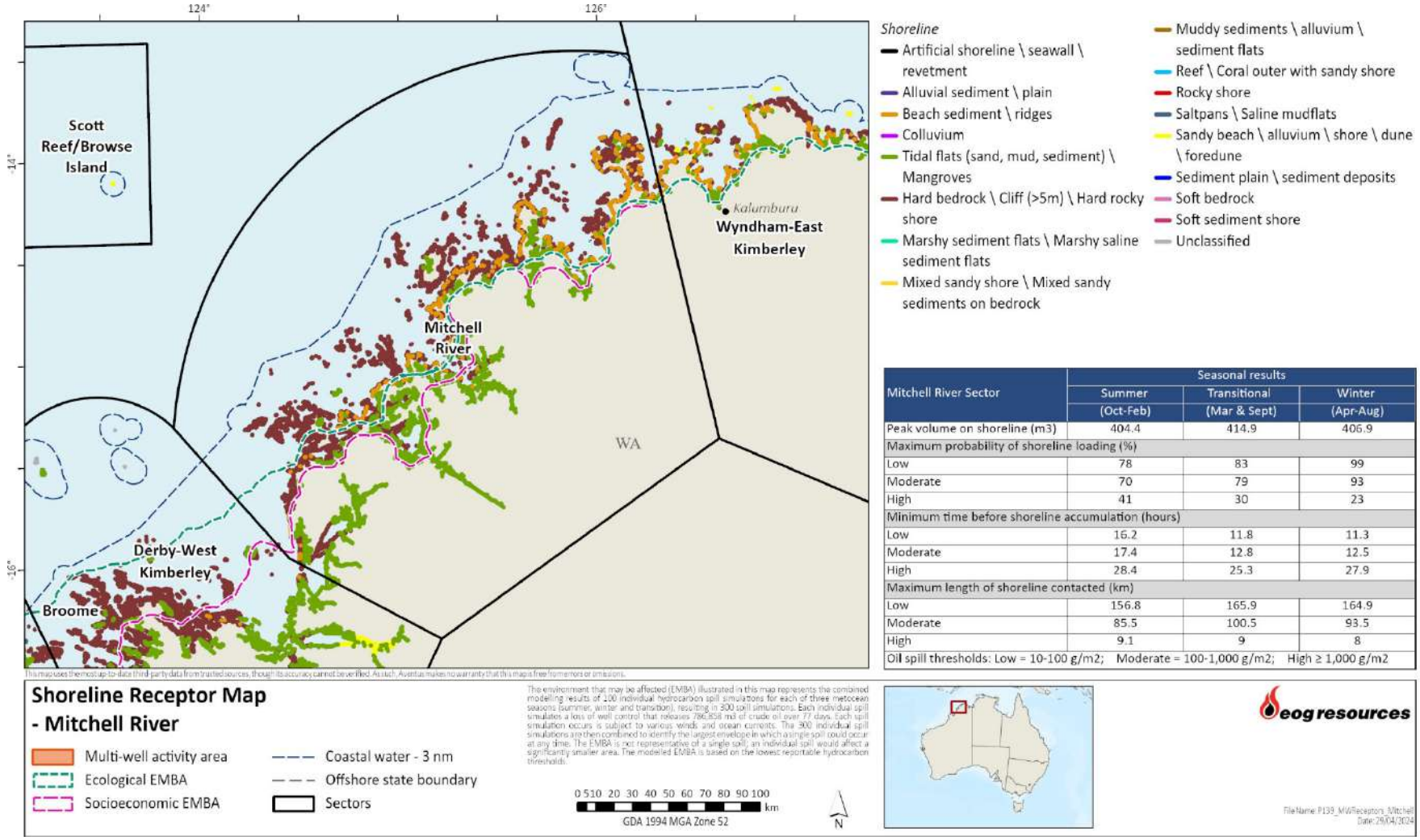
Broome sector	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	0.5	-	0.5
Maximum probability of shoreline loading (%)			
Low	1	-	1
Moderate	-	-	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	97.2	-	88.8
Moderate	-	-	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	1	-	1
Moderate	-	-	-
High	-	-	-
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

Figure 11.10 Spill EMBA shoreline sector - Broome



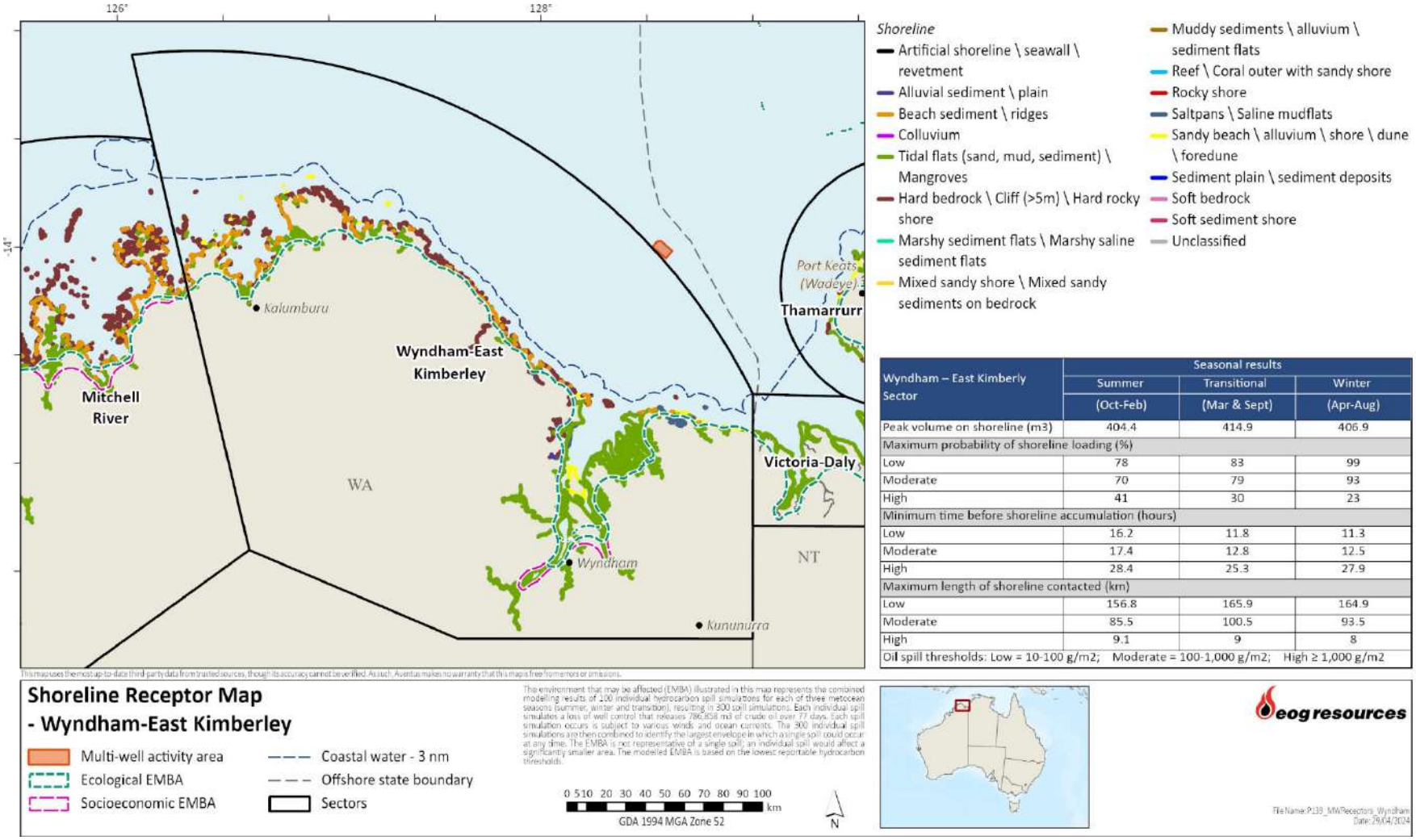
Derby – West Kimberly Sector	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	1	1.1	-
Maximum probability of shoreline loading (%)			
Low	2	2	-
Moderate	-	-	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	90.3	54.8	-
Moderate	-	-	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	2	2	-
Moderate	-	-	-
High	-	-	-
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

Figure 11.11 Spill EMBA shoreline sector - Derby-West Kimberley



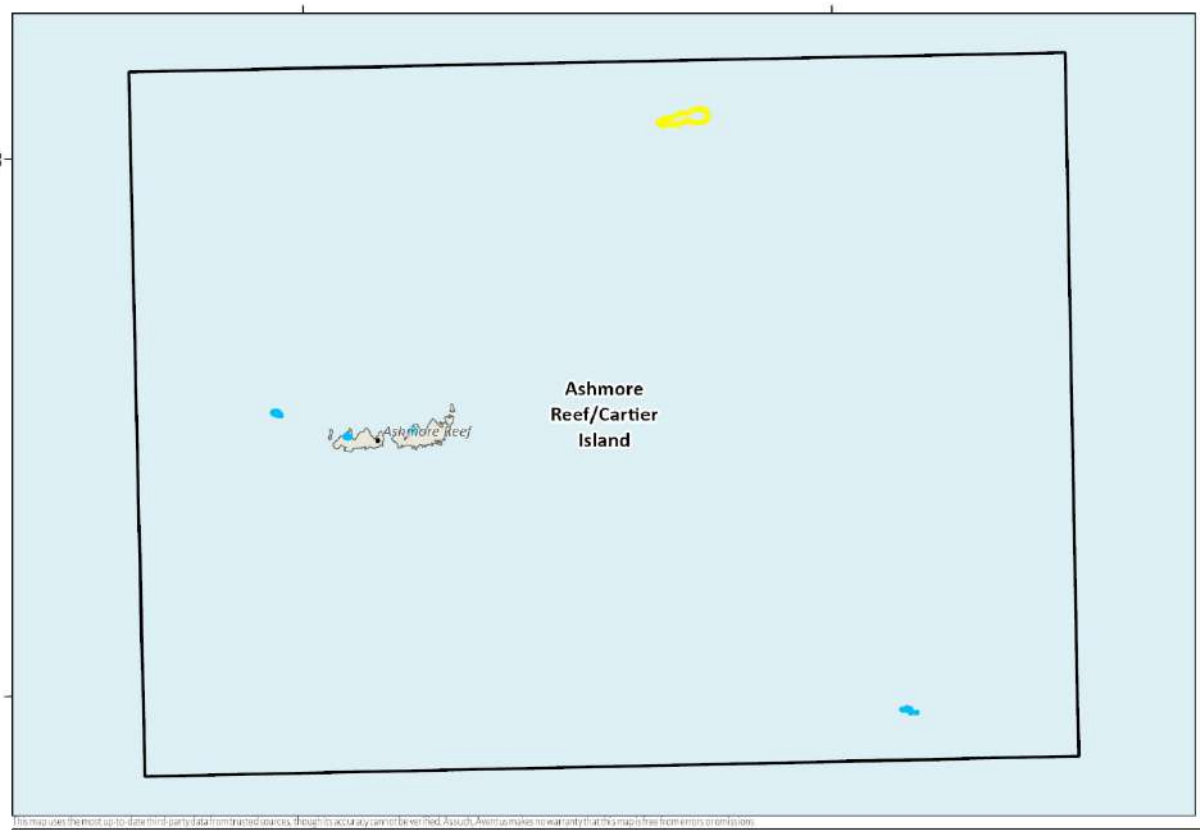
Mitchell River Sector	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	404.4	414.9	406.9
Maximum probability of shoreline loading (%)			
Low	78	83	99
Moderate	70	79	93
High	41	30	23
Minimum time before shoreline accumulation (hours)			
Low	16.2	11.8	11.3
Moderate	17.4	12.8	12.5
High	28.4	25.3	27.9
Maximum length of shoreline contacted (km)			
Low	156.8	165.9	164.9
Moderate	85.5	100.5	93.5
High	9.1	9	8
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

Figure 11.12 Spill EMBA shoreline sector - Mitchell River



Wyndham – East Kimberly Sector	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	404.4	414.9	406.9
Maximum probability of shoreline loading (%)			
Low	78	83	99
Moderate	70	79	93
High	41	30	23
Minimum time before shoreline accumulation (hours)			
Low	16.2	11.8	11.3
Moderate	17.4	12.8	12.5
High	28.4	25.3	27.9
Maximum length of shoreline contacted (km)			
Low	156.8	165.9	164.9
Moderate	85.5	100.5	93.5
High	9.1	9	8
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

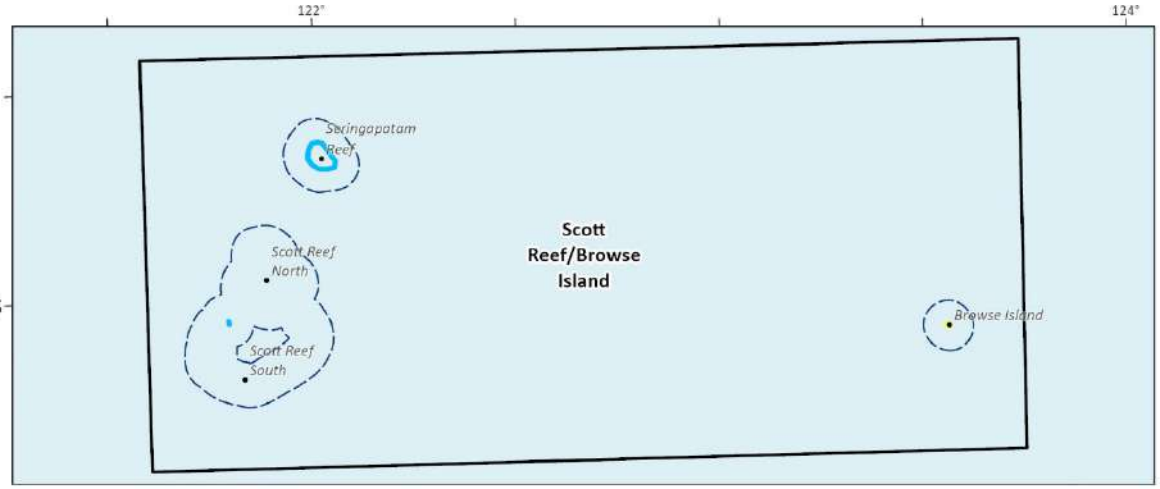
Figure 11.13 Spill EMBA shoreline sector - Wyndham-East Kimberley



Hibernia Reef	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	-	-	7.8
Maximum probability of shoreline loading (%)			
Low	-	-	6.0
Moderate	-	-	3.0
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	-	-	70.6
Moderate	-	-	87.2
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	-	-	8.0
Moderate	-	-	1.0
High	-	-	-
Cartier Island			
Peak volume on shoreline (m3)	-	-	11.2
Maximum probability of shoreline loading (%)			
Low	-	-	11
Moderate	-	-	5
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	-	-	66.08
Moderate	-	-	67.13
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	-	-	9.0
Moderate	-	-	3.0
High	-	-	-
Ashmore Reef			
Peak volume on shoreline (m3)	-	-	14.4
Maximum probability of shoreline loading (%)			
Low	-	-	7
Moderate	-	-	3
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	-	-	69.75
Moderate	-	-	80.88
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	-	-	19.1
Moderate	-	-	3
High	-	-	-

Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2

Figure 11.14 Spill EMBA shoreline sector - Ashmore Reef & Cartier Island



Shoreline
- Reef \ Coral outer with sandy shore
- Sandy beach \ alluvium \ shore \ dune \ foredune

Seringapatam Reef	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	3.5	3.4	0.7
Maximum probability of shoreline loading (%)			
Low	8	4	2
Moderate	1	1	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	70.3	68.6	56.5
Moderate	97.6	94.2	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	4	6	1
Moderate	2	1	-
High	-	-	-
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

Browse Island	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	64.4	57.2	14.3
Maximum probability of shoreline loading (%)			
Low	23	38	22
Moderate	20	27	11
High	1	7	-
Minimum time before shoreline accumulation (hours)			
Low	48.5	40.6	37
Moderate	50.5	47.3	37.9
High	91.9	59.7	-
Maximum length of shoreline contacted (km)			
Low	4	4	4
Moderate	4	4	4
High	3	3	-
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

Scott Reef North	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	12.4	1.3	2
Maximum probability of shoreline loading (%)			
Low	10	1	5
Moderate	3	-	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	64.1	66.3	63.8
Moderate	64.1	-	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	14.1	2	4
Moderate	6	-	-
High	-	-	-
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

Scott Reef South	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	57.5	4.8	3.5
Maximum probability of shoreline loading (%)			
Low	12	3	7
Moderate	7	2	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	62.1	43.3	74.8
Moderate	63.5	44.4	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	29.2	6	6
Moderate	18.1	1	-
High	-	-	-
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

This map uses the most up-to-date third-party data from trusted sources, though its accuracy cannot be verified. As such, Aventus makes no warranty that this map is free from errors or omissions.

Shoreline Receptor Map
- Scott Reef and Browse Island

Ecological EMBA
Socioeconomic EMBA
Coastal water - 3 nm
Sectors

The environment that may be affected (EMBA) illustrated in this map represents the combined modelling results of 100 individual hydrocarbon spill simulations for each of three metocean seasons (summer, winter and transition), resulting in 300 spill simulations. Each individual spill simulates a loss of well control that releases 786,858 m3 of crude oil over 77 days. Each spill simulation occurs is subject to various winds and ocean currents. The 300 individual spill simulations are then combined to identify the largest envelope in which a single spill could occur at any time. The EMBA is not representative of a single spill; an individual spill would affect a significantly smaller area. The modelled EMBA is based on the lowest reportable hydrocarbon thresholds.

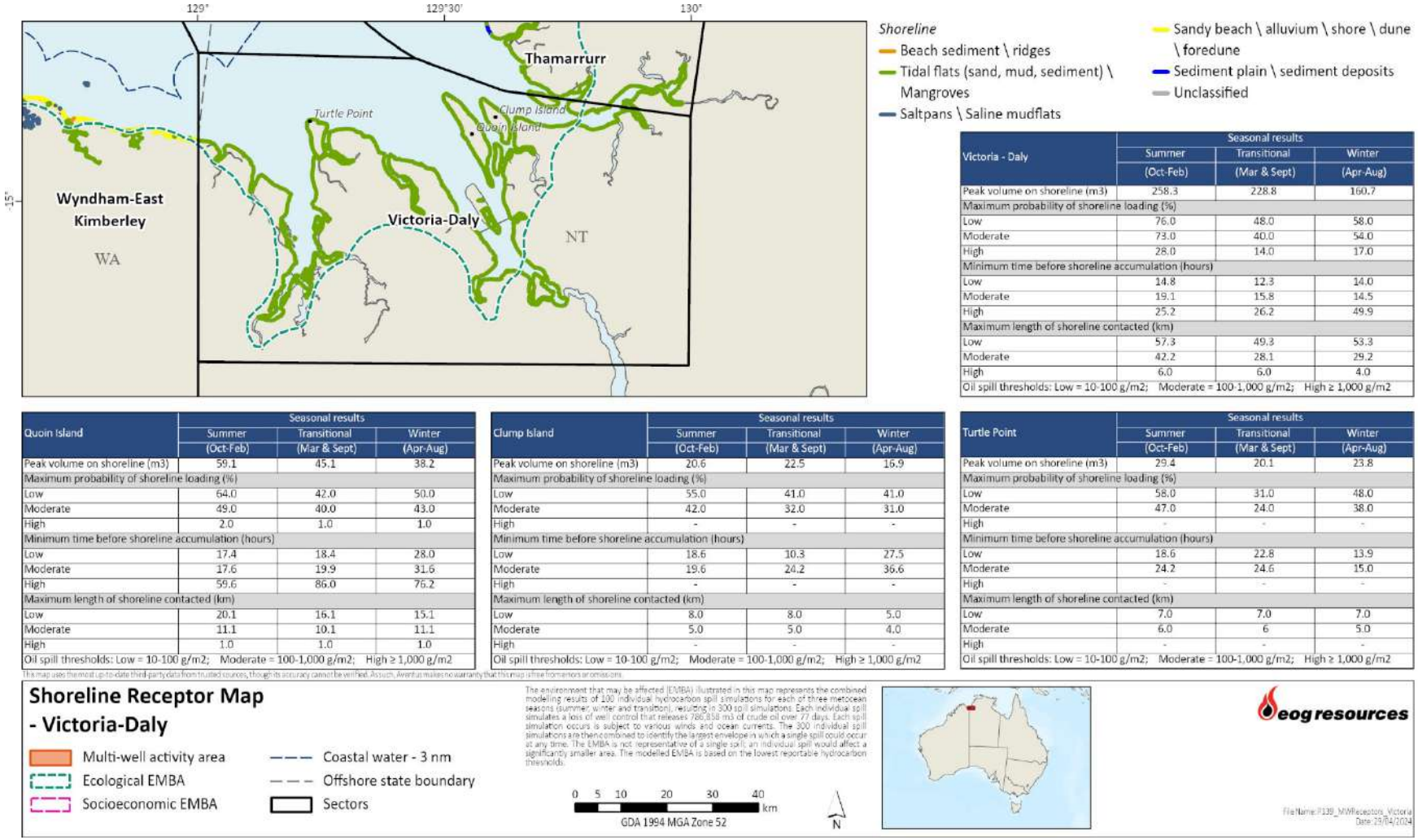
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GDA 1994 MGA Zone 52

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Date: 29/04/2024

Figure 11.15 Spill EMBA shoreline sector - Scott Reef & Browse Island



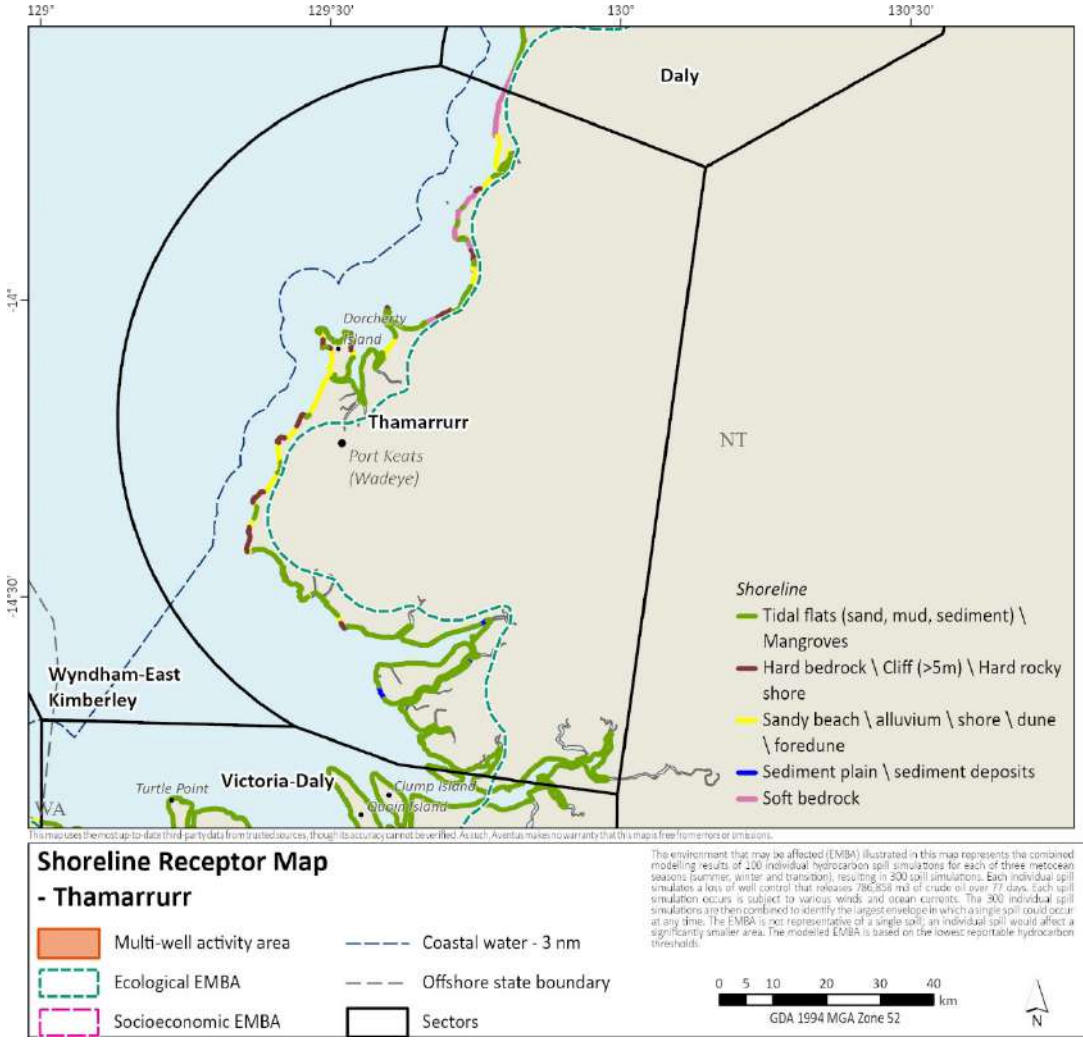
Victoria - Daly	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	258.3	228.8	160.7
Maximum probability of shoreline loading (%)			
Low	76.0	48.0	58.0
Moderate	73.0	40.0	54.0
High	28.0	14.0	17.0
Minimum time before shoreline accumulation (hours)			
Low	14.8	12.3	14.0
Moderate	19.1	15.8	14.5
High	25.2	26.2	49.9
Maximum length of shoreline contacted (km)			
Low	57.3	49.3	53.3
Moderate	42.2	28.1	29.2
High	6.0	6.0	4.0
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

Quoin Island	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	59.1	45.1	38.2
Maximum probability of shoreline loading (%)			
Low	64.0	42.0	50.0
Moderate	49.0	40.0	43.0
High	2.0	1.0	1.0
Minimum time before shoreline accumulation (hours)			
Low	17.4	18.4	28.0
Moderate	17.6	19.9	31.6
High	59.6	86.0	76.2
Maximum length of shoreline contacted (km)			
Low	20.1	16.1	15.1
Moderate	11.1	10.1	11.1
High	1.0	1.0	1.0
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

Clump Island	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	20.6	22.5	16.9
Maximum probability of shoreline loading (%)			
Low	55.0	41.0	41.0
Moderate	42.0	32.0	31.0
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	18.6	10.3	27.5
Moderate	19.6	24.2	36.6
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	8.0	8.0	5.0
Moderate	5.0	5.0	4.0
High	-	-	-
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

Turtle Point	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	29.4	20.1	23.8
Maximum probability of shoreline loading (%)			
Low	58.0	31.0	48.0
Moderate	47.0	24.0	38.0
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	18.6	22.8	13.9
Moderate	24.2	24.6	15.0
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	7.0	7.0	7.0
Moderate	6.0	6	5.0
High	-	-	-
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

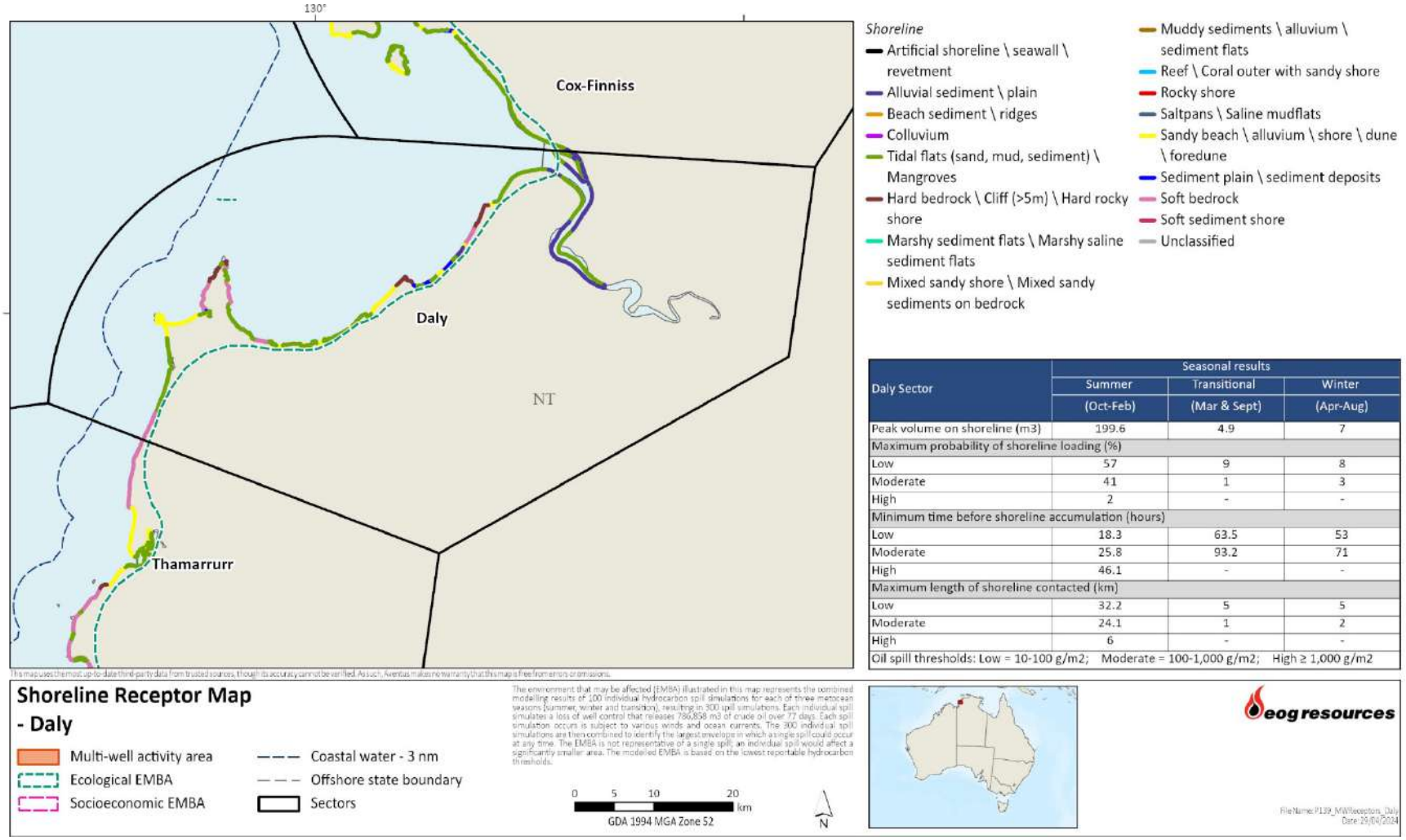
Figure 11.16 Spill EMBA shoreline sector - Victoria-Daly



Dorcherty Island	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	134.8	23.2	22.5
Maximum probability of shoreline loading (%)			
Low	66	21	26
Moderate	54	13	19
High	12	2	-
Minimum time before shoreline accumulation (hours)			
Low	17.4	23	38.5
Moderate	19.3	25.2	39.5
High	50.5	72.1	-
Maximum length of shoreline contacted (km)			
Low	12.1	7	6
Moderate	8	6	6
High	2	1	-
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

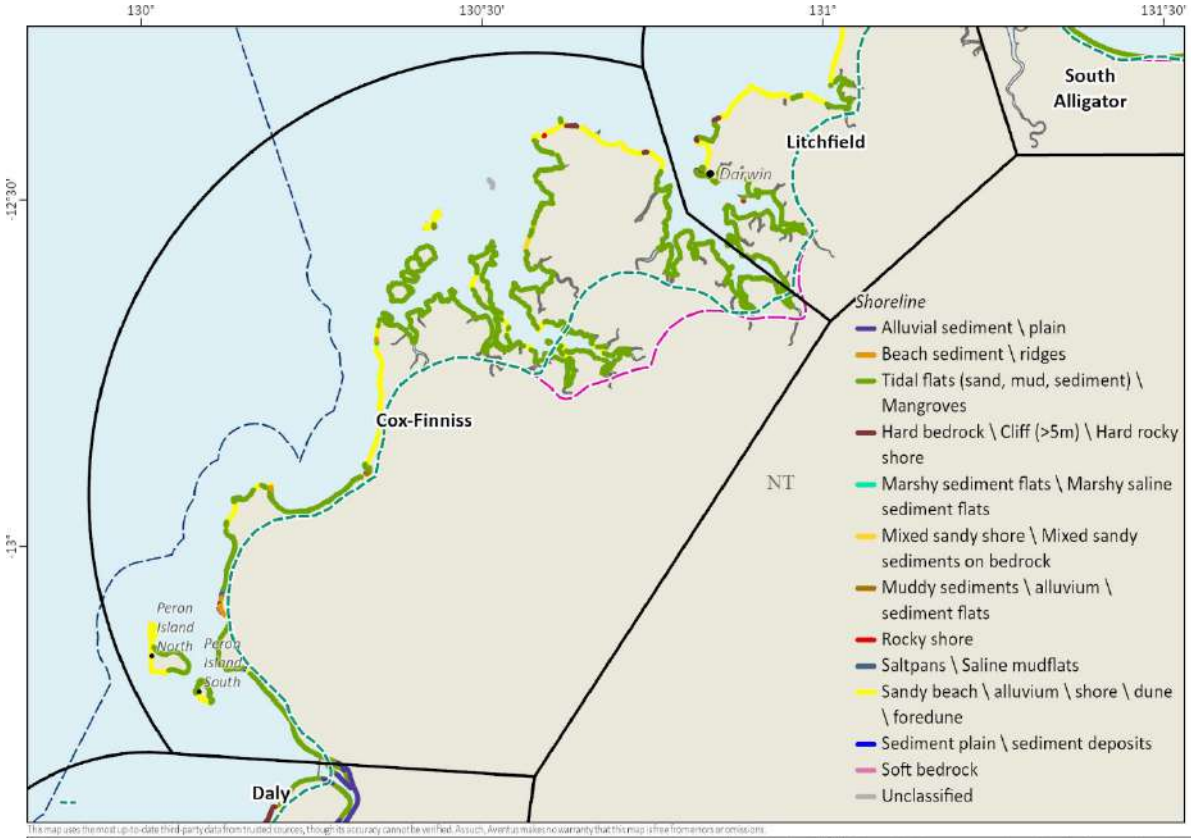
Thamarrurr	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	271.2	164.9	155.6
Maximum probability of shoreline loading (%)			
Low	80	45	41
Moderate	74	41	35
High	31	21	16
Minimum time before shoreline accumulation (hours)			
Low	11.6	15.7	31.2
Moderate	14.5	22.8	37.2
High	18.9	29.8	56.1
Maximum length of shoreline contacted (km)			
Low	60.3	47.2	46.2
Moderate	40.2	27.1	30.2
High	7	4	3
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

Figure 11.17 Spill EMBA shoreline sector - Thamarrurr



Daly Sector	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	199.6	4.9	7
Maximum probability of shoreline loading (%)			
Low	57	9	8
Moderate	41	1	3
High	2	-	-
Minimum time before shoreline accumulation (hours)			
Low	18.3	63.5	53
Moderate	25.8	93.2	71
High	46.1	-	-
Maximum length of shoreline contacted (km)			
Low	32.2	5	5
Moderate	24.1	1	2
High	6	-	-
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

Figure 11.18 Spill EMBA shoreline sector – Daly



Peron Island North	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	32.4	17.6	-
Maximum probability of shoreline loading (%)			
Low	27	2	-
Moderate	17	2	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	18.7	92.1	-
Moderate	21.6	92.5	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	8	6	-
Moderate	7	5	-
High	-	-	-
Peron Island South			
Peak volume on shoreline (m3)	10.6	0.9	-
Maximum probability of shoreline loading (%)			
Low	12	1	-
Moderate	6	-	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	22.6	93.1	-
Moderate	22.7	-	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	4	1	-
Moderate	4	-	-
High	-	-	-
Cox – Finnis			
Peak volume on shoreline (m3)	51.4	5	-
Maximum probability of shoreline loading (%)			
Low	20	1	-
Moderate	14	1	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	23.8	94.6	-
Moderate	26.1	96.7	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	43.2	3	-
Moderate	19.1	1	-
High	-	-	-

Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2

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Shoreline Receptor Map
- Cox-Finniss

Multi-well activity area
Ecological EMBA
Socioeconomic EMBA
Coastal water - 3 nm
Offshore state boundary
Sectors

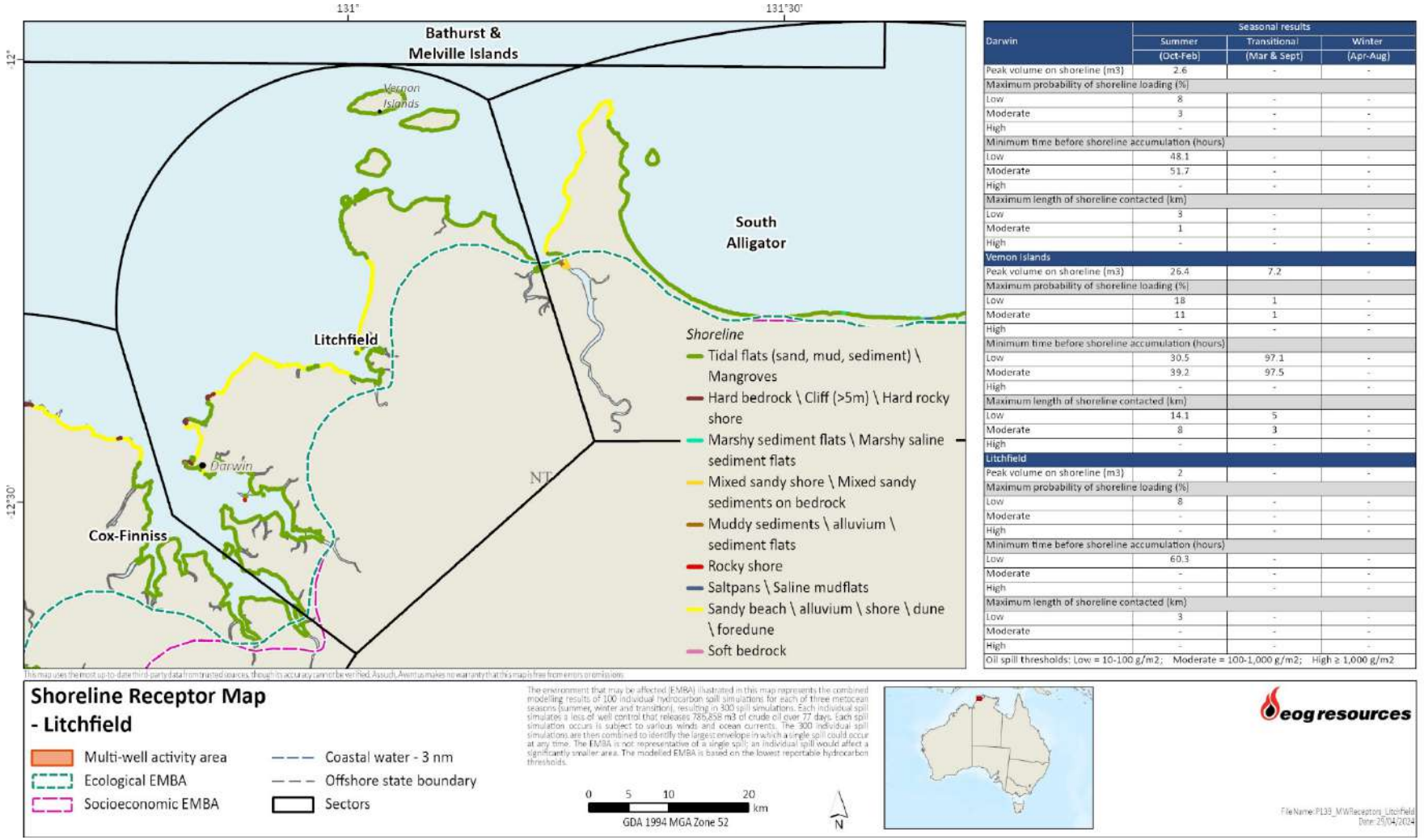
The environment that may be affected (EMBA) illustrated in this map represents the combined modelling results of 100 individual hydrocarbon spill simulations for each of three metocean seasons (summer, winter and transition), resulting in 300 spill simulations. Each individual spill simulates a loss of well control that releases 786,858 m3 of crude oil over 77 days. Each spill simulation occurs is subject to various winds and ocean currents. The 300 individual spill simulations are then combined to identify the largest envelope in which a single spill could occur at any time. The EMBA is not representative of a single spill, an individual spill would affect a significantly smaller area. The modelled EMBA is based on the lowest reportable hydrocarbon thresholds.

0 5 10 20 30 km
GDA 1994 MGA Zone 52

N

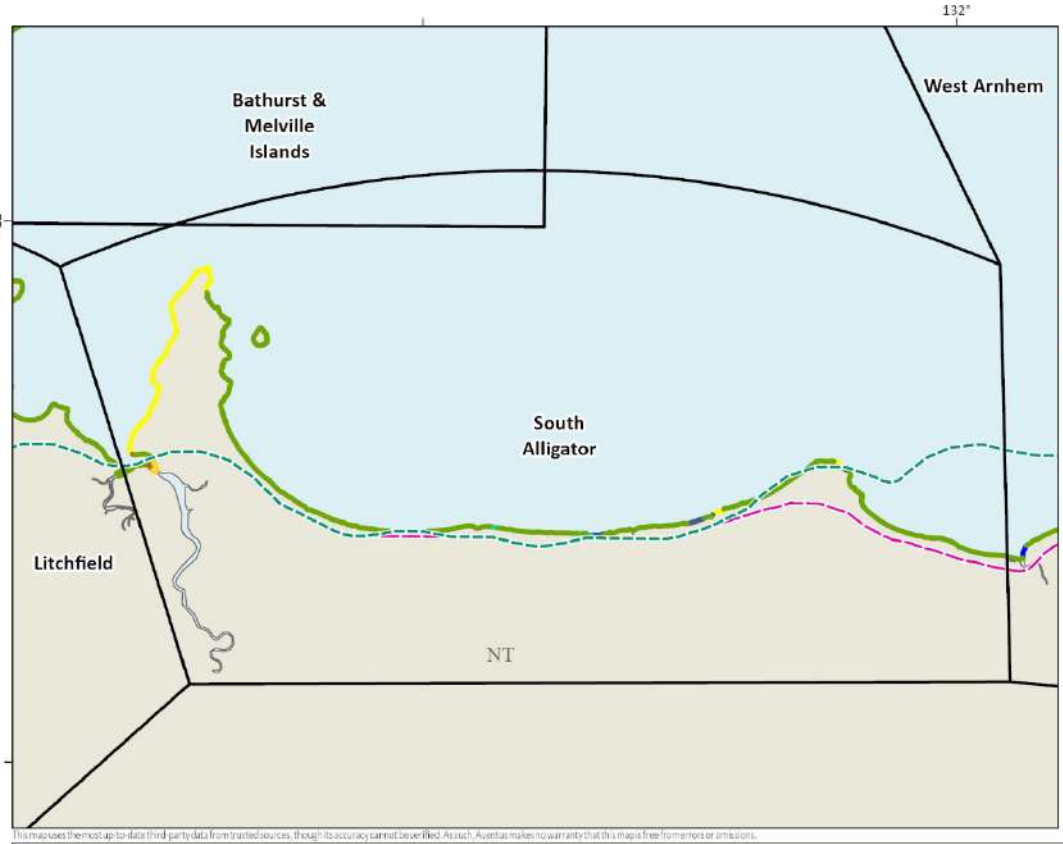
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Date: 29/04/2024

Figure 11.19 Spill EMBA shoreline sector - Cox-Finniss



Darwin	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	2.6	-	-
Maximum probability of shoreline loading (%)			
Low	8	-	-
Moderate	3	-	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	48.1	-	-
Moderate	51.7	-	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	3	-	-
Moderate	1	-	-
High	-	-	-
Vernon Islands			
Peak volume on shoreline (m3)	26.4	7.2	-
Maximum probability of shoreline loading (%)			
Low	18	1	-
Moderate	11	1	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	30.5	97.1	-
Moderate	39.2	97.5	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	14.1	5	-
Moderate	8	3	-
High	-	-	-
Litchfield			
Peak volume on shoreline (m3)	2	-	-
Maximum probability of shoreline loading (%)			
Low	8	-	-
Moderate	-	-	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	60.3	-	-
Moderate	-	-	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	3	-	-
Moderate	-	-	-
High	-	-	-
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

Figure 11.20 Spill EMBA shoreline sector – Litchfield



Shoreline

- Artificial shoreline \ seawall \ revetment
- Alluvial sediment \ plain
- Beach sediment \ ridges
- Colluvium
- Tidal flats (sand, mud, sediment) \ Mangroves
- Hard bedrock \ Cliff (>5m) \ Hard rocky shore
- Marshy sediment flats \ Marshy saline sediment flats
- Mixed sandy shore \ Mixed sandy sediments on bedrock
- Muddy sediments \ alluvium \ sediment flats
- Reef \ Coral outer with sandy shore
- Rocky shore
- Saltpans \ Saline mudflats
- Sandy beach \ alluvium \ shore \ dune \ foredune
- Sediment plain \ sediment deposits
- Soft bedrock
- Soft sediment shore
- Unclassified

South Alligator Sector	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	3.1	-	-
Maximum probability of shoreline loading (%)			
Low	8	-	-
Moderate	4	-	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	54.2	-	-
Moderate	57.8	-	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	5	-	-
Moderate	1	-	-
High	-	-	-
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

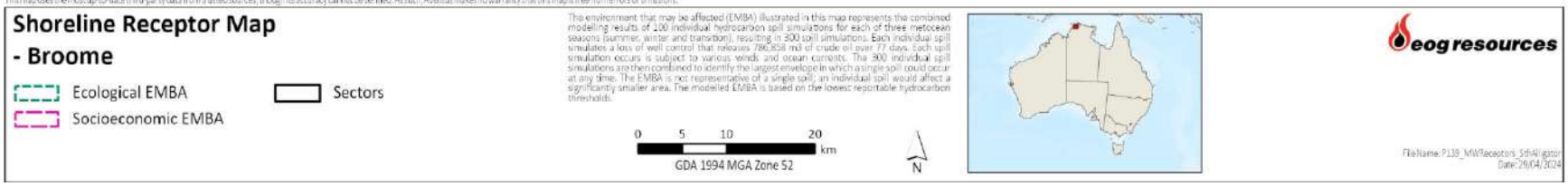
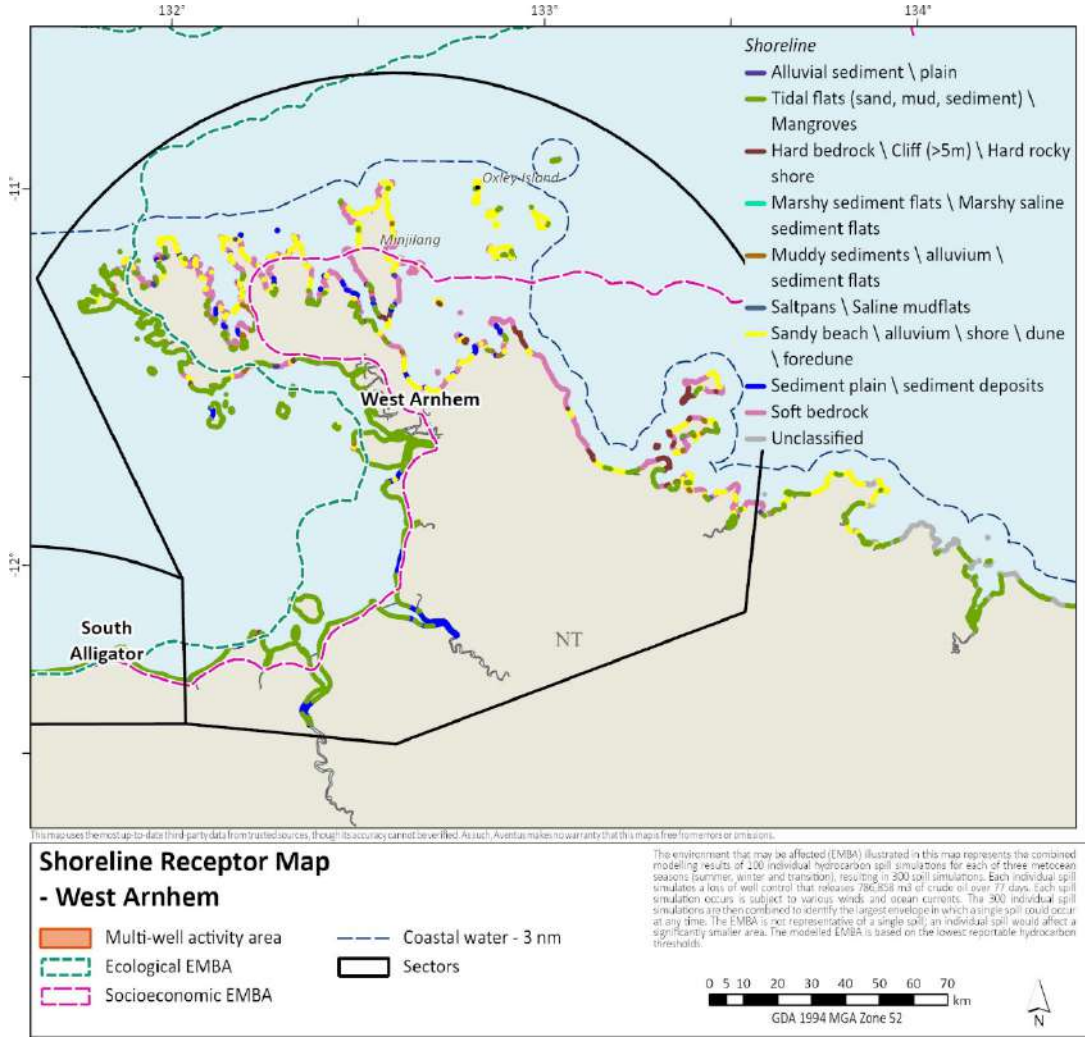


Figure 11.21 Spill EMBA shoreline sector - South Alligator

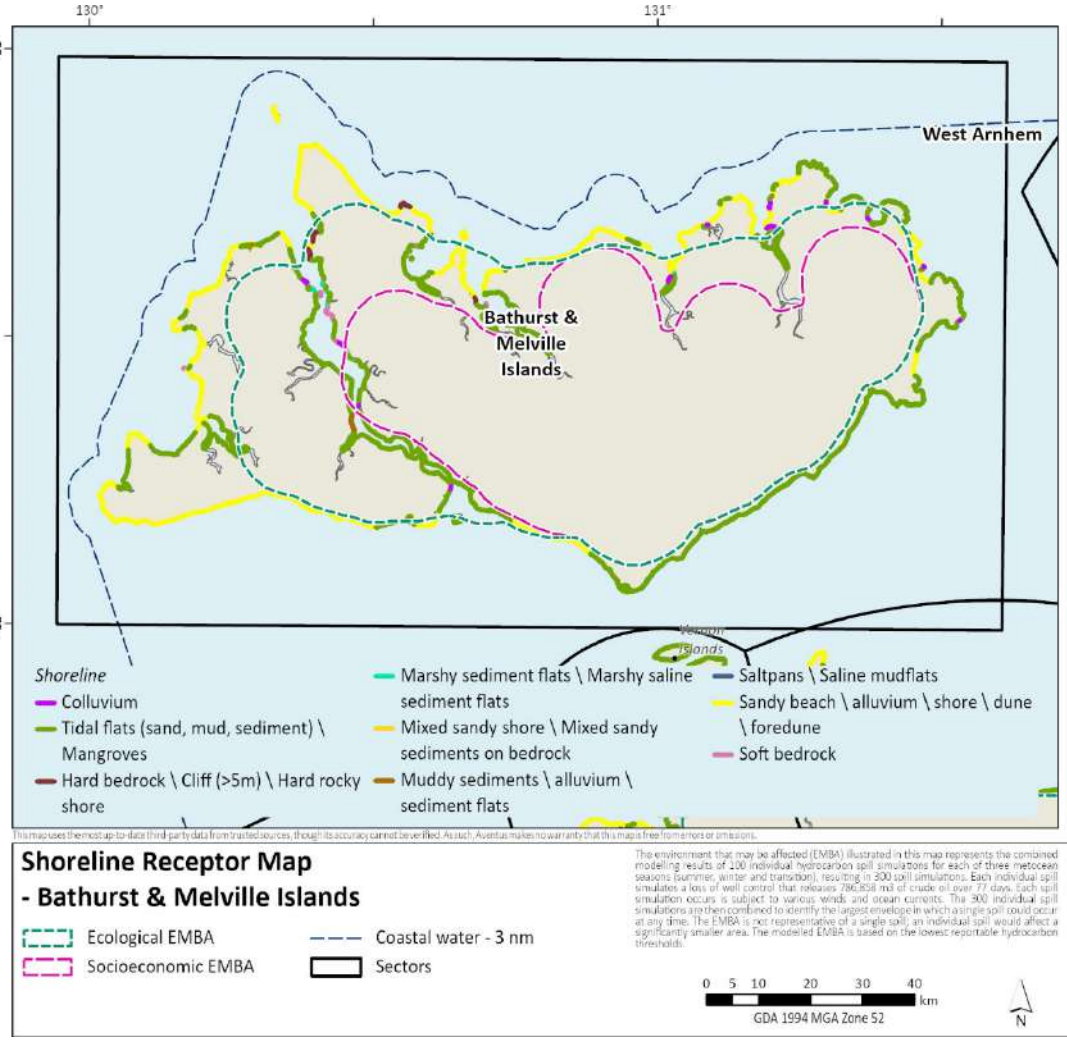


Minjilang	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	1.1	-	-
Maximum probability of shoreline loading (%)			
Low	3	-	-
Moderate	-	-	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	70.83	-	-
Moderate	-	-	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	1	-	-
Moderate	-	-	-
High	-	-	-

Oxley Island	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	0.5	-	-
Maximum probability of shoreline loading (%)			
Low	2	-	-
Moderate	-	-	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	81.3	-	-
Moderate	-	-	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	1	-	-
Moderate	-	-	-
High	-	-	-

Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2

Figure 11.22 Spill EMBA shoreline sector - West Arnhem



Bathurst Island	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	12.2	-	-
Maximum probability of shoreline loading (%)			
Low	4	-	-
Moderate	3	-	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	69.1	-	-
Moderate	71.8	-	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	17.1	-	-
Moderate	3	-	-
High	-	-	-

Melville Island	Seasonal results		
	Summer (Oct-Feb)	Transitional (Mar & Sept)	Winter (Apr-Aug)
Peak volume on shoreline (m3)	4.2	-	-
Maximum probability of shoreline loading (%)			
Low	9	-	-
Moderate	-	-	-
High	-	-	-
Minimum time before shoreline accumulation (hours)			
Low	62	-	-
Moderate	-	-	-
High	-	-	-
Maximum length of shoreline contacted (km)			
Low	8	-	-
Moderate	-	-	-
High	-	-	-
Oil spill thresholds: Low = 10-100 g/m2; Moderate = 100-1,000 g/m2; High ≥ 1,000 g/m2			

Figure 11.23 Spill EMBA shoreline sector - Melville and Bathurst islands

11.3 Biological Environment

The sources listed at the start of this chapter have been used in the preparation of this section. Additionally, BIAs are identified for those species that may occur in the spill EMBA. BIAs are spatially defined areas, defined by the DCCEEW based on expert scientific knowledge, where aggregations of individuals of a species are known, or likely, to display biologically important behaviour such as breeding, foraging, resting or migration (DCCEEW, 2024a). The BIAs do not represent a species' full distribution range.

11.3.1 Benthic Assemblages

The benthic environment of the JBG is linked to its geomorphic features, with the majority of the area characterised by infaunal plains, with some localised reefs and outcrops supporting sponge gardens. Przeslawski et al (2011) provides an overview of the benthic environment associated with the different geomorphic features within the spill EMBA (see Figure 11.8), which are outlined below.

- Slope – the majority of the Northwest marine bioregion consists of either continental slope or continental shelf. Biological productivity is reliant upon seasonal changes in the strength of surface and subsurface currents.

- Shelf – sediment plains that are swept by strong tidal currents and are subject to large influxes of suspended sediment and freshwater, particularly during the wet season. Support diverse infaunal communities that play a key ecological role by contributing to nutrient cycling and sediment turnover (bioturbation) at the local scale. Low abundance of crustaceans, echinoderms and sessile epifauna are expected.

- Banks/shoals - elevated features with a relatively high proportion of hard substrate that support patches of moderately dense octocoral and sponge gardens which in turn provide habitat for other epifauna and cryptofauna. Banks support high numbers of epifaunal species. Infaunal species richness is moderately high in bank sediments. Very few macroalgae (including Halimeda) or reef-forming hard corals were recorded. Carbonate banks and shoals occur predominantly in the JBG (Baker *et al.,* 2008), with the Glomar Shoals and Rowley Shoals situated within the NWS region. Many shoals identified within the socio-economic EMBA are also found offshore in the NT region including the Timor Sea (see Table 11.2 and Figure 11.24).

- Basin - low-relief expanses of unconsolidated sediment, and the available biological data suggests that these habitats are dominated by infauna with limited epifauna.

- Canyons – the canyons on the slope of the Argo Abyssal Plain and Scott Plateau and to the north of Scott Reef (in the NWMR) are a unique seafloor feature associated with small periodic upwellings that enhance biological productivity and aggregations of marine life (DEWHA, 2008b). The tributary canyons of the Arafura Depression located in the NMR are a key ecological feature (KEF) known to support both benthic and pelagic habitats including a diverse range of invertebrates (e.g., sponges, corals, sea anemones, tunicates, worms, crustaceans, brittle stars and feather stars).

- Cliffs and coral reefs - within the spill EMBA, offshore coral reefs include Ashmore reef and Hibernia Reef, Cartier Island, Browse Island, the Vernon Islands, with many other islands in coastal waters supporting fringing coral reefs. Submerged cliffs and coral reefs of the Kimberley and atolls and reefs on the edge of the continental shelf support a high diversity of benthic filter-feeders and producers.

- Deep/hole/valley - dominated by flat soft sediment expanses. Support low-moderate numbers of epifaunal species and include many debris-swept channels, which in places expose small patches of underlying rock that support moderate densities of sessile animals.
- Tidal-sandwave/sand bank – high disturbance, soft substrate, limited biota.
- Pinnacles – limestone pinnacles of the of the Bonaparte Depression are thought to be associated with enhance local biological productivity due to the movement of water around these features to facilitate mixing of nutrients and sediments. Associated communities include sessile benthic invertebrates including hard and soft corals and sponges (DEWHA, 2008b).

Infaunal communities

The offshore marine environment off WA (from Busselton) to the Northern Territory (NT) border is dominated by soft sediment seabeds; sandy and muddy substrates, occasionally interspersed with hard substrates covered with sand veneers, and rarely, exposed hard substrate. In shallow waters, non-coral benthic invertebrates may form part of the mosaic of benthic organisms found on hard substrates, alongside macrophytes and coral colonies. As light reduces with water depth, non-coral benthic invertebrates are the dominant community, albeit at low densities.

Infauna are animals that inhabit sandy or muddy surface layers of the ocean floor these may include deposit feeders, filter-feeders, grazers and predators. The distribution of infauna and benthic invertebrate species is influenced by many physical parameters (e.g., water temperature, dissolved oxygen, pH, salinity) and biological (e.g., primary productivity, acclimatisation) factors.

Within the spill EMBA deep offshore areas such as the Northwest Transition support infauna such as sediment burrowing polychaetes and isopods.

Crustaceans

See EP Chapter 5 Section 5.4.1. Crustaceans are found throughout the spill EMBA primarily in the inner shelf (30 m to 60 m water depth) and the continental slope (between 200 m to 1000 m) of the NWS region, although little is known about the benthic environment in the latter (DWHA, 2008b).

Molluscs

See EP Chapter 5 Section 5.4.1. Molluscs are also found in the mid shelf (60 m to 100 m water depth) of the NWS region which includes the Glomar Shoals. Distinct assemblages of molluscs are also found in depths between 100 m to 200 m and 200 m to 500 m with no overlap. Areas of the continental slope, offshore from North West Cape to the southern boundary of the NWMR Region of 200 m to 4,000 m contain molluscs and large isopods that feed on particulate organic matter (DEWHA, 2008b).

Reefs, Shoals and Banks

Coral reefs are habitats with high diversity of corals, associated fish and other species of both commercial and conservation importance. The spill EMBA overlaps with areas of coral reef habitats. The closest identified coral reef habitat is located within the Joseph Bonaparte Gulf AMP (JBG AMP). Emu Reefs (located 92 km northeast of the multi-well location) was recently surveyed by traditional owners of the Thamarrur region in partnership with the Australian Institute of Marine Science (AIMS), Eni Australia and Parks Australia. The survey deployed Baited Remote Underwater Video Systems (BRUVS) and captured a diversity of fish, sharks and crabs as well as the protected and culturally significant eyebrow wedgefish (*Rhynchobatus palpebratus*) (Parks Australia, 2021). Emu Reef is protected from recreational fishermen by a fish protection area (NT Government, 2016).

Oceanic shoals and banks are abrupt geological features that rise from the deep continental shelf to within 15-20 m of the sea surface, with many occurring within the spill EMBA. These unique habitats contain submerged reefs that support a very high diversity of coral reef ecosystems (Heyward *et al.,* 2017). It is likely that the open oceanic environment that the northwest banks and shoals are situated in contributes to their high species diversity and abundance as their exposure to oceanic influences may enhance productivity and in turn the diversity of species inhabiting them (Parks Australia, 2021). There are several identified shoals and banks in the western extent of the socio-economic EMBA including Holothuria Banks, Tait Bank, Penguin Shoal and Bassett-Smith Shoal (RPS, 2021).

Though there is a paucity of information relevant to these specific features, studies of similar shoals not located in the spill EMBA have found a high diversity of free-living corals, sponges, gorgonian soft corals, hard corals, rhodoliths, tropical fish, rays and sharks (Heyward *et al.,* 2017; Moore *et al.,* 2017; Heyward *et al.,* 2010). It is expected that the shoals and banks located in the spill EMBA may include a similar assemblage of species.

In total there are approximately 306 shoals that are known to occur within or in close proximity to the socio-economic EMBA; of these 53 are named and 242 are unnamed. Table 11.2 lists the shoals present within the spill EMBA and location by depth below sea surface. The vast majority of the identified shoals are located in water depths greater than 10 m. Many of these shoals are marked on marine charts and are popular areas for recreational fishing, however given the paucity of information, only publicly accessible information in relation to features is included in Table 11.2.

Identified banks, reefs, and shoals in the spill EMBA are presented in Figure 11.24.

Table 11.2 Shoals present within the spill EMBA

Name	Area of coverage ($km^{2)}$	Minimum depth below water (m)	Maximum depth below water (m)	Key features
Abbott Shoal	3.4	10	24	-
Afghan Shoal	59.8	6	35	-
Ann Shoals	8.8	4	25	-
Barbara Shoal	9.5	4	22	-
Barcoo Shoal	8.0	3	50	-
Barracouta Shoal	9.0	19	139	Supports reef building corals, seagrass and algae, particularly the calcareous green algae *Halimeda* spp (Heyward *et.al.*, 2010).
Bassett-Smith Shoal	6.8	13	97	-
Beagle Shoals	7.9	3	24	-
Big Bank Shoals	96.0	1	303	Submerged carbonate banks in the Timor Sea, which rise up from depths of 200 to 300 metres to within 20 m to 30 m below sea level. Supports 3 distinct ecosystems: algae-dominated by *Halimeda*, coral and filter feeding ecosystems.
Bill Shoal	1.0	9	15	-

Name	Area of coverage ($km^{2)}$	Minimum depth below water (m)	Maximum depth below water (m)	Key features
Britomart Shoal	1.4	9	36	-
Calder Shoal	80.4	20	73	-
Cootamundra Shoal	84.4	15	98	Ancient coral reefs consisting of flat-topped banks of fossil coral platforms.
Deep Shoal 1	2.0	25	63	-
Deep Shoal 2	2.6	115	120	-
Echuca Shoal	12.3	19	104	Predominantly an extensive claystone; organic-rich, oil-prone marine shale.
Eugene McDermott Shoal	4.8	19	101	Coral shoal
Evans Shoal	49.7	15	69	-
Fantome Shoal	3.6	13	297	-
Fitzpatrick Shoal	12.4	9	38	-
Giles Shoal	8.3	2	22	-
Goeree Shoal	2.1	23	83	According to a seabed biodiversity survey done in 2016 by the Australian Institute of Marine science for PTTEP, Goeree Shoal contained 161 species and 2,527 individuals (Heyward *et.al*, 2017). Multiple species of emperor fish were present as well as large groups of fish from the genus *Cirrhilabrus*. Wrasses, lyretail and two-spot red snapper were also present. Overall, fish communities appeared relatively stable in terms of richness and abundance. Goeree Shoal also displayed unique patterns of hard coral, sponge and *Halimeda*, algae was the most abundant benthic group, the results of the survey indicated that Goeree shoals support diverse benthic communities as well as benthic primary producers and many species typical of tropical coral reef ecosystems (Heyward *et.al*, 2017).
Hancox Shoal	14.4	5	28	-
Heywood Shoal	23.3	18	95	A report written by Moore et al. (2017) explores the biodiversity of submerged oceanic shoals in north

Name	Area of coverage ($km^{2)}$	Minimum depth below water (m)	Maximum depth below water (m)	Key features
				WA. Heywood Shoal is described as being oval is shape and comprising primarily of rubble (51.2%), sand (23.3%) and calcareous coral (22.3%) substrates. Whilst 58.5% of Heywood Shoal's epibenthic cover was reported as being bare, hard coral was the most dominant epibenthic species (17.9%). Encrusting organisms, macroalgae, filter feeders and soft coral accounted for the remaining 23.6%. Heywood Shoal was noted as having distinctive fish communities, with over 200 species recorded.
Howland Shoals	0.4	3	12	-
Jabiru Shoals	21.7	13	261	-
Jones Shoal	1.8	10	28	-
Karmt Shoal	263.5	2	316	-
Lowry Shoal	3.0	10	23	-
Mangola Shoal	2.7	11	233	-
Margaret Shoal	11.4	1	17	-
Marie Shoal	8.9	11	63	-
Marsh Shoal	2.8	7	19	-
Mataram Shoal	21.9	3	45	-
Mermaid Shoal	326.1	30	17	-
Money Shoal	20.1	0	65	-
Moss Shoal	4.0	11	72	-
Newby Shoal	4.8	19	74	-
Ommaney Shoals	6.5	6	24	-
Parry Shoal	62.8	13	80	-
Pee Shoal	3.3	10	332	-
Penguin Shoal	17.3	4	49	-
Rainbow Shoals	0.7	9	30	-
Renard Shoals	5.4	5	22	-
Shepparton Shoal	41.6	19	57	-
Skottowe Shoal	9.9	12	27	-
Taiyun Shoal	17.2	3	30	-
Tassie Shoal	8.1	12	78	-

Name	Area of coverage ($km^{2)}$	Minimum depth below water (m)	Maximum depth below water (m)	Key features
Van Cloon Shoal	37.7	16	62	-
Vee Shoal	3.2	12	171	-
Victoria Shoal	9.3	2	13	-
Vulcan Shoal	11.5	17	133	Supports reef building corals, seagrass and algae, particularly the calcareous green algae *Halimeda* spp (Heyward *et.al.,* 2010). Contains an extensive field of the seagrass *Thallasodendron ciliatum*.
Wells Shoal	6.3	7	25	-

Source: High-resolution depth model for Northern Australia – 30m (Geoscience Australia), except for a small area in the vicinity of Clerke/Mermaid/Imperieuse reef which is standard ausbath 2009 v4 (~250m resolution). Australian Stratigraphic Units Database (accessed May 2022). Note the absence of information regarding key features is marked as "-".

A description of the most well-known reefs, shoals, and islands within the socio-economic EMBA is provided here.

Scott and Seringapatam Reefs

The Scott and Seringapatam reefs are regionally significant due to its high representation of species not found in coastal waters off WA and unusual nature of its fauna that has affinities with the oceanic reef habitats of the Indo-West Pacific as well as the reefs of the Indonesian region. Scott Reef is important for its contribution to understanding long-term geomorphological and reef formation processes and past environments (Gilmour and Smith, 2013).

Scott Reef is the largest of the oceanic reef systems off WA and comprises two major formations: North Reef and South Reef, separated by a channel 2 km wide and between 400 and 700 m deep. North Reef is an annular reef enclosing a shallow lagoon (as is Seringapatam) and South Reef is a crescent-shaped reef with a deeper and more extensive lagoon environment.

Scott Reef is the region's best-understood reef from the point of view of resident communities and how they function and change. The most comprehensive datasets come from a long-term monitoring program run by AIMS has provided the most comprehensive dataset of the reef's resident communities. A diverse assemblage of hard coral species has been recorded from the shallow and deep-water environments at Scott Reef, with 306 species from 60 genera and 14 families (Gilmour *et al,* 2012). Two hundred and ninety-five species have been recorded from shallow-water environments (<30 m) and 51 species from deep water habitats (>30 m). Community composition in the deep-water lagoon at South Reef is markedly different to the shallow-water habitats at Scott Reef. The shallow-water coral communities comprise typical reef front, lagoon and reef-flat assemblages, while the deepwater communities are dominated by extensive areas of foliaceous *Agariciidae, Pectinidae, Poritidae and Montipora* species, and fragile branching and plating Acropora species.

Compared with other offshore reefs in the region, Scott Reef appears to have a comparable diversity of hard corals. A shallow-water survey (0 - 20 m) of Ashmore, Scott and Seringapatam reefs and Mermaid Reef (Rowley Shoals) in 2006 recorded 211 species of corals at Mermaid Reef, 159 species at Seringapatam, 255 species at Ashmore Reef, and 201 and 224 species at North and South (Scott) reefs respectively (WAM, 2009). All coral taxa were predominantly widespread Indo-Pacific species that have clear affinities with the coral assemblages of Ashmore Reef and the Indonesian provinces to the north.

Ashmore Reef

Ashmore Reef is a commonwealth marine park (see Section 11.4.1). The marine fauna at Ashmore Reef has the highest diversity of the reefs on the North-West Shelf, with the mollusc fauna being substantially more diverse here (433 species) than either Scott and Seringapatam Reefs (279 species) or Rowley Shoals (DAWE, 2013). Ninety-nine species of decapod crustaceans have been recorded at Ashmore Reef compared with 56 for Scott and Seringapatam Reefs) and 178 echinoderms species have been recorded (compared with 119 species for Scott and Seringapatam and 90 species for Rowley Shoals). A total of 560 fish species have also been recorded at the reef, with the most species-rich fish families being the Gobiidae (small to mid-sized gobies, 66 species), Pomacentridae (small and brightly coloured damselfish and anemonefish, 66 species), Labridae (wrasse, 54 species) and Apogonidae (36 species) (DSEWPC, 2013).

Fringing Reefs

Fringing reefs exist on almost all the shores of all islands off the Kimberley coast between the Bonaparte Archipelago Islands and Buccaneer Archipelago Islands, and they also occur on the mainland shores of Cape Londonderry, Cape Voltaire, One Arm Point and Yampi Sound (all of which are within the spill EMBA) (Wilson, 2013). This stretch of coast is over 600 km long.

Within the Kimberley region, it is likely fringing reefs are developed by rocky shores that are exposed to the prevailing westerly ocean swell (Wilson, 2013). Many Kimberley fringing reefs are limestone wedges built by coral and crustose algal communities. The assemblages of coral reef within the Bonaparte Archipelago intertidal regionnotes that the intertidal zone of the Bonaparte Archipelago is a hub of diverse corals (Richards *et al*., 2015). In total, 225 species of hard coral were identified, with the species richness likely to represent the species found on fringing reefs within other areas of the Kimberley region. *Glomar Shoals*

The Glomar Shoals are defined as a KEF for their high productivity and aggregations of marine life. Further information on the Glomar Shoals is provided in Section 11.4.7**.**

Rowley Shoals

The Rowley Shoals is defined as a KEF or its enhanced productivity and high species richness, that apply to both benthic and pelagic habitats within the feature. Further information on the Rowley Shoals is provided in Section 11.4.7.

King Shoals

King Shoals is located within the North Kimberley Marine Park (WA) and is protected by a Sanctuary Zone. The King Shoals sanctuary zone includes some of the only mapped tidal sand waves and banks in the Kimberley, as well as containing a KEF (Carbonate bank and terrace system of the Sahul Shelf). Carbonate banks are significant due to their known potential to support high levels of biodiversity of reef fish, sponges, corals, and filter feeders. The banks are likely to be foraging areas for the flatback turtle and are known to provide protection to the threatened species green sawfish and freshwater sawfish (Department of Parks and Wildlife, 2016).

Cartier Island

Cartier Island is a commonwealth marine park (see Section 11.4.1) consisting of an un-vegetated sand cay surrounded by mature reef flats; it sits at the centre of a reef platform that rises steeply from the seabed. The island is composed of coarse sand and is stabilised by patches of beach rock around its perimeter. The effects of wind, tides and rain periodically expose and remove areas of shifting sandbanks. The island supports large populations of nesting marine turtles and seabirds/shorebirds. The crested tern (Thalasseus bergii) is known to breed on the island, with most other species occurring as occasional visitors or vagrants (Clarke *et al*., 2017).

Cartier Island is located about 55 km southeast of the Ashmore Island complex and in the absence of specific information regarding species assemblages, is likely to host a similar assemblage of fish species to Ashmore Reef given their close proximity.

Browse Island

Browse Island is an isolated sandy cay surrounded by an intertidal reef platform and shallow fringing reef located 536 km northeast from the multi-well location. This reef rises from a depth of 200 m and is a flat-topped, oval-shaped platform reef with a diameter of 2.2 km at its widest point. The benthic habitats and biotic assemblages are characteristic of coral platform reefs throughout the Indo-West region (Inpex, 2010). Intertidal habitats around Browse Island include a sandy beach (known for green turtle nesting (DCCEEW, 2024a) rocky beach, a lagoon supporting macroalgae and coral such as Acropora species and Porites species, a reef platform supporting sparse algal turf, and the reef crest (supporting hard corals such as Goniastrae spp and a high diversity of molluscs). The reef platform is barren in many places, and seagrasses are not present (Inpex, 2010).

Adele Island

Adele Island is a hook shaped island off the central Kimberley coast, located around 97 km north-northwest from Cape Leveque and 600 km from the multi-well location. The island measures 2.9 km by 1.6 km with an area of 2.17 km^2. Its surrounding sand banks sit atop a shallow-water limestone platform, surrounded by an extensive reef system.

Adele Island is an important site for breeding seabirds with several Japan-Australia Migratory Birds Agreement (JAMBA), China-Australia Migratory Birds Agreement (CAMBA) and Republic of Korea Migratory Birds Agreement (ROKAMBA) listed species breeding there, with rookeries of cormorants, Australian pelicans, lesser frigate birds (2,000-5,700 breeding pairs), brown booby (1,500-8,500 breeding pairs), red-footed booby and masked booby (DSEWPC, 2008; Kimberley Coast, 2013).

Cunningham Island

Cunningham Island is an unvegetated sand cay surrounded by a small lagoon which lies near the northern extent of Imperieuse Reef. The island is situated 1,100 km from multi-well location and its shoreline is dominated by white sandy shores and low-lying beach rock. There is limited data on the benthic assemblages supported by the island.

Bedwell Island

Bedwell Island a small sandy cay inside Clerke Reef situated 1,048 km from multi-well location. The island is home to one of only two colonies of red-tailed tropicbirds in WA. The tropicbirds nest on the island, along with wedge-tailed shearwaters, white-bellied sea-eagles, various terns, eastern reef-egrets and even a pair of white-tailed tropicbirds.

Lacepede Island

The Lacepede Islands situated 752 km from the multi-well location provide critical nesting and internesting habitat for green turtles and are the site of the largest green turtle rookery in Western Australia. The Commonwealth waters surrounding the islands are important for migrating marine turtles as they move between nesting and feeding sites in this bioregion and beyond. The Lacepede Islands also support some of the largest brown booby colonies in Western Australia. Other seabirds also breed in the area, including lesser frigatebirds, bridled terns, roseate terns and common noddies. The surrounding waters are likely to provide food for seabird species (DEWHA, 2008b).

Tiwi Islands

Located 20 km north of Darwin, the Tiwi Islands are made up of two main islands namely Melville Island (Australia's second largest island) and Bathurst Island (Department of Natural Resources, Environment, the Arts and Sport, 2009) The coasts of the Tiwi Islands support important nesting sites for marine turtles, internationally significant seabird rookeries, and some major aggregations of migratory shorebirds (Department of Natural Resources, Environment, the Arts and Sport, 2009).

Vernon Islands

The Vernon islands are located in the Clarence Strait in the NT, between the Australian mainland at Gunn Point and Melville Island's southernmost point, Cape Gambier (Tiwi Land Council, 2013). There are three major islands making up the Vernon Islands group; north-west Vernon Island, south-west Vernon Island and east Vernon Island, including a large reef and numerous lesser reefs and sand islands (Tiwi Land Council, 2013). The Vernon Islands are rich in mangrove forests, reef systems, rocky shelves and stacks, and seagrass and algal beds (Tiwi Land Council, 2013). The islands are an important coral reef locality, and there is a small number of naturally occurring deep holes (up to 20 m deep) which support coral communities with high species diversity (Tiwi Land Council, 2013). The waters surrounding the Vernon Islands support populations of dugong and turtles (Tiwi Land Council, 2013).

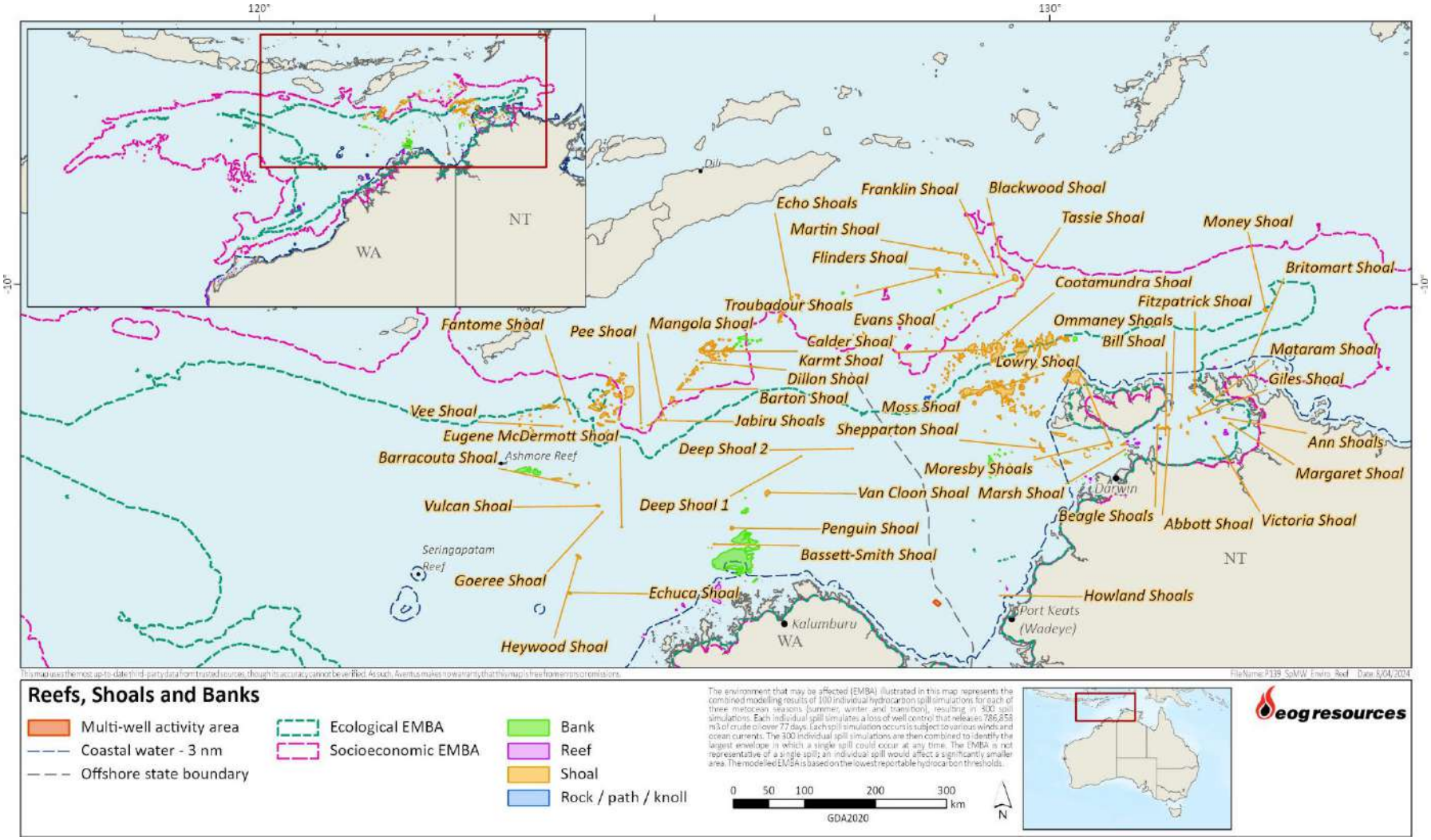


Figure 11.24 Reefs, shoals and banks overlapped by the spill EMBA

11.3.2 Marine Flora

Marine flora is generally limited to mangroves and seagrass beds and macroalgae, which is generally confined to shallow, nearshore waters.

Mangroves

Mangroves provide nutrient to surrounding waters and are also important habitat and nursery areas for fish and invertebrates. The north Kimberley region contains some of the most species rich systems of mangroves in the world (DPaW, 2016). The mangroves and estuarine habitats of the north Kimberley support a range of threatened, protected and culturally important species including estuarine crocodiles, turtles, dolphins, sawfish, mud crabs, fish and specialist mangrove birds (DPaW, 2016).

In the JBG, mangroves occur in river estuaries. The mangroves surrounding the Ord River are notable in terms of their structural complexity and diversity. Fourteen species of mangroves have been identified within the Ord River alone (Pedretti & Paling, 2001). This diverse area is known to support significant habitats for saltwater crocodiles, migratory birds and supports populations of the commercially exploited species of red-legged banana prawn (*Penaeus indicus*) (Kenyon *et al*., 2004).

Seagrass Beds and Macroalgae

Seagrass beds and macroalgae communities are the primary food source for many marine species and provide important habitats and nursery grounds (Heck *et al*., 2003; Wilson *et al*., 2010). Within the north Kimberley marine region, seagrass and macroalgae communities are an important source of primary productivity. They provide vital habitat for juvenile fish, turtles and dugongs and can be found around Cape Londonderry (176 km northwest from the multi-well location), is within the spill EMBA (DPAW, 2016).

11.3.3 Plankton

Plankton is a key component in oceanic food chains and comprises two elements; phytoplankton and zooplankton, as described in Section 5.4.3 of Chapter 5 of the EP.

11.3.4 Finfish, Sharks, and Rays

There are 60 fish species listed under the EPBC Act with potential to occur in the spill EMBA (DCCEEW, 2024a). This includes ten species listed as threatened, eleven species listed as migratory and a further 44 listed marine species, all of which are Sygnathiformes (seahorses, pipefishes and their relatives) (Table 11.3).

The likely temporal presence and absence of these fish species in the spill EMBA is illustrated in Figure 5.13 in Section 5.4.4 of Chapter 5 of The EP. Species listed as threatened or migratory are described in this section. BIAs for fish species that overlap the spill EMBA are presented in Table 11.4.

Table 11.3 EPBC Act-listed finfish, sharks and rays that may occur in the spill EMBA

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Anoxypristis cuspidate	Narrow sawfish	-	Yes	-	Yes	Yes	No	-
Carcharias taurus	Grey nurse shark (west coast population)	V	-	-	-	Yes	No	RP
Carcharodon carcharias	Great white shark	V	Yes	-	Yes	Yes	No	RP
Carcharhinus longimanus	Oceanic whitetip shark	-	Yes	-	Yes	Yes	No	-
Glyphis garricki	Northern river shark	E	-	-	Yes	Yes	No	CA, RP
Glyphis glyphis	Speartooth shark	CE	-	-	Yes	Yes	No	CA
Isurus oxyrinchus	Shortfin mako	-	Yes	-	Yes	Yes	No	-
Isurus paucus	Longfin mako	-	Yes	-	Yes	Yes	No	-
Manta alfredi	Reef manta ray	-	Yes	-	Yes	Yes	No	-
Manta birostris	Giant manta ray	-	Yes	-	Yes	Yes	No	-
Pristis clavate	Dwarf sawfish	V	Yes	-	Yes	Yes	Yes	CA, RP
Pristis pristis	Largetooth sawfish	V	Yes	-	Yes	Yes	No	CA, RP
Pristis zijsron	Green sawfish	V	Yes	-	Yes	Yes	Yes	CA, RP
Rhincodon typus	Whale shark	V	Yes	-	Yes	Yes	Yes	CA
Sphyrna lewini	Scalloped Hammerhead	CD	-	-	Yes	Yes	No	-
Thunnus maccoyii	Southern Bluefin Tuna	CD	-	-	Yes	Yes	No	-
Seahorses, pipefish and pipehorses								

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Acentronura larsonae	Helen's pygmy pipehorse	-	-	Yes	-	Yes	No	-
Bhanotia fasciolata	Corrugated pipefish	-	-	Yes	Yes	Yes	No	-
Bulbonaricus brauni	Braun's pughead pipefish	-	-	Yes	-	Yes	No	-
Campichthys tricarinatus	Three-keel pipefish	-	-	Yes	Yes	Yes	No	-
Choeroichthys brachysoma	Pacific short-bodied pipefish	-	-	Yes	Yes	Yes	No	-
Choeroichthys latispinosus	Murion Island pipefish	-	-	Yes	-	Yes	No	-
Choeroichthys suillus	Pig-snouted pipefish	-	-	Yes	Yes	Yes	No	-
Corythoichthys amplexus	Fijian banded pipefish	-	-	Yes	Yes	Yes	No	-
Corythoichthys flavofasciatus	Reticulate pipefish	-	-	Yes	Yes	Yes	No	-
Corythoichthys haematopterus	Reef-top pipefish	-	-	Yes	Yes	Yes	No	-
Corythoichthys intestinalis	Australian messmate pipefish	-	-	Yes	Yes	Yes	No	-
Corythoichthys schultzi	Schultz's pipefish	-	-	Yes	Yes	Yes	No	-
Cosmocampus banneri	Roughridge pipefish	-	-	Yes	Yes	Yes	No	-
Doryrhamphus dactyliophorus	Banded pipefish	-	-	Yes	Yes	Yes	No	-
Doryrhamphus excisus	Bluestripe pipefish	-	-	Yes	Yes	Yes	No	-

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Doryrhamphus janssi	Cleaner pipefish	-	-	Yes	Yes	Yes	No	-
Doryrhamphus multiannulatus	Many-banded pipefish	-	-	Yes	-	Yes	No	-
Doryrhamphus negrosensis	Flagtail pipefish	-	-	Yes	-	Yes	No	-
Festucalex cinctus	Girdled pipefish	-	-	Yes	Yes	Yes	No	-
Festucalex scalaris	Ladder pipefish	-	-	Yes	-	Yes	No	-
Filicampus tigris	Tiger pipefish	-	-	Yes	Yes	Yes	No	-
Halicampus brocki	Brock's pipefish	-	-	Yes	Yes	Yes	No	-
Halicampus dunckeri	Red-hair pipefish	-	-	Yes	Yes	Yes	No	-
Halicampus grayi	Mud pipefish	-	-	Yes	Yes	Yes	No	-
Halicampus nitidus	Glittering pipefish	-	-	Yes	Yes	Yes	No	-
Halicampus spinirostris	Spiny-snout pipefish	-	-	Yes	Yes	Yes	No	-
Haliichthys taeniophorus	Ribboned pipehorse	-	-	Yes	Yes	Yes	No	-
Hippichthys cyanospilos	Blue-speckled pipefish	-	-	Yes	Yes	Yes	No	-
Hippichthys parvicarinatus	Short-keel pipefish	-	-	Yes	Yes	Yes	No	-
Hippichthys penicillus	Beady pipefish	-	-	Yes	Yes	Yes	No	-
Hippocampus angustus	Western spiny seahorse	-	-	Yes	Yes	Yes	No	-
Hippocampus histrix	Spiny seahorse	-	-	Yes	Yes	Yes	No	-

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Hippocampus kuda	Spotted seahorse	-	-	Yes	Yes	Yes	No	-
Hippocampus planifrons	Flat-face seahorse	-	-	Yes	Yes	Yes	No	-
Hippocampus spinosissimus	Hedgehog seahorse	-	-	Yes	Yes	Yes	No	-
Hippocampus trimaculatus	Three-spot seahorse	-	-	Yes	Yes	Yes	No	-
Micrognathus micronotopterus	Tidepool pipefish	-	-	Yes	Yes	Yes	No	-
Phoxocampus belcheri	Black rock pipefish	-	-	Yes	-	Yes	No	-
Solegnathus hardwickii	Pallid pipehorse	-	-	Yes	Yes	Yes	No	-
Solegnathus lettiensis	Gunther's pipehorse	-	-	Yes	Yes	Yes	No	-
Solenostomus cyanopterus	Robust ghost pipefish	-	-	Yes	Yes	Yes	No	-
Syngnathoides biaculeatus	Double-end pipehorse	-	-	Yes	Yes	Yes	No	-
Trachyrhamphus bicoarctatus	Bentstick pipefish	-	-	Yes	Yes	Yes	No	-
Trachyrhamphus longirostris	Straightstick pipefish	-	-	Yes	Yes	Yes	No	-

Definitions

EPBC Act	Description
Listed threatened species	A native species listed in Section 178 of the *EPBC Act* as either extinct, extinct in the wild, critically endangered, endangered, and vulnerable or conservation dependent.
Listed migratory species	A native species that from time to time is included in the appendices to the Bonn Convention and the annexes of JAMBA, CAMBA and ROKAMBA, as listed in Section 209 of the *EPBC Act*.
Listed marine species	As listed in Section 248 of the *EPBC Act*.

Key

EPBC status	V	Vulnerable
	E	Endangered
	CE	Critically endangered
BIA	A	Aggregation
	D	Distribution (i.e., presence only)
	F	Foraging
	M	Migration

Recovery plans (under the EPBC Act 1999)	CA	Conservation Advice
	CD	Conservation Dependent
	CMP	Conservation Management Plan
	RP	Recovery Plan
	NRP	National Recovery Plan

Table 11.4 BIAs of fish species within the spill EMBA

Species	BIA	Location within the spill EMBA
Dwarf sawfish (Figure 11.28)	Reproduction	Fitzroy River Mouth Coastal waters between Broome and Port Hedland King Sound (Inshore waters).
	Foraging	Camden Sound
Largetooth sawfish *(Freshwater sawfish)* (Figure 11.30)	Foraging and reproduction	King Sound - tidal tributaries King Sound (Inshore waters). Fitzroy River And River Mouth Coastal waters between Broome and Port Hedland Minyirr Crab Creek
Green sawfish (Figure 11.32)	Foraging	Camden Sound.
	Reproduction	Damper Peninsula (eastern coast) Ardyaloon coast Coastal waters between Broome and Port Hedland Minyirr Crab Creek Willie Creek
Whale shark (Figure 11.25)	Foraging	Northward from Ningaloo (outside of the spill EMBA) along 200 m isobath, extending offshore off the Kimberley coastline (within the spill EMBA).

Note: Biologically important areas have not yet been identified for seahorse or pipefish species in the North-west Marine Region as stated in the Species group report card– bony fishes (Supporting the marine bioregional plan for the North-west Marine Region (Commonwealth of Australia, 2012) accessed via DCCEEW (February 2022).

Grey nurse shark (west coast population) (EPBC Act: Vulnerable)

The grey nurse shark (*Carcharias taurus*) has a broad inshore distribution, primarily in sub-tropical to cool temperate waters (Last and Stevens, 2009). The west coast population of grey nurse shark are predominantly found in the south-west coastal waters of WA (DCCEEW, 2024b) and has been recorded as far north as the Northwest Shelf (NWS) (DoE, 2014b).

Grey nurse sharks are often observed hovering motionless just above the seabed, in or near deep sandy-bottomed gutters or rocky caves, and in the vicinity of inshore rocky reefs and islands (Pollard *et al*., 1996). The species has been recorded at varying depths but generally found between 15–40 m (DoE 2014b).

Grey nurse sharks have also been recorded in the surf zone, around coral reefs, and to depths of around 200 m on the continental shelf. They generally occur either alone or in small to medium sized groups, usually of fewer than 20 sharks (Pollard *et al*., 1996). Grey nurse sharks that are observed alone are thought to be moving between aggregation sites (DCCEEW, 2024b). Grey nurse sharks are often observed aggregating around inshore rocky reefs or islands (DoE, 2014b). At these locations, grey nurse sharks are typically found near the seabed (at depths of 10 m to 40 m) in deep sandy or gravel filled gutters, or in rocky caves (DoE, 2014b). There are no known aggregation sites critical to the grey nurse shark in WA waters (DoE, 2014b).

There are no biologically important aggregation, breeding or foraging areas intersected by the spill EMBA; however, it is likely that individuals may transit through the spill EMBA.

Great white shark (EPBC Act: Vulnerable, Listed migratory)

The great white shark (*Carcharodon carcharias*) is widely distributed and located throughout temperate and sub-tropical waters with their known range in Australian waters including all coastal areas except the NT (DCCEEW, 2024b). Studies of the great white shark indicates that they appear to be largely transient, with a few longer-term residents; however, individuals are known to return to feeding grounds on a seasonal basis (Klimey and Anderson, 1996). Observations of adult white sharks are more frequent around fur-seal and sea lion colonies whilst juveniles are known to congregate in certain key areas.

There are no biologically important aggregation, breeding or foraging areas intersected by the spill EMBA; however, it is likely that individuals may transit through the spill EMBA.

Shortfin mako shark (EPBC Act: Listed migratory)

The shortfin mako (*Isurus oxyrinchus*) is a pelagic species with a circumglobal, wide ranging oceanic distribution in tropical and temperate seas (Mollet *et al.,* 2000). It is widespread in Australian waters, recorded in offshore waters all around the continent's coastline with exception of the Arafura Sea, the Gulf of Carpentaria and Torres Strait (DCCEEW, 2024b). Shortfin makos are also highly migratory and travel large distances (DCCEEW, 2024b).

Due to their widespread distribution in Australian waters, their presence in the spill EMBA is likely to be limited to transiting individuals.

Longfin mako shark (EPBC Act: Listed migratory)

The longfin mako is widely distributed; however, it is rarely encountered and can be found along the WA coastline as a far south as Geraldton (Last and Stevens, 2009). There is limited research into the species within Australian waters; however, Sepulveda et al (2004) recorded southern Californian juveniles favoured surface waters, while larger adults were frequently observed at depths of up to 250 m. Whilst assumed to be a deep-dwelling shark, sightings on the ocean surface, and the species' diet, suggest a greater depth range (Reardon *et al*., 2006).

Though there is limited information about the longfin mako, their presence in the spill EMBA is likely to be limited to transiting individuals.

Whale shark (EPBC Act: Vulnerable, listed migratory)

The whale shark (*Rhincodon typus*) is a filter-feeding shark and is the largest known species of fish in the world (DCCEEW, 2024b). It is considered to be an oceanic and coastal species, commonly seen far offshore but also closer inshore near coral atolls (DCCEEW, 2024b). Whale sharks generally prefer tropical to warm temperate waters where surface sea temperature ranges from 21° to 25 °C (DCCEEW, 2024b).

In Australian waters the whale shark is commonly seen in waters off northern WA, NT and Queensland with only very occasional sightings off Victoria and South Australia (Last and Stevens, 2009). The movements of whale sharks are not well documented; however, they are known to seasonally aggregate (March and April) in shallow tropical waters off the North West Cape in WA (DCCEEW, 2024b).

Whale sharks may occur within the spill EMBA. A foraging BIA is intersected by the socio-economic EMBA (see Table 11.4 and Figure 11.25) and hence, individuals may forage in the far western extent of the spill EMBA.

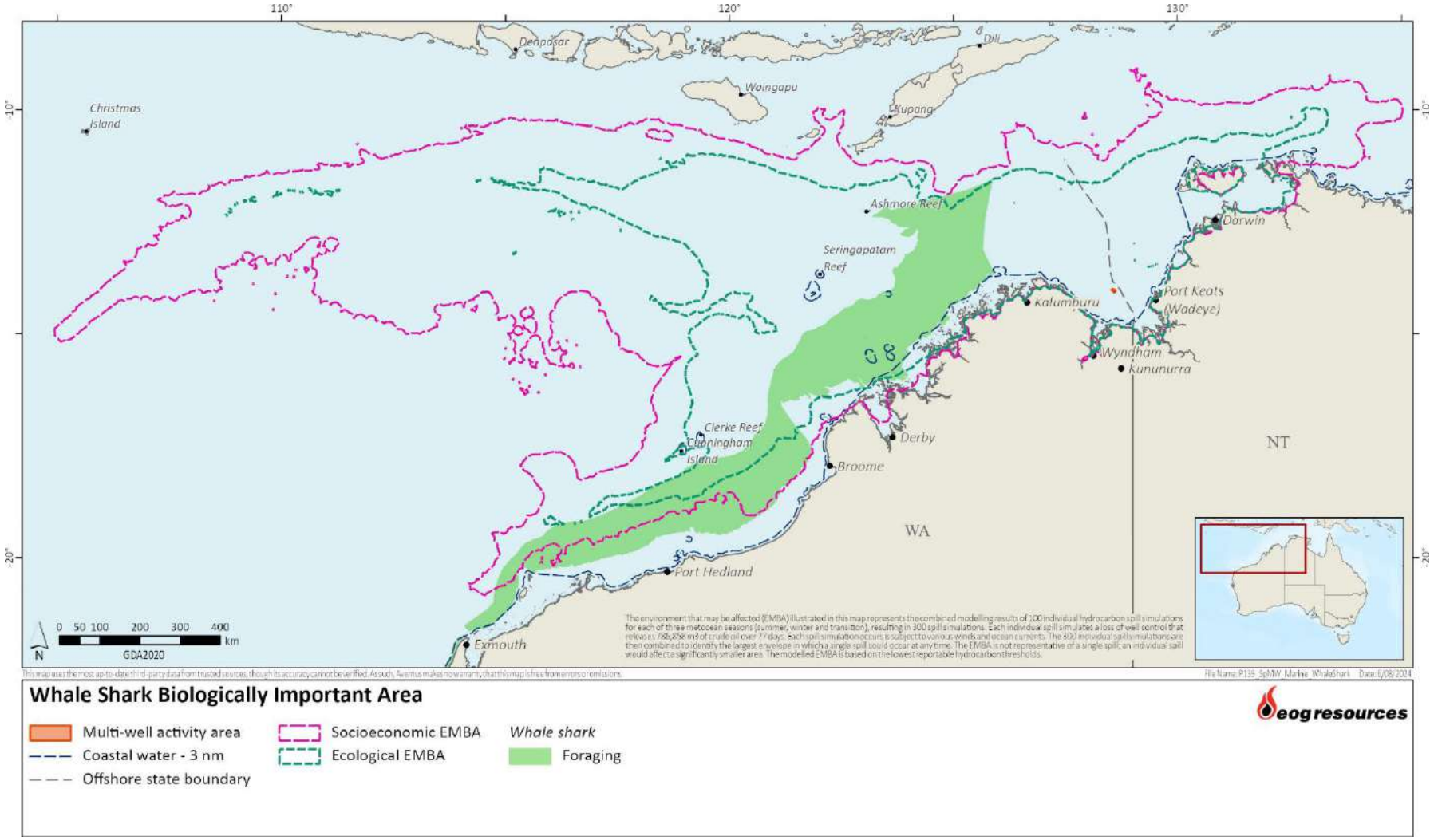


Figure 11.25 Whale shark BIA intersected by the spill EMBA

Northern river shark (EPBC Act: Endangered)

The northern river shark (*Glyphis garricki*) is an elasmobranch capable of living and moving between freshwater and seawater. The species utilises rivers, tidal sections of large tropical estuarine systems, macro tidal embayments, inshore and offshore marine habitats. The species is listed as endangered under the EPBC Act, based partly on its limited geographic distribution (TSSC, 2014a). Within Australia, the northern river shark is known to occur in WA and the NT, occupying both marine and freshwater environments including the JBG, Daly River, Adelaide River and the South and East Alligator Rivers (TSSC, 2014a) (Figure 11.26). Whilst northern river sharks have been observed well offshore, the extent to which this occurs is unknown (TSSC, 2014a). Individuals may be present within the nearshore areas of the spill EMBA.

Speartooth shark (EPBC Act: Listed Critically Endangered)

Speartooth sharks (*Glyphis glyphis*) occur in geographically distinct locations across northern Australia in the NT including Queensland, having been recorded in tidal rivers and estuaries with turbid waters, fine muddy substrates and temperatures ranging from 27°C to 33°C (DoE, 2014c). In the NT, they are found in the Van Diemen Gulf drainage, including the Adelaide River, South, East and West Alligator rivers and Murganella creek (DoE, 2014c). Due to their similarity to bull sharks, it is thought that adult speartooth sharks may live outside of rivers in the coastal marine environment (DoE 2014c). Given the species preference for estuarine and coastal waters, the speartooth shark may be present in the socioeconomic EMBA along the NT coastline. Given the absence of BIAs for this species, significant numbers are not expected to be impacted.

Blind Gudgeon (EPBC Act: Listed vulnerable)

The blind gudgeon is a small fish known to occur on the Cape Range Peninsula in the arid NW of WA (Humphreys and Feinberg, 1995) and at Barrow Island, to the northeast of the Cape Range Peninsula, off the WA coastline (Humphreys ,1999). The species is known only from the underground waters which lie beneath the narrow coastal plain of the Cape Range Peninsula in WA (Allen, 1982; Humphreys and Blyth, 1994) in water temperatures ranging from 27°C to 30°C in May and Aug (Mees, 1962).

Although the PMST report identifies this species or its habitat may be present within the spill EMBA, the closest area of presence is 33 km southeast from the southern extent of the socioeconomic EMBA. Therefore, given the location preference and there are no BIAs for this species, the blind gudgeon is not expected to occur within the spill EMBA.

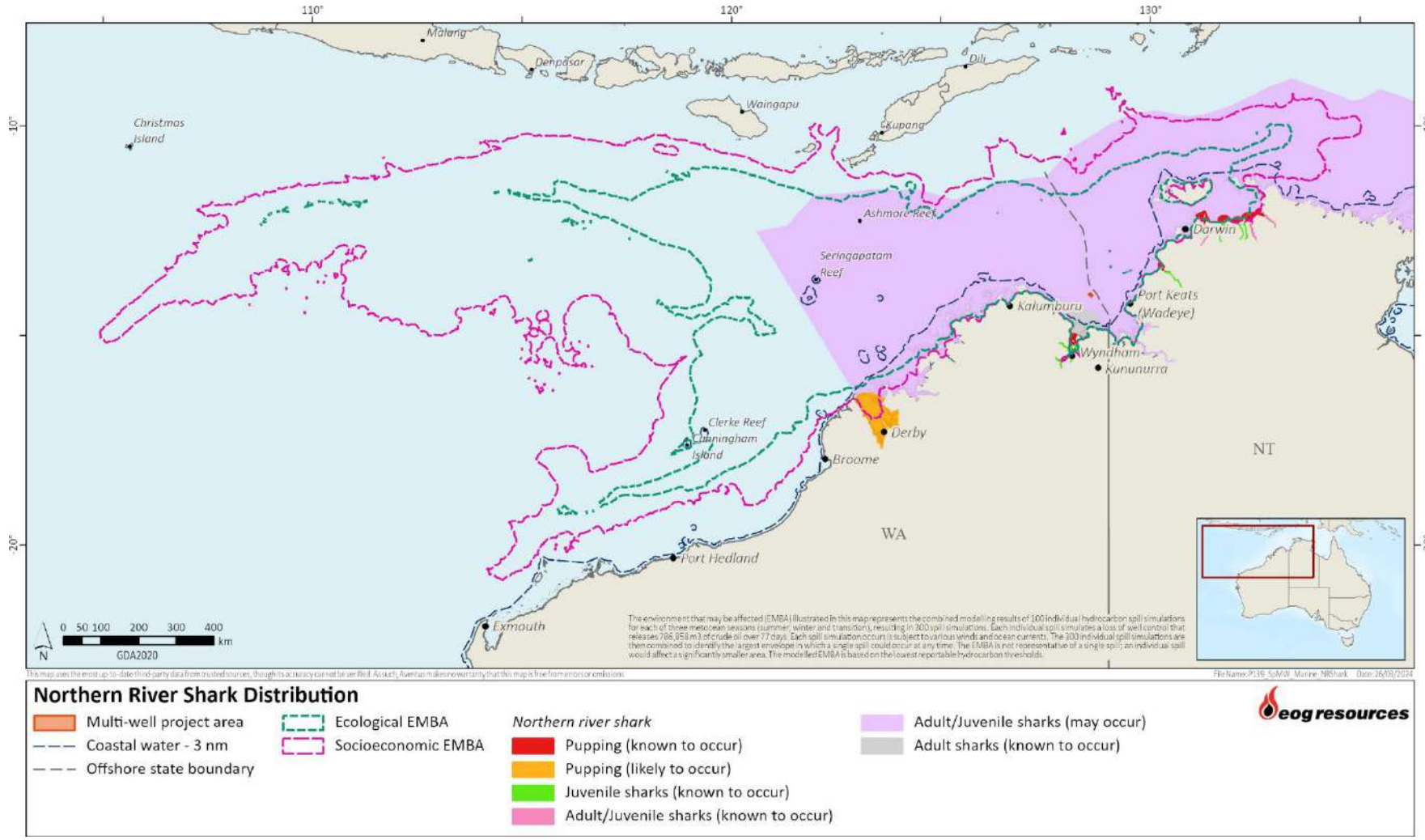


Figure 11.26 Northern river shark presence in the spill EMBA

Reef manta ray (EPBC Act: Listed migratory)

The reef manta ray (*Manta alfredi*) has a circum-global range in tropical and sub-tropical waters with sightings between waters off Perth, all along the northern coastline of Australia to the waters off the Solitary Islands, NSW (Marshall *et al*., 2011a). While this species tends to inhabit nearshore environments, it is known to occurs in waters as deep as 300 m and has been sighted around offshore coral reefs, rocky reefs and seamounts (Marshall *et al*., 2011a). In addition, it makes seasonal migrations of several hundred kilometres (Marshall *et al*., 2011a).

Despite there being no known aggregation sites within close proximity to the spill EMBA, reef manta rays may be present in the spill EMBA as transiting individuals.

Giant manta ray (EPBC Act: Listed migratory)

The giant manta ray (*Manta birostris*) has a widespread distribution along the coast of Australia and is known to seasonally migrate between aggregation sites (Marshall *et al*., 2011b). The giant manta ray is commonly sighted along productive coastlines with regular upwelling, oceanic island groups and particularly offshore pinnacles and seamounts (Marshall *et al*., 2011b).

This species has also been recorded within the Oceanic Shoals Marine Park, which is located within the spill EMBA (Nichol *et al*., 2013). Despite there being no known aggregation sites within close proximity to the activity area, giant manta rays may be present in the spill EMBA as transiting individuals.

Narrow sawfish (EPBC Act: Listed migratory)

The narrow sawfish lives in coastal and estuarine habitats across northern Australia and is generally restricted to shallow waters (less than 40 m) (D'Anastasi *et al*., 2013). The species is known to occur in the Gulf of Carpentaria but its distribution and migration is largely unknown. The narrow sawfish has the potential to occur within the spill EMBA because it has been caught as bycatch by the NPF in these areas (Tonks *et al*., 2008).

Dwarf sawfish (EPBC Act: Vulnerable, Listed migratory)

The dwarf sawfish (*Pristis clavata*) usually inhabits shallow (2–3 m deep) coastal waters and estuarine habitats. Its distribution is considered to extend north from Cairns around the Cape York Peninsula in Queensland, across northern Australian waters to the Pilbara coast in WA (DCCEEW, 2024b). The dwarf sawfish uses its rostrum to stun schooling fish by sideswiping or threshing while swimming through a school. The main prey species is popeye mullet (*Rhinomugil nasutus*). The main threats to dwarf sawfish are habitat loss and entanglement in fishing nets.

Adult dwarf sawfish are known to occur in the nearshore areas of the spill EMBA (Figure 11.27). The spill EMBA overlaps with a foraging and reproduction BIAs for this species as shown in Table 11.4 and Figure 11.28).

Largetooth sawfish (EPBC Act: Vulnerable, Listed migratory)

Largetooth sawfish (*Pristis pristis*) also known as the freshwater sawfish, utilise both freshwater (juvenile) and marine (adult) environments during the different stages of its lifecycle (TSSC, 2014b). Within Australia, largetooth sawfish have been recorded in numerous drainage systems across northern WA, NT and northern Queensland (TSSC, 2014b). Growing up to 7 m in length, the largetooth sawfish feeds on fishes and benthic invertebrates. The saw is used to stun schooling fish, such as mullet, and for extracting molluscs and small crustaceans from the benthic sediment. Nursing areas for the species include Eighty Mile Beach, Roebuck Bay and King Sound (which is also a known foraging area).

The spill EMBA overlaps areas where adult largetooth sawfish are known to occur. The spill EMBA overlaps with foraging and reproduction and BIAs for this species as shown in Table 11.4 and Figure 11.30.

Green sawfish (EPBC Act: Vulnerable, Listed migratory)

The green sawfish (*Pristis zijsron*) occurs in both inshore and offshore marine coastal waters of northern Australia. Green sawfish have been recorded in very shallow water (less than one metre) to offshore trawl grounds in over 70 m of water (Stevens *et al.,* 2005). Despite being found in deep water, evidence suggests that the range of green sawfish is mostly restricted to the inshore coastal fringe, with a strong association with mangroves and adjacent mudflats (Stevens e*t al.,* 2008). Its current known distribution stretches from Broome, WA around northern Australia and down the east coast as far as Jervis Bay, NSW (DCCEEW, 2024b).

The main threats to green sawfish are habitat loss and entanglement in fishing nets. The spill EMBA overlaps areas where both adult and juvenile sawfish are known to occur and is adjacent to the inner waters of the southern JBG where pupping of this species is likely to occur (Figure 11.31). It has also been caught as bycatch from the NPF in the area overlapped by the activity area and spill EMBA and therefore is likely to be present in both (Tonks *et al*., 2008). The spill EMBA overlaps with foraging and reproduction and BIAs for this species as shown in Table 11.4 and Figure 11.32.

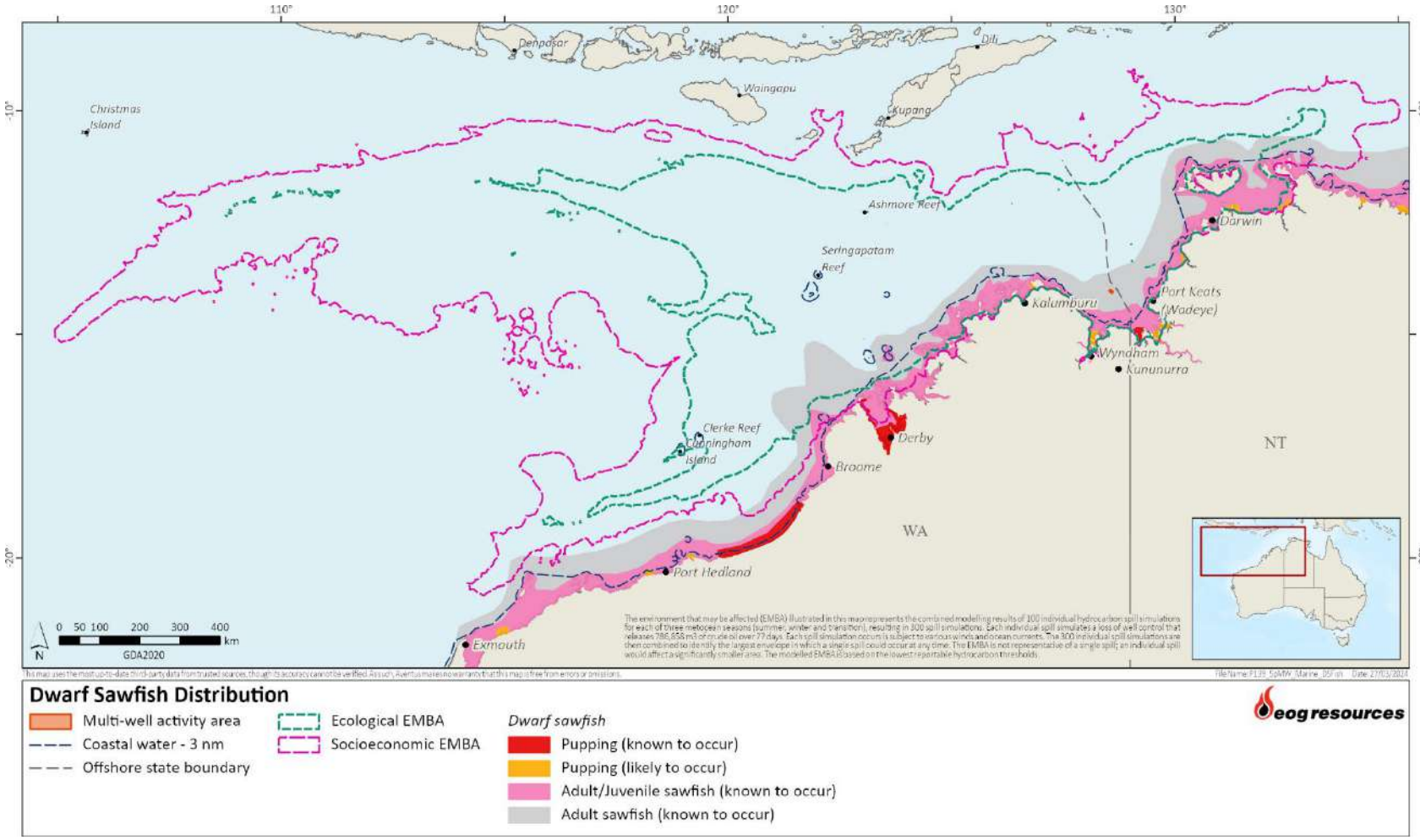


Figure 11.27 Dwarf sawfish presence in the spill EMBA

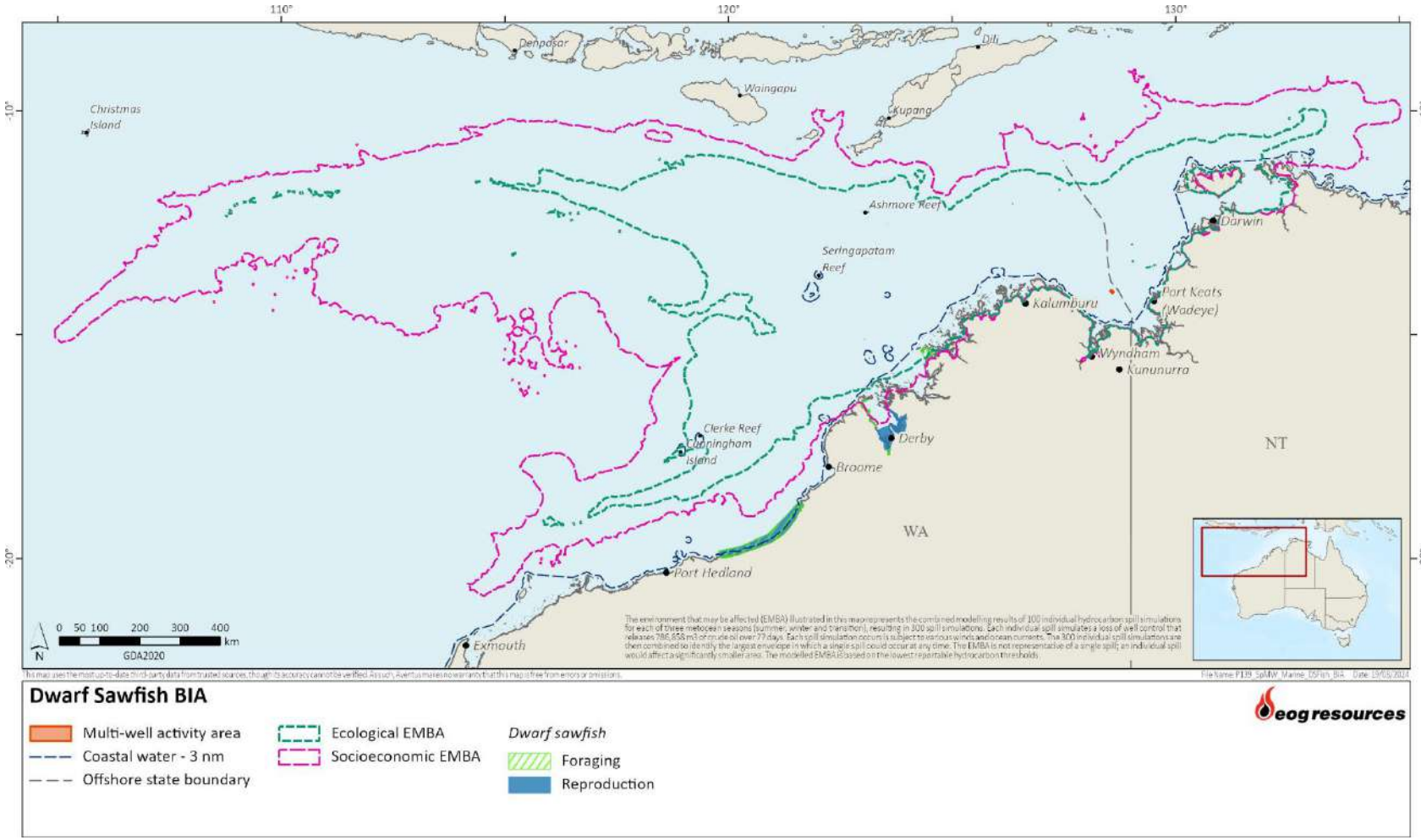


Figure 11.28 Dwarf sawfish BIAs in the spill EMBA

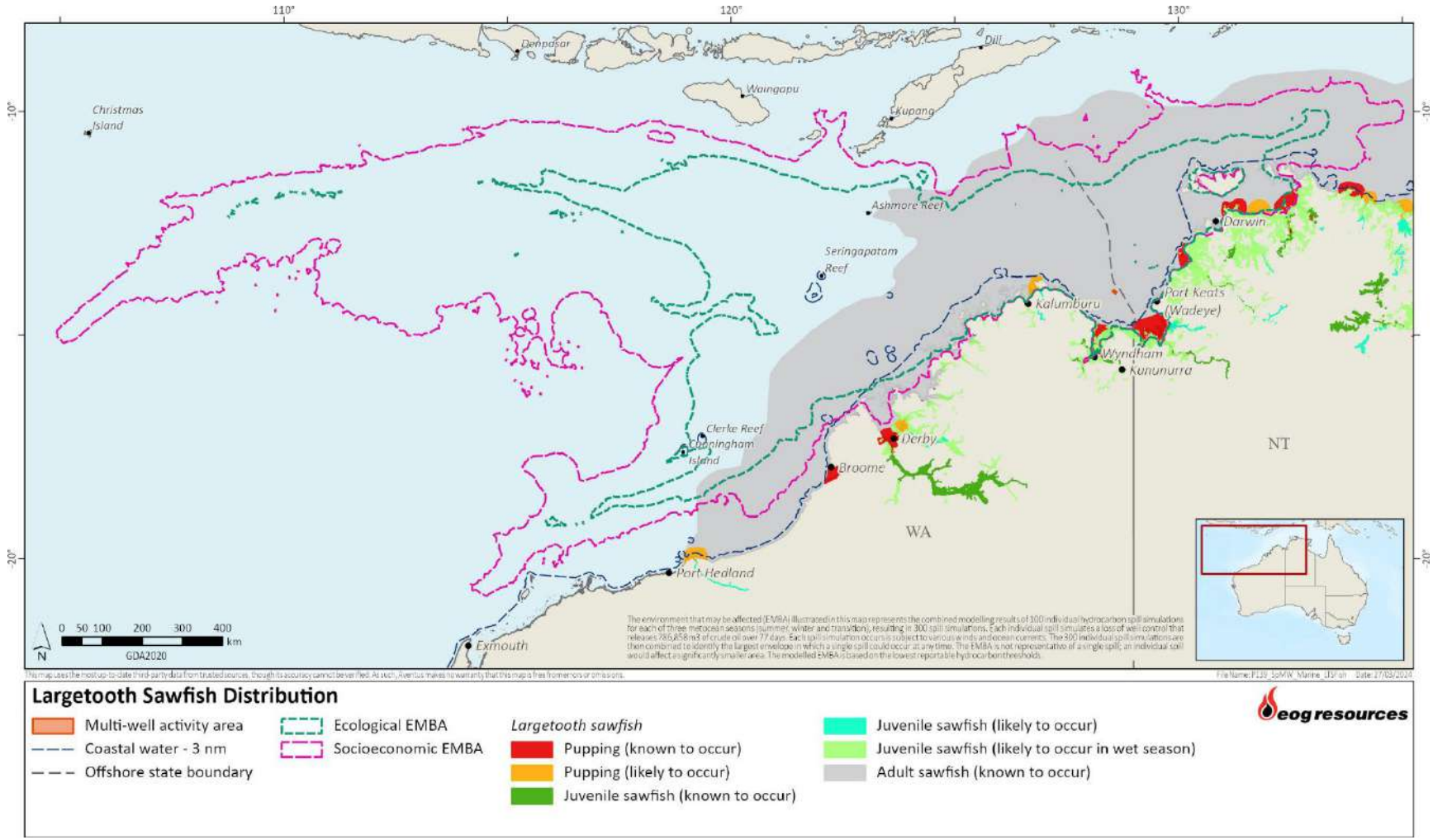


Figure 11.29 Largetooth sawfish presence in the spill EMBA

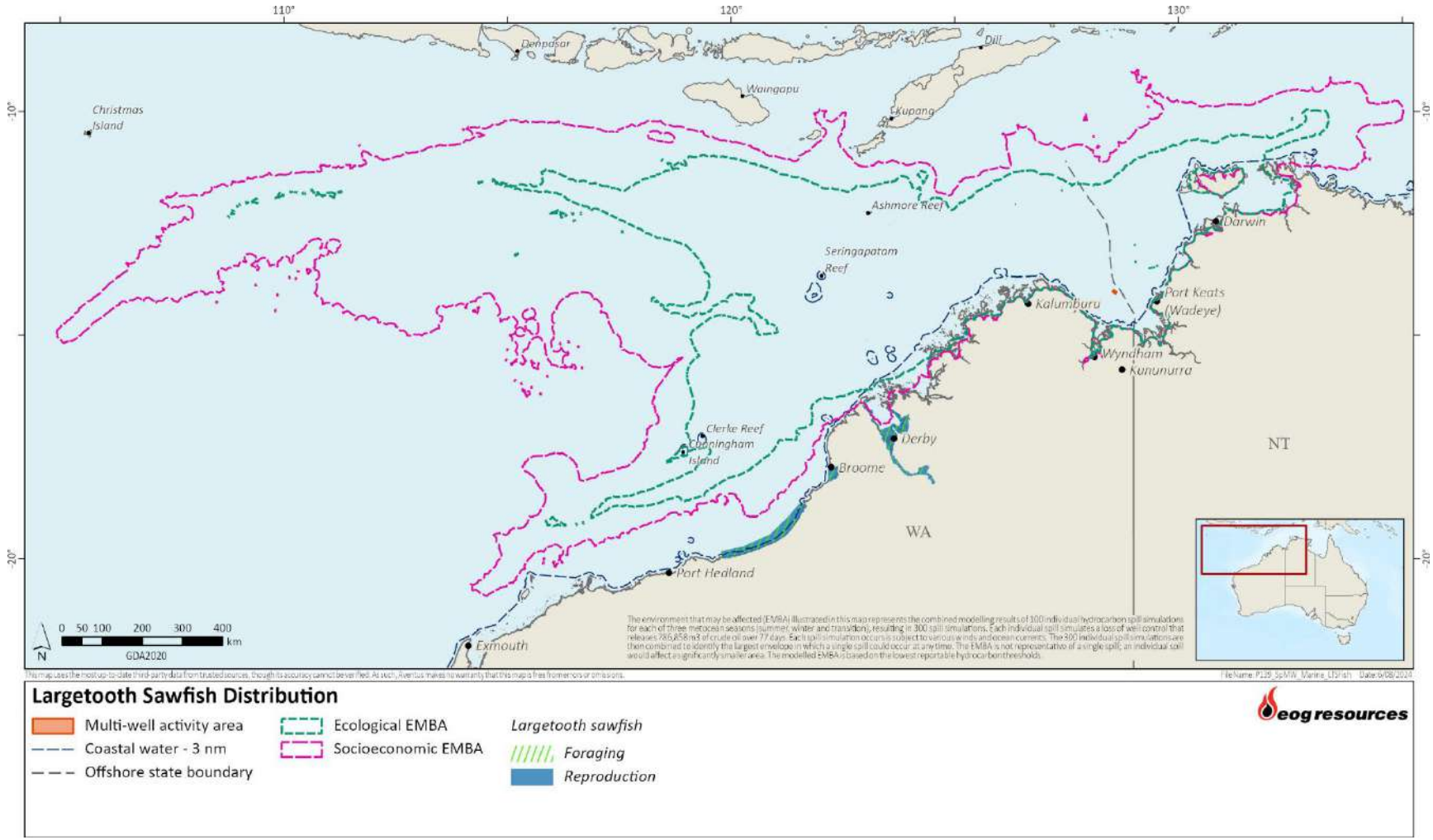


Figure 11.30 Largetooth sawfish BIAs in the spill EMBA

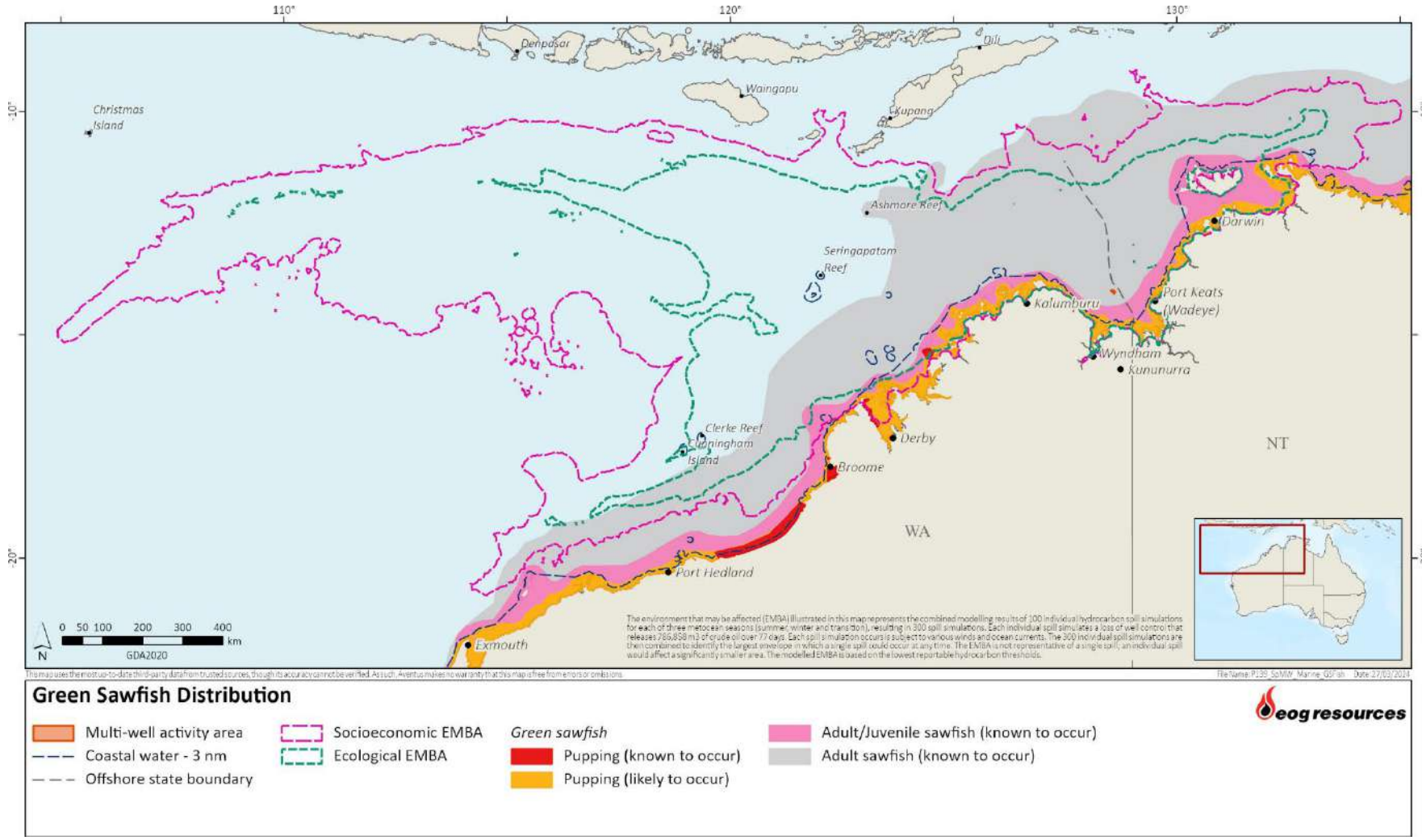


Figure 11.31 Green sawfish presence in the spill EMBA

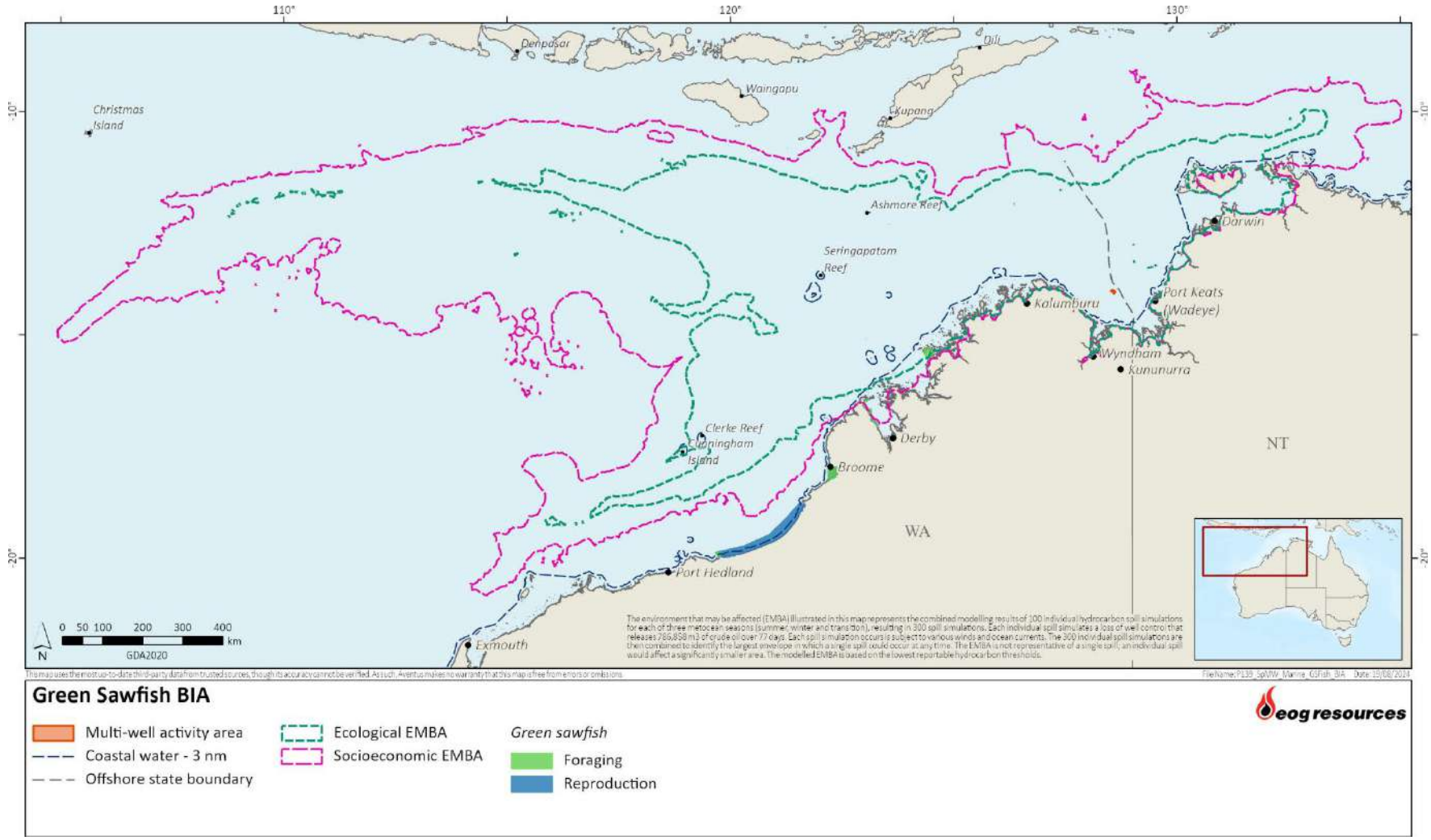


Figure 11.32 Green sawfish BIAs in the spill EMBA

Scalloped hammerhead (EPBC Act: Conservation Dependent)

The scalloped hammerhead (*Sphyrna lewini*) is a relatively large, fusiform-bodied, moderately slender shark. has a circum-global distribution in tropical and sub-tropical waters. This species has a strong genetic population structuring across ocean basins as it rarely ventures into or across deep ocean waters, but ranges quite widely over shallow coastal shelf waters. Within Australian waters the scalloped hammerhead extends from New South Wales (around Wollongong, where it is less abundant), around the north of the continent and then south into Western Australia to approximately Geographe Bay, though it is rarely recorded south of the Houtman Abrolhos Islands (TSSC, 2018a). It is currently under threatened listing assessment (current status is Conservation Dependent) which was due 30 April 2022, but has not been updated since.

As per the PMST report, breeding of the scallop hammerhead is known to occur in the spill EMBA.

Southern Bluefin Tuna (EPBC Act: Conservation Dependent)

This species is described in Chapter 5 of the EP.

As per the PMST report, breeding of the southern bluefin tuna is known to occur in the spill EMBA.

Sygnathids (EPBC Act: Listed marine species, FFG Act: Not listed)

Thirty-five (35) of the 47 marine ray-finned fish species identified in the EPBC Act PMST (74%) are sygnathiformes, which includes seahorses, seadragon, pipehorse and pipefish. The majority of these fish species are associated with seagrass meadows, macroalgal seabed habitats, reefs and sponge gardens located in shallow, inshore waters (e.g., protected coastal bays, harbours and jetties) less than 50 m deep. They are sometimes recorded in deeper offshore waters, where they depend on the protection of sponges and rafts of floating seaweed such as *Sargassum*. It is likely that sygnathid species will occur in the deeper waters of the spill EMBA.

The PMST species profile and threats profiles indicate that the sygnathiforme species listed in the spill EMBA are widely distributed throughout northern and north-western Australian waters. The diverse range of ecological niches afforded by reef sites would be expected to provide suitable habitat for these listed species.

11.3.5 Marine Mammals

The PMST indicates that 15 whale species and 17 dolphin species may occur within or migrate through the spill EMBA (DCCEEW, 2024a). These species are presented in Table 11.5 and a description focused on threatened species follows.

The likely temporal presence and absence of cetaceans in the spill EMBA is illustrated in Figure 5.18 in Section 5.4.5 of Chapter 5.

The species listed as threatened or migratory are described in this section. BIAs for marine mammals that overlap the spill EMBA are presented in Table 11.6.

Table 11.5 EPBC Act-listed cetaceans that may occur in the spill EMBA

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Whales								
Balaenoptera acutorostrata	Minke whale	-	-	Yes	-	Yes	No	-
B. bonaerensis	Antarctic minke whale	-	Yes	Yes	-	Yes	No	-
B. borealis	Sei whale	V	Yes	Yes	Yes	Yes	No	CA
B. edeni	Bryde's whale	-	Yes	Yes	Yes	Yes	No	-
B. musculus	Blue whale	E	Yes	Yes	Yes	Yes	Yes	CMP
B. physalus	Fin whale	V	Yes	Yes	Yes	Yes	No	CA
Eubalaena australis	Southern right whale	E	Yes	Yes	-	Yes	No	NRP
Indopacetus pacificus	Longman's beaked whale	-	-	Yes	Yes	Yes	No	-
Kogia breviceps	Pygmy sperm whale	-	-	Yes	Yes	Yes	No	-
K. simus	Dwarf Sperm Whale	-	-	Yes	Yes	Yes	No	-
Megaptera novaeangliae	Humpback whale	-	Yes	Yes	Yes	Yes	Yes	-
Mesoplodon densirostris	Blainville's beaked whale	-	-	Yes	Yes	Yes	No	-
Mesoplodon ginkgodens	Ginko-toothed beaked whale	-	-	Yes	Yes	Yes	No	-
Physeter macrocephalus	Sperm whale	-	Yes	Yes	Yes	Yes	No	-

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Ziphius cavirostris	Cuvier's beaked whale	-	-	Yes	Yes	Yes	No	
Dolphins								
Delphinus delphis	Common dolphin	-	-	Yes	Yes	Yes	No	-
Feresa attenuata	Pygmy killer whale	-	-	Yes	Yes	Yes	No	-
Globicephala macrorhynchus	Short-finned pilot whale	-	-	Yes	Yes	Yes	No	-
Grampus griseus	Risso's dolphin	-	-	Yes	Yes	Yes	No	-
Lagenodelphis hosei	Fraser's dolphin	-	-	Yes	Yes	Yes	No	-
Orcaella brevirostris	Australian snubfin dolphin	-	Yes	Yes	Yes	Yes	Yes	-
Orcinus orca	Killer whale	-	Yes	Yes	Yes	Yes	No	-
Peponocephala electra	Melon-headed whale	-	-	Yes	Yes	Yes	No	-
Pseudorca crassidens	False killer whale	-	-	Yes	Yes	Yes	No	-
Sousa chinensis	Indo-Pacific Humpback Dolphin	-	Yes	Yes	Yes	Yes	Yes	-
Stenella attenuata	Spotted dolphin	-	-	Yes	Yes	Yes	No	-
Stenella coeruleoalba	Striped dolphin	-	-	Yes	Yes	Yes	No	-

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Stenella longirostris	Long-snouted spinner dolphin	-	-	Yes	Yes	Yes	No	-
Steno bredanensis	Rough-toothed dolphin	-	-	Yes	Yes	Yes	No	-
Tursiops aduncus	Spotted bottlenose dolphin	-	-	Yes	Yes	Yes	Yes	-
Tursiops aduncus (Arafura/Timor Sea populations)	Indian ocean Bottlenose dolphin *(Arafura/Timor Sea populations)*	-	Yes	Yes	Yes	Yes	No	-
Tursiops truncatus	Bottlenose dolphin	-	-	Yes	Yes	Yes	No	-
Dugong								
Dugong dugon	Dugong	-	Yes	Yes	Yes	Yes	Yes	-

Legend and key are the same as Table 11.2

Table 11.6 BIAs of marine mammals within the spill EMBA

Species	BIA	Location within the spill EMBA
Pygmy blue whale (Figure 11.33)	Foraging	Scott Reef.
	Migration	Augusta to Derby (tend to pass along the shelf edge at depths of 500 m to 1,000 m; appear close to coast in the Exmouth-Montebello Islands area on southern migration). Indonesia - Banda Sea.
Humpback whale (Figure 11.36)	Reproduction	Kimberley/Coastal North Lacepede Island, Camden Sound.
	Migration	The migration corridor extends from the coast to out to approximately 100 km offshore in the Kimberley region extending south to Northwest Cape.
	Resting	Kimberley/Coastal North Lacepede Island, Camden Sound.
Indo-pacific humpback dolphin (Figure 11.37)	Foraging	Port Essington (Cobourg Peninsula). Van Diemen Gulf (East Alligator River). Van Diemen Gulf (South Alligator). Darwin Harbour. King Sound Southern Sector. Pender Bay. Carnot & Beagle Bay.
	Reproduction	Port Essington (Cobourg Peninsula). Van Diemen Gulf (East Alligator River). Van Diemen Gulf (South Alligator). Darwin Harbour. Port Nelson, York Sound, Prince Frederick Harbour. Prince Regent River. Camden Sound Area - Walcott Inlet, Doubtful Bay, Deception Bay, Augustus Island (Kuri Bay). Maret and Biggee Island. Willie Creek.
Australian snubfin dolphin (Figure 11.38)	Foraging	Ord River (high density prey). Cape Londonderry and King George River (high density prey). Napier Broome Bay/Deep Bay (high density prey). Vansittart Bay (Anjo Peninsula) (high density prey). Bougainville Peninsula (high density prey). Admiralty Gulf & Parry Harbour. Maret and Biggee Island. Port Nelson, York Sound, Prince Frederick Harbour. Prince Regent River (high density prey). Camden Sound Area (Walcott Inlet, Doubtful Bay, Deception Bay, Augustus Island (Kuri Bay)).

Species	BIA	Location within the spill EMBA
		King Sound North, Yampi Sound and Talbot Bay Fjord area near horizontal falls. King Sound Southern Sector.
	Reproduction	Port Essington (Cobourg Peninsula). Van Diemen Gulf (South Alligator River). Darwin Harbour. Ord River. Napier Broome Bay/Deep Bay. Vansittart Bay (Anjo Peninsula). Bougainville Peninsula. Admiralty Gulf & Parry Harbour. Port Nelson, York Sound, Prince Frederick Harbour. Prince Regent River (high density prey). Camden Sound Area (Walcott Inlet, Doubtful Bay, Deception Bay, Augustus Island (Kuri Bay)). King Sound North, Yampi Sound and Talbot Bay Fjord area near horizontal falls. King Sound Southern Sector.
	Resting	Ord River. Napier Broome Bay/Deep Bay. Vansittart Bay (Anjo Peninsula). Bougainville Peninsula. Admiralty Gulf & Parry Harbour. Port Nelson, York Sound, Prince Frederick Harbour. Camden Sound Area (Walcott Inlet, Doubtful Bay, Deception Bay, Augustus Island (Kuri Bay)).
Dugong (Figure 11.40)	Foraging	Kimberley coast (Dampier Peninsula). Exmouth. Broome.
	Reproduction	Exmouth.
	Migration	Minyirr.

Pygmy blue whale (EPBC Act: Endangered, Listed migratory)

Pygmy blue whales are described in Section 5.4.5 of Chapter 5.

The spill EMBA is considered within the 'likely' distribution of the species and therefore pygmy blue whales may be present in the region during the southern migration period (September to December) (DoE, 2015b).

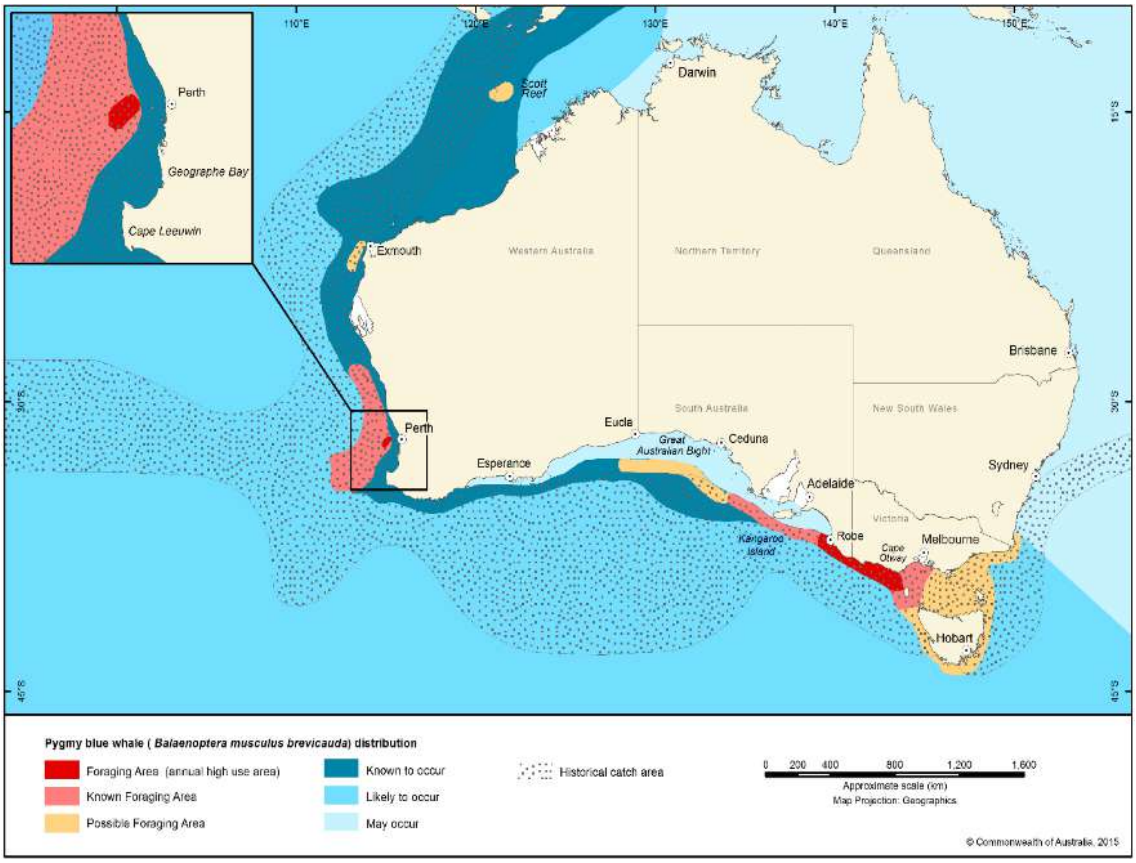
There is a foraging, migration and distribution BIA located off the Northwest Shelf is and Scott Reef (within the spill EMBA) is considered to be a 'possible' foraging area (see Table 11.6 and Figure 11.33).

Southern right whale (EPBC Act: Endangered, Listed migratory)

The southern right whale (*Eubalaena australis*) is present in the southern hemisphere between approximately 20° and 65°S (DCCEEW, 2024c). The species feeds in the Southern Ocean in summer, moving close to the Australian shore in winter.

In Australian waters, the southern right whales distribution range from Perth, along the southern coastline, to Sydney. Sightings have been recorded as far north as Exmouth (Bannister *et al*., 1996)(DCCEEW, 2024c). BIAs including reproduction and migration areas are recorded for this species along the southern coastline of Australia (Geoscience Australia, 2024).

There are no established BIAs for the southern right whale in the spill EMBA. Given the preference for the southern coastline of Australia, it is unlikely that southern right whales will be present the spill EMBA.



Source: DoE (2015a)

Figure 11.33 Pygmy blue whale BIAs

Humpback whale (EPBC Act: Listed migratory)

Humpback whales are described in Section 5.4.5 of Chapter 5 and their distribution is illustrated in Figure 11.34.

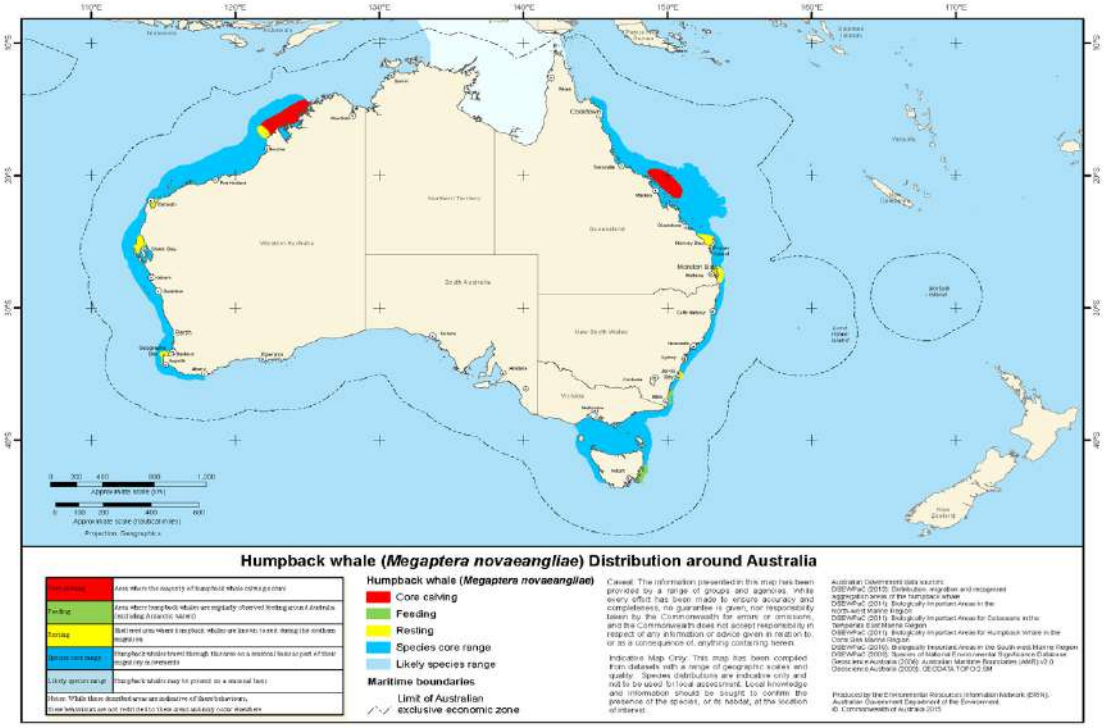
Humpback whales travel northbound from Northwest Cape, along the continental shelf and pass the west of the Muiron, Barrow and Montebello Islands (within the spill EMBA), peaking in late July (Jenner *et al*., 2001). Southbound migrations are more diffuse and irregular with no obvious peak. The southerly migration extends parallel to the coast on the 20 – 30 m depth contour from Lacepede Islands (north of Broome) (Jenner *et al.* 2001, DEWHA, 2008b). An increase in southerly migrating individuals may be observed between the North West Cape and the Montebello Islands around November (Jenner *et al*., 2001).

In the NWMR, humpback whales are known to have breeding and foraging grounds between Broome and the northern end of Camden Sound, with the highest concentrations occurring between June and September (DEWHA, 2008b). Camden Sound appears to be the northern most

limit for the majority of the west coast whales (Figure 11.35) (Jenner *et al*., 2001). Although, the breeding and calving BIA for humpbacks off the west Kimberley coastline extends as far as Bigge Island (offshore from Mitchell Plateau) located within the spill EMBA.

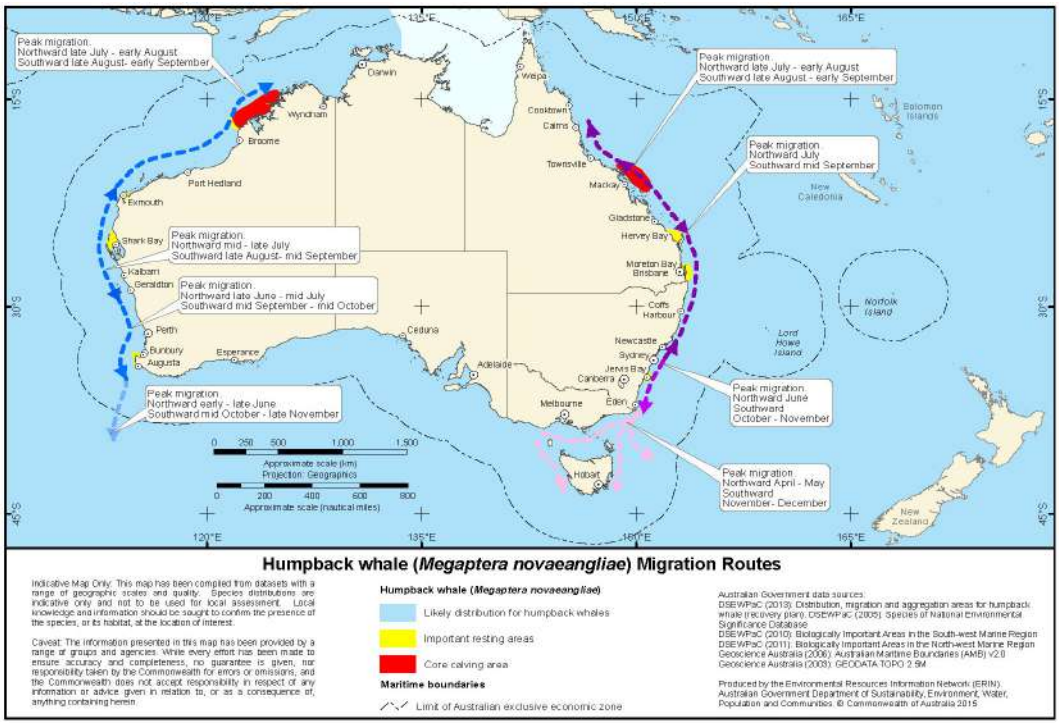
Given the activity timing is outside of the humpback whale period of peak presence in north western Australia (June – September), it is unlikely that the whales are present in significant numbers within the spill EMBA.

The humpback whale migration BIA is located in the spill EMBA. Other BIAs for this species that overlap the spill EMBA are presented in Table 11.6 and Figure 11.36.



Source: TSSC (2015a).

Figure 11.34 Distribution of the humpback whale around Australia



Humpback whale (*Megaptera novaeangliae*) Migration Routes

Indicative Map Only: This map has been compiled from datasets with a range of geographic scales and quality. Species distributions are indicative only and not to be used for local assessment. Local knowledge and information should be sought to confirm the presence of the species, or its habitat, at the location of interest.

Caveat: The information presented in this map has been provided by a range of groups and agencies. While every effort has been made to ensure accuracy and completeness, no guarantee is given, nor responsibility taken by the Commonwealth for errors or omissions, and the Commonwealth does not accept responsibility in respect of any information or advice given in relation to, or as a consequence of, anything contained herein.

Humpback whale (*Megaptera novaeangliae*)

- Likely distribution for humpback whales
- Important resting areas
- Core calving area

Maritime boundaries

- Limit of Australian exclusive economic zone

Australian Government data sources:
DSEWPaC (2013). Distribution, migration and aggregation areas for humpback whale (recovery plan). DSEWPaC (2005). Species of National Environmental Significance Database
DSEWPaC (2010). Biologically Important Areas in the South-west Marine Region
DSEWPaC (2011). Biologically Important Areas in the North-west Marine Region
Geoscience Australia (2006). Australian Maritime Boundaries (AMB) v2.0
Geoscience Australia (2003). GEODATA TOPO 2.5M

Produced by the Environmental Resources Information Network (ERIN). Australian Government Department of Sustainability, Environment, Water, Population and Communities. © Commonwealth of Australia 2015

Source: TSSC (2015a).

Figure 11.35 Migration routes of humpback whales around Australia

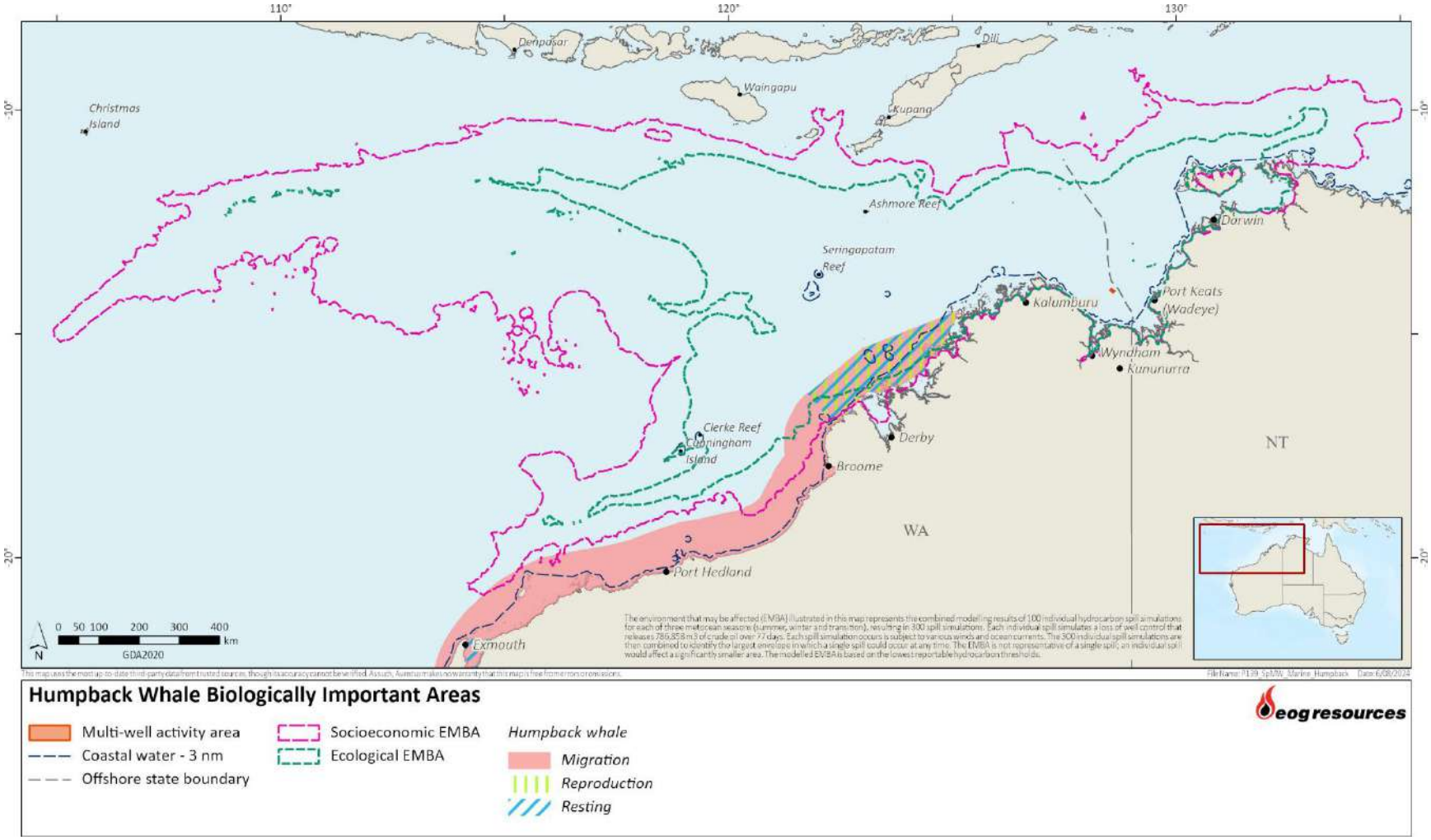


Figure 11.36 Humpback whale BIAs in the spill EMBA

Sei whale (EPBC Act: Vulnerable, Listed migratory)

Sei whales are described in Section 5.4.5 of Chapter 5.

Based upon the species preference for deep offshore waters, the wide-ranging nature of this species, and the small number of sei whale sightings in Australia, the presence of the species within the spill EMBA is likely to be low.

Fin whale (EPBC Act: Vulnerable, Listed migratory)

Fin whales are described in Section 5.4.5 of Chapter 5.

Based on the fin whale preference for deep offshore waters and the minimal sightings in the coastal waters of the spill EMBA, the presence of this species in the spill EMBA is considered to be limited.

Sperm whale (EPBC Act: Vulnerable, listed migratory)

Sperm whales (*Physeter macrocephalus*) are the largest of the toothed whales and are generally found in pods of up to 50 individuals (DCCEEW, 2024b). Sperm whales have a global distribution. They generally inhabit deeper oceanic waters with a water depth of 600 m or more and are uncommon in waters less than 300 m (DoEE 2019a).

The PMST indicates that the species is known to occur within the spill EMBA. No BIAs for the species are recorded in the spill EMBA.

It is possible that sperm whales may transit through the spill EMBA, but they are not expected to be present in significant numbers.

Bryde's whale (EPBC Act: Listed migratory)

Bryde's whales are described in Section 5.4.5 of Chapter 5.

The PMST indicates that the species may occur within the spill EMBA. However, there are no feeding or breeding BIAs within the spill EMBA.

Killer whale (EPBC Act: Listed migratory)

Killer whales are described in Section 5.4.5 of Chapter 5.

Sightings of killer whale around the Australian coast are typically recorded along the continental slope and shelf, and predominantly in the vicinity of seal colonies, which are not known to exist in the region (DEWHA 2008b). No areas of significance and no determined migration routes have been identified for this species within waters off WA (DoEE, 2019a).

The spill EMBA is unlikely to represent important habitat for this species. Therefore, killer whales are unlikely to be present in the spill EMBA.

Indo-Pacific humpback dolphin (EPBC Act: Listed migratory)

Indo-pacific humpback dolphins (*Sousa sahulensis*) are found primarily in coastal waters and feed mainly on fish associated with coastal-estuarine waters (DCCEEW, 2024b). In Queensland and the NT, Australian humpback dolphins are mainly found in water less than 20 km from the nearest river mouth, and in water less than 15–20 m deep (DCCEEW, 2024b). They are generally found in river mouths, mangroves, seagrass beds, tidal channels and inshore reefs. They are known to have resident groups that forage, feed, breed and calve in state and territory waters. Calves may be born throughout the year, but peaks in summer and spring have been reported.

A foraging BIA is located along the Kimberley coastline, as well as reproduction. A reproduction BIA for the species are also located in Darwin Harbour (approximately 275 km north-east of the activity area). Foraging BIAs are also located in Van Diemen Gulf and Port Essington (Cobourg Peninsula) (see Table 11.6 and Figure 11.37).

The PMST indicates that the species is known to occur within the spill EMBA. The coastal area of the socio-economic EMBA overlaps the significant habitat BIA for this species located in the north Kimberley coastline and NT coastline are outlined in Table 11.6 and Figure 11.37. Therefore, the species is likely to be present in the spill EMBA.

Australian snubfin dolphin (EPBC Act: Listed migratory)

The Australian snubfin dolphins (*Orcaella brevirostris*) is described in Section 5.4.5 of the EP.

The PMST indicates that the species is known to occur within the spill EMBA. The spill EMBA overlaps with the foraging, resting and reproduction BIA as outlined in Table 11.6 and Figure 11.38.

Spotted bottlenose dolphin (EPBC Act: Listed marine)

The spotted bottlenose dolphin (*tursiops aduncus)* resembles common bottlenose dolphins (*T. truncatus)* in their general colour pattern. They have a dark grey dorsal cape, with a paler grey dorsal overlay extending onto the flanks, and an off-white ventral area (DCCEEW, 2024b). This species has been confirmed to occur in estuarine and coastal waters of eastern, western and northern Australia. They are restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters including coastal areas around oceanic islands. The spill EMBA overlaps reproduction, migration and foraging BIAs for the spotted bottlenose dolphin which can be seen in Figure 11.39.

The spotted bottlenose dolphin is likely to be present in the spill EMBA.

Indian ocean bottlenose dolphin (Arafura/Timor Sea populations) (EPBC Act: listed migratory)

The Indian Ocean bottlenose dolphin (*Tursiops aduncus Arafura/Timor Sea populations)* is described in Section 5.4.5 of Chapter 5.

Dugong (EPBC Act: Listed marine, migratory)

Dugongs are described in Section 5.4.5 of Chapter 5.

Dugongs have been reported to occur along the coastline from Cape Hay to Pearce Point with the main populations concentrated around Dorcherty Island (Woodside, 2004), approximately 92 km east of the activity area. The closest dugong foraging BIA is located south of Ashmore Reef, with additional foraging BIA on the Kimberley coastline off the Dampier Archipelago (within the spill EMBA) (see Table 11.6). Ashmore Reef supports a population of less than 50 individuals that are genetically distinct from other Australian populations. The reef provides breeding and feeding habitats, with seagrass beds of the reef flats and lagoon their preferred food source. Breeding occurs year round at Ashmore Reef (DoEE, 2019a). An additional three BIAs for this species overlaps with the spill EMBA (see Table 11.6 and Figure 11.40).

Dugongs have high cultural value to Indigenous coastal communities. The coastal waters of northwest Australia, encompassing the Kimberley and Pilbara regions (within the spill EMBA) down to Shark Bay (outside of the spill EMBA), are home to one of the largest remaining dugong populations in the world (Bayliss & Hutton, 2017; Lincoln *et al.,* 2021). To date there have been limited human-induced threats to dugongs in the Kimberley, making the area an important global stronghold for the species (Bayliss & Hutton, 2017).

Dugongs live and move between the traditional Sea Country and Native Title determination areas of numerous Indigenous communities along the length of the Kimberley coastline. Within the Kimberley region it is known that there is a deep ancient and contemporary Indigenous knowledge surrounding dugongs relating to people, culture, livelihoods, and spiritual belief (Lincoln *et al.,* 2021). This knowledge ties into sustainable harvest, local abundance, ecology, biology, diet, and movement of this species (Lincoln *et al.,* 2021). The Balanggarra Healthy Country Plan (HCP), Wunambal Gaambera HCP, Dambimangari HCP and the Mayala Country Plan all discuss the historical and cultural

significance of the dugong, particularly as a food and trade source (Balanggarra Aboriginal Corporation/KLC, 2011; Wunambal Gaambera Aboriginal Corporation, 2010; Dambimangari Aboriginal Corporation, 2012; Mayala Inninalang Aboriginal Corporation, 2019).

Therefore, dugongs are likely to be present in the nearshore areas of the spill EMBA within the Kimberely and Pilbara regions.

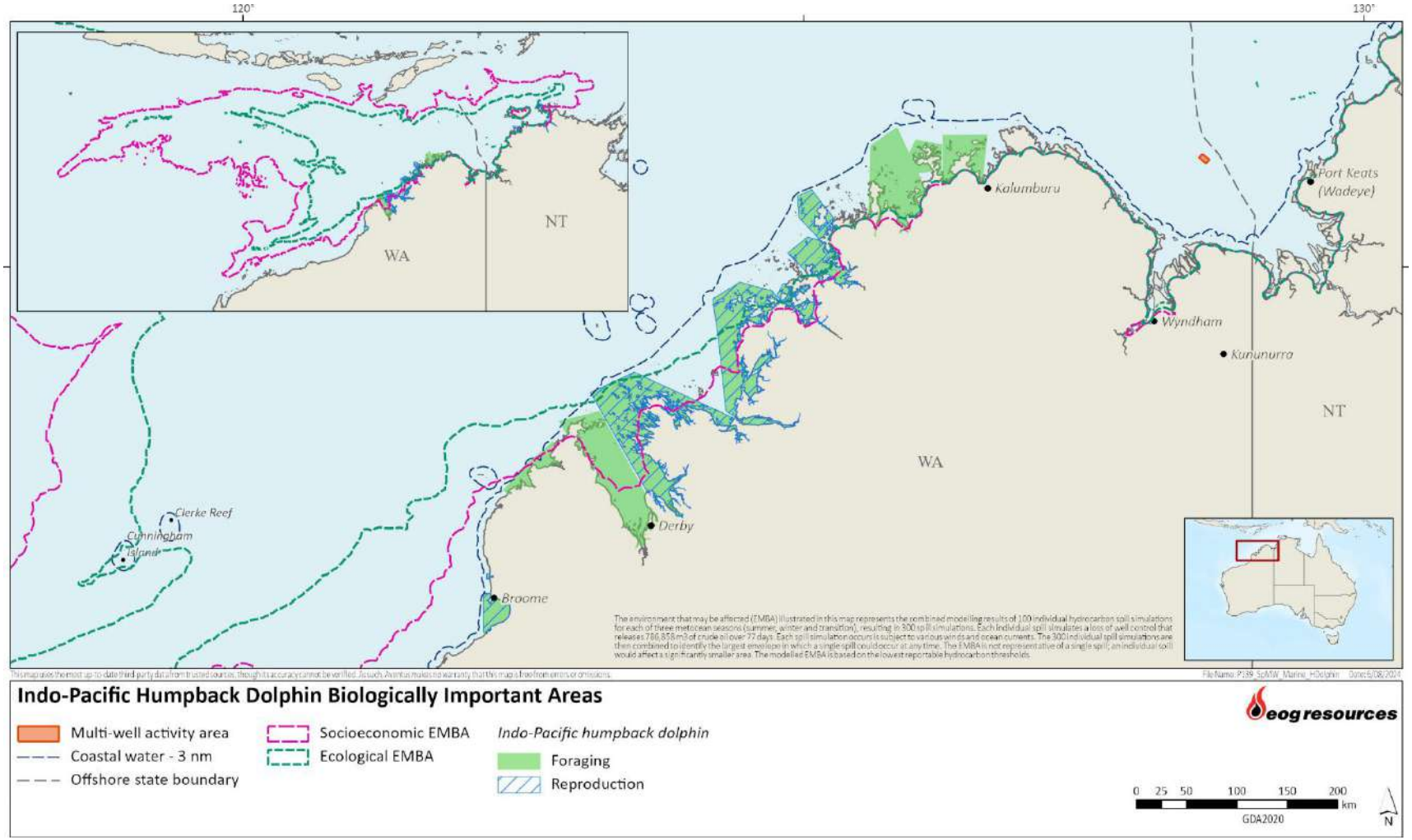


Figure 11.37 Indo-pacific humpback dolphin BIAs in the spill EMBA

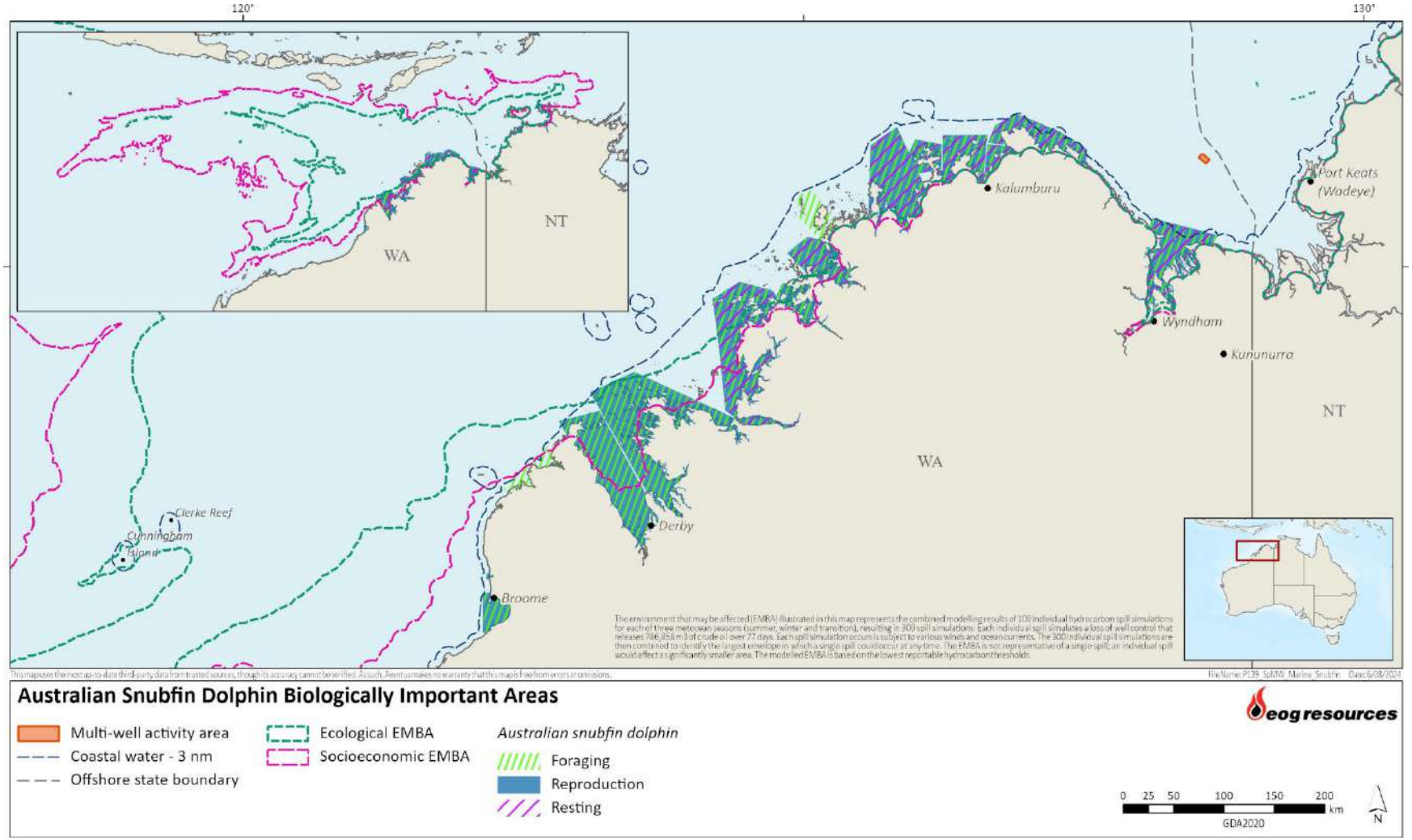


Figure 11.38 Australian snubfin dolphin BIAs in the spill EMBA

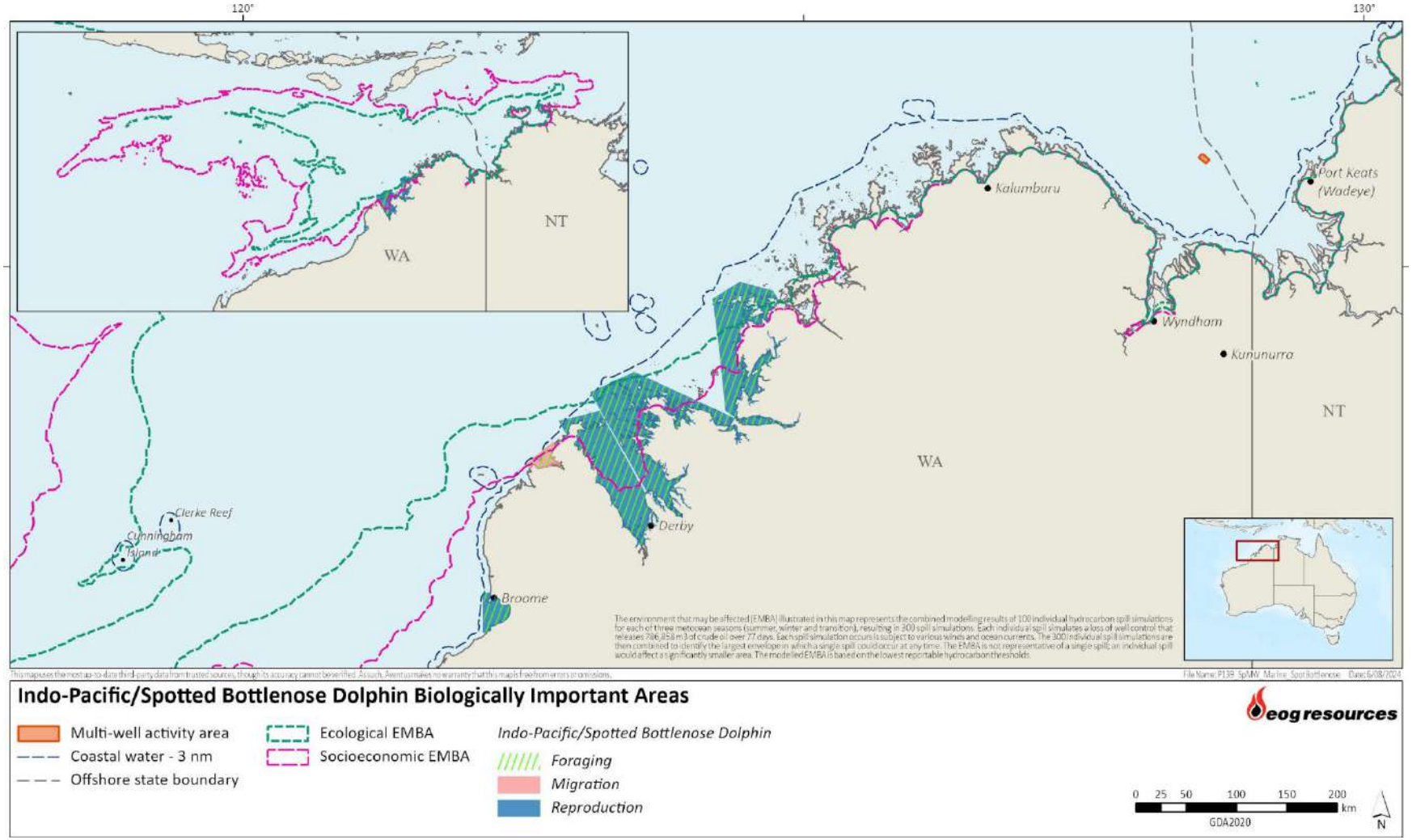


Figure 11.39 Spotted bottlenose dolphin BIAs in the spill EMBA

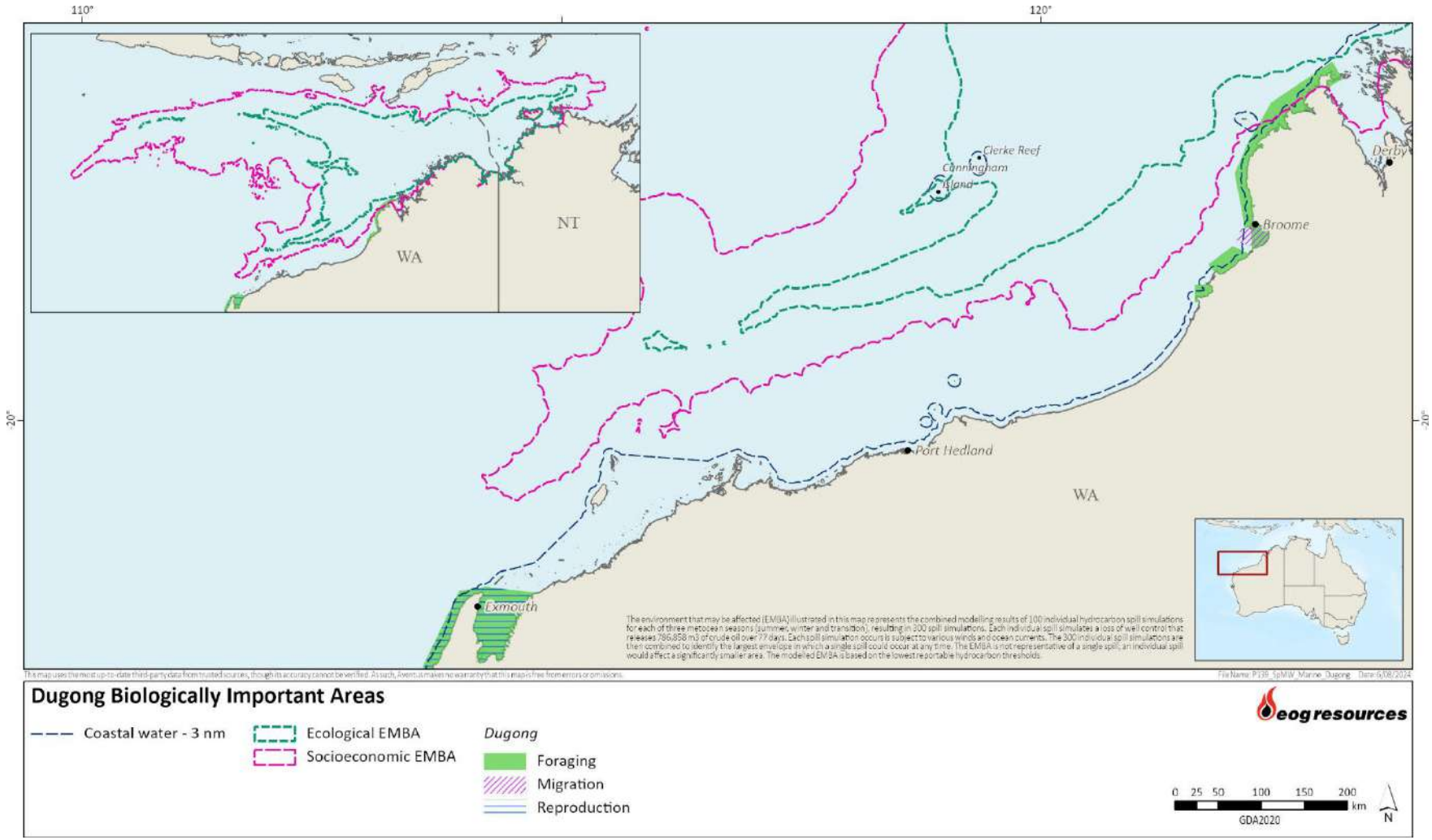


Figure 11.40 Dugong BIAs in the spill EMBA

11.3.6 Reptiles

Six species of marine turtle are listed under the EPBC Protected Matters Search Tool (PMST) as potentially occurring in the spill EMBA, as listed in Table 11.7 (DCCEEW, 2024a). Three of the turtle species are listed as endangered, with the other three listed as vulnerable.

Species of marine turtles listed in Table 11.7 occur in and nest on the sandy beaches of WA, all of which are likely to be present within the spill EMBA. Details on these species are provided in this section. Ecological stages and temporal occupation of the turtle species is presented in Figure 5.20 in Section 5.4.6 of Chapter 5.

BIAs and habitat critical for turtle species that overlap the spill EMBA are presented in Table 11.8. Additionally, 26 species of seasnake were identified as potentially occurring in the spill EMBA (two of which are listed as critically endangered). Two species of crocodile and two species of terrestrial reptiles that are known to occur in coastal or semi-coastal habitats are also listed in Table 11.7.

Sea turtles are culturally important to First Nation groups, particularly to those groups who exist along the northern coast of Australia where sea turtles are abundant and were traditionally used as a food source and for other cultural purposes. The Balanggarra HCP, Wunambal Gaambera HCP, Dambimangari HCP and the Mayala Country Plan all discuss the current and historical cultural significance of sea turtles, particularly the green turtle as it is the most common turtle within the region. The green and hawksbill turtles are hunted for their meat that is shared amongst the community; however, the hawksbill turtle is poisonous if it is not prepared correctly in the traditional way. The flatback turtle is occasionally hunted for its meat, but more often for its eggs which are found on the mainland and inshore islands.

Turtle eggs can be used as drink (raw) or cooked as food (Balanggarra Aboriginal Corporation/KLC, 2011; Wunambal Gaambera Aboriginal Corporation, 2010; Dambimangari Aboriginal Corporation, 2012; Mayala Inninalang Aboriginal Corporation, 2019). Where water was not available, people were able to survive for a few days by obtaining moisture from sea turtle eggs (Vigilante *et al*., 2013). One of the earliest recorded encounters of Aboriginal people harvesting turtle eggs was recorded in 1819 on Lacrosse Island (WA) (within the spill EMBA) (Vigilante *et al*., 2013).

Table 11.7 EPBC Act-listed reptiles that may occur in the spill EMBA

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological spill EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Marine Turtles								
Caretta caretta	Loggerhead turtle	E	Yes	Yes	Yes	Yes	Yes	RP for all turtles in Australia
Chelonia mydas	Green turtle	V	Yes	Yes	Yes	Yes	Yes	
Dermochelys coriacea	Leatherback turtle	E	Yes	Yes	Yes	Yes	No	
Eretmochelys imbricate	Hawksbill turtle	V	Yes	Yes	Yes	Yes	Yes	
Lepidochelys olivacea	Olive ridley turtle	E	Yes	Yes	Yes	Yes	Yes	
Natator depressus	Flatback turtle	V	Yes	Yes	Yes	Yes	Yes	
Seasnakes								
Acalyptophis peronii	Horned seasnake	-	-	Yes	Yes	Yes	No	-
Aipysurus apraefrontalis	Short-nosed seasnake	CE	-	Yes	Yes	Yes	No	CA
Aipysurus duboisii	Dubois' seasnake	-	-	Yes	Yes	Yes	No	-
Aipysurus eydouxii	Spine-tailed seasnake	-	-	Yes	Yes	Yes	No	-
Aipysurus foliosquama	Leaf-scaled seasnake	CE	-	Yes	Yes	Yes	No	CA
Aipysurus fuscus	Dusky seasnake	-	-	Yes	Yes	Yes	No	-
Aipysurus laevis	Olive seasnake	-	-	Yes	Yes	Yes	No	-
Aipysurus tenuis	Brown-lined seasnake	-	-	Yes	Yes	Yes	No	-
Astrotia stokesii	Stokes' seasnake	-	-	Yes	Yes	Yes	No	-

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological spill EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Disteira kingii	Spectacled seasnake	-	-	Yes	Yes	Yes	No	-
Disteira major	Olive-headed seasnake	-	-	Yes	Yes	Yes	No	-
Emydocephalus annulatus	Turtle-headed seasnake	-	-	Yes	Yes	Yes	No	-
Enhydrina schistosa	Beaked seasnake	-	-	Yes	Yes	Yes	No	-
Ephalophis greyi	North-western mangrove seasnake	-	-	Yes	Yes	Yes	No	-
Hydrelaps darwiniensis	Black-ringed seasnake	-	-	Yes	Yes	Yes	No	-
Hydrophis atriceps	Black-headed seasnake	-	-	Yes	Yes	Yes	No	-
Hydrophis coggeri	Slender-necked seasnake	-	-	Yes	Yes	Yes	No	-
Hydrophis czeblukovi	Fine-spined seasnake	-	-	Yes	Yes	Yes	No	-
Hydrophis elegans	Elegant seasnake	-	-	Yes	Yes	Yes	No	-
Hydrophis inornatus	Plain seasnake	-	-	Yes	Yes	Yes	No	-
Hydrophis mcdowelli	Small-headed seasnake	-	-	Yes	Yes	Yes	No	-
Hydrophis ornatus	Spotted seasnake	-	-	Yes	Yes	Yes	No	-
Hydrophis pacificus	Large-headed seasnake	-	-	Yes	Yes	Yes	No	-

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological spill EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Lapemis hardwickii	Spine-bellied seasnake	-	-	Yes	Yes	Yes	No	-
Parahydrophis mertoni	Northern mangrove seasnake	-	-	Yes	Yes	Yes	No	-
Pelamis platurus	Yellow-bellied seasnake	-	-	Yes	Yes	Yes	No	-
Terrestrial reptiles								
Acanthophis hawkei	Plains death adder	V	-	-	Yes	Yes	No	CA
Cryptoblepharus gurrmul	Arafura snake-eyed skink	E	-	-	-	Yes	No	CA
Tiliqua scincoides intermedia	Northern blue-tongued Skink	CE	-	-	Yes	Yes	No	CA
Varanus mertensi	Mertens' water monitor	CE	-	-	Yes	Yes	No	CA
Varanus mitchelli	Mitchell's water Monitor	E	-	-	Yes	Yes	No	CA
Crocodiles								
Crocodylus johnstoni	Freshwater crocodile	-	-	Yes	Yes	Yes	No	-
Crocodylus porosus	Salt-water crocodile	-	Yes	Yes	Yes	Yes	No	-

Legend and key are the same as Table 11.2.

Table 11.8 BIAs and habitat critical to marine turtles within the spill EMBA

Species	BIA	Location within the spill EMBA	Habitat critical	Location within the spill EMBA
Loggerhead turtle (Figure 11.41)	Foraging	James Price Point. Western Joseph Bonaparte Depression.	-	-
Green turtle (Figure 11.42)	Foraging	Field Island (west and east). Joseph Bonaparte Gulf. James Point Price. Montgomery Reef.	Nesting	Garig Gunak Barlu National Park, Waters within the North Kimberley marine park west of Kalumburu, Ashmore reef, Seringapatam reef, Lacepede islands nature reserve.
	Reproduction	Islands north-east of Cobourg Peninsula. Northwest of Melville Island. Lacepede Island. Montebello Islands. Cassini Island. Cartier Island. Ashmore Reef. Scott Reef.		
Leatherback turtle (Figure 11.43)	Reproduction	Cobourg Peninsula.	Nesting	Croker Island and Garig Gunak Barlu National Park
Hawksbill turtle (Figure 11.46)	Foraging	Ashmore Reef. Cartier Island.	Nesting	New Year Island
	Reproduction	Islands north-east of Cobourg Peninsula. Greenhill Island (off Cobourg Peninsula). Ashmore Reef. Scott Reef. Dampier Archipelago (islands to the west of the Burrup Peninsula). Barrow Island. Thevernard Island and south coast. West of Cape Lambert.		
Olive ridley turtle (Figure 11.45)	Foraging	Fog Bay Northern Joseph Bonaparte Gulf Western Joseph Bonaparte Depression Joseph Bonaparte Gulf Western Joseph Bonaparte Gulf - banks	Nesting	Tiwi Islands, Kakadu National Park, west of the Garig Gunak Barlu National Park, Augustus Island and Dampier peninsula
	Reproduction	Islands north-east of Cobourg Peninsula. Greenhill Island (off Cobourg Peninsula). Bathurst Island/Melville Island - North-west.		

Species	BIA	Location within the spill EMBA	Habitat critical	Location within the spill EMBA
		Fog Bay and the Cox Peninsula.		
Flatback turtle (Figure 11.43)	Foraging	Western Joseph Bonaparte Depression James Price Point.	Nesting	Tiwi Islands, Kakadu National Park, Darwin, waters adjacent to Wyndham and Lacepede Islands
	Reproduction	Melville Island, Cobourg Peninsula. Scott Reef. Lacepede Island. Montebello Islands. Cape Domett. Lacepede Island. Eighty Mile Beach. Delambre Island. Legendre Island, Huay Island. Dampier Archipelago (islands to the west of the Burrup Peninsula). Delambre Island Legendre Island, Huay Island.		

Loggerhead turtle (EPBC Act: Endangered, listed migratory)

Loggerhead turtles are described in Section 5.4.6 of Chapter 5.

Loggerhead turtles are known to forage around the pinnacles of the Bonaparte Basin and the carbonate bank and terrace system of the Sahul Shelf KEFs. Two foraging BIAs for the loggerhead turtle overlap with the socio-economic EMBA (see Table 11.8 and Figure 11.41). No habitat critical to the survival of this species overlaps the spill EMBA, with the nearest area being close to the far western extent of the socio-economic EMBA near waters surrounding Exmouth (Figure 11.41).

Habitat critical to the survival of a species is defined in Section 5.4.6 of the EP.

Green turtle (EPBC Act: Vulnerable, listed migratory)

Green turtles are described in Section 5.4.6 of Chapter 5.

Nesting on the Scott Reef-Sandy Islet and Browse Island has been observed all year round with peaks between December and January (DoEE, 2017c). Satellite tracking studies have shown that green turtles migrate between breeding beaches and feeding grounds off the northwest coast (DoE, 2017c). However, during the internesting periods green turtles are known to remain within 10 km of nesting beaches (DoE, 2017c). The foraging, nesting and interesting BIAs and habitat critical to the survival of green turtles that overlap the spill EMBA are presented in Table 11.8.

The AMSIS identifies that the spill EMBA overlaps the foraging BIA for this species (Figure 11.42). As such, green turtles are likely to occur in the spill EMBA. The closest nesting and interesting BIAs are also intersected by the spill EMBA (Table 11.8 and Figure 11.42). The spill EMBA overlaps areas of habitat critical to the survival of the green turtle around Cobourg Peninsula and Croker Island in the NT, the coastal areas of Kalumburu, Ashmore Reef, Scott Reef, Lacepede Islands and reaches the edge of critical habitat in the Montebello Islands Conservation Park (see Figure 11.42). Habitat critical to the survival of green turtles occurs at Ashmore Reef all year (peaking in January-February) and Scott Reef and Browse Island (November to March) (DoEE, 2022).

Leatherback turtle (EPBC Act; Endangered, listed migratory)

Leatherback turtles are described in Section 5.4.6 of Chapter 5.

No major nesting has been recorded in Australia, with isolated nesting recorded in Queensland and the NT (DSEWPC, 2012). Nesting occurs on tropical beaches and subtropical beaches (Marquez 1990), but no major centres of nesting activity have been recorded in Australia. The species is understood to migrate from Australian waters to breed at larger rookeries in neighbouring countries such as Indonesia, Papua New Guinea and Solomon Islands between December and January (DoE, 2008). The closest confirmed inter-nesting site for the leatherback turtle is at Cobourg Peninsula (DCCEEW, 2024b) located in the eastern extent of the spill EMBA (Table 11.8 and Figure 11.43). The spill EMBA overlaps with habitat critical to the survival of the leatherback turtle, within the waters surrounding the Garig Gunak Barlu National Park. Habitat critical is present between December and January (DoEE, 2017). The socio-economic spill EMBA extends into habitat critical to the survival of this species around Croker Island and Garig Gunak Barlu National Park, NT (see Figure 11.43).

Flatback turtle (EPBC Act: Vulnerable, listed migratory)

The flatback turtle (*Natador depressus*) is only found in Australian waters and some nearby waters in Indonesia and Papua New Guinea. It is commonly found in the NWMR and NMR, nesting in northern Australia and foraging in the region.

Breeding occurs all year round; however, in northern Australia most nesting occurs between June and August (DCCEEW, 2024b). Flatback turtle nesting is widespread across the islands and mainland beaches east of Dampier Peninsula in winter, with Cape Domett (within the spill EMBA) reported to support the highest density (Whiting *et al*., 2008). Flatback turtles nest at Cape Domett throughout the year. The Recovery Plan for Marine Turtles in Australia 2017 -2027 (DoEE, 2017c) notes that the peak nesting period at Cape Domett is July to September. The Cape Domett nesting population appears to be one of the largest known nesting populations of this species, with an estimated yearly population in the order of several thousand turtles (Whiting *et al*., 2008).

The 60 km inter-nesting buffer for flatback turtles in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017) is based primarily on the movements of tagged inter-nesting flatback turtles along the Northwest Shelf reported by Whittock et al (2016), which found that flatback turtles may demonstrate inter-nesting displacement distances up to 62 km from nesting beaches. However, these movements were confined to longshore movements in nearshore coastal waters or travel between island rookeries and the adjacent mainland (Whittock *et al*., 2016). There is no evidence to date to indicate flatback turtles swim out into deep offshore waters during the inter-nesting period. Flatback turtle hatchlings do not have an offshore pelagic phase. Instead, hatchlings grow to maturity in shallow coastal waters thought to be close to their natal beaches (DoEE, 2017c). Flatback turtle hatchlings do not undertake oceanic migrations like the juveniles of other turtle species do, but spend their juvenile life phase within continental shelf waters. The spill EMBA intersects an inter-nesting BIA, as illustrated in Figure 11.44 and outlined in Table 11.8.

Adult flatback turtles are primarily carnivorous, feeding on soft-bodied invertebrates. Juveniles eat gastropod molluscs, squid, siphonophores, and limited data indicate that cuttlefish, hydroids, soft corals, crinoids, molluscs and jellyfish are also eaten (DCCEEW, 2024b). The species has been recorded foraging in depths less than 10 m to over 40 m on the carbonate bank and terrace system of the Sahul Shelf KEF and around the pinnacles of the Bonaparte Basin KEF. The spill EMBA intersects a foraging BIA located in the Bonaparte Basin, as illustrated in Figure 11.44 and outlined in Table 11.8.

The AMSIS identifies the area out to 60 km offshore from Cape Domett and Lacrosse Island in the Cambridge Gulf as a inter-nesting BIA for flatback turtles, which is intersected by the spill EMBA. Hence, it is likely that flatback turtles will be present in the spill EMBA. The habitat critical is defined as year-round peaking in July to September (DoEE, 2017). The spill EMBA overlaps habitat critical to the survival of the flatback turtle within the waters surrounding the Tiwi Islands, Kakadu National Park and Darwin (all year-round) as well as waters adjacent to Wyndham and Lacepede Islands (defined as critical from October to March) (see Figure 11.44).

Olive Ridley turtle (EPBC Act: Endangered, listed migratory)

The olive ridley turtle (*Lepidochelys olivacea*) has a worldwide tropical and sub-tropical distribution and is known to occur in both WA and the NT (DoEE 2017c). While nesting has been recorded in WA, it is far more common in the NT (DSEWPC, 2012).

Although olive ridley turtles nest all year round, nesting activity peaks around April to November, with the majority of nesting occurring from the Arnhem Land coast (including Bathurst Island, within the spill EMBA) to the northwest coast of Cape York Peninsula (Qld) (outside of the spill EMBA) (DSEWPC, 2012). After nesting, Olive Ridley turtles are known to migrate up to 1,050 km to various foraging areas (DCCEEW, 2024b), including the pinnacles of the Bonaparte Basin and the carbonate bank and terrace system of the Sahul Shelf KEF (DSEWPC, 2012).

The spill EMBA overlaps with the inter-nesting BIA of the olive ridley turtle located between Fog Bay and the Cox Peninsula (NT) (see Table 11.8 and Figure 11.45).

The olive ridley turtle is known to primarily forage in soft-bottom habitats ranging in depths from 6 – 35 m, though they are also known to forage in pelagic waters (DEWHA 2008b). Adult turtles forage for crabs, shrimp, tunicates, jellyfish, salps and algae in depths ranging from several metres to over 100 m (DCCEEW, 2024b). The AMSIS identifies that EMBA overlaps with the foraging BIA for this species as outlined in Table 11.8 and Figure 11.45. The spill EMBA overlaps habitat critical to the survival of olive ridley turtle, within waters surrounding the Tiwi Islands and Kakadu National Park, and the west of the Garig Gunak Barlu National Park as well as waters surrounding Augustus Island and Dampier peninsula. Habitat critical is present year-round (DoEE, 2017). The spill EMBA overlaps the entirety of the waters surrounding Garig Gunak Barlu National Park in the NT, as well as Croker Island and multiple islands to the east and southeast of Croker Island (see Figure 11.45).

Hawksbill turtle (EPBC Act: Vulnerable, listed migratory)

Hawksbill turtles (*Eretmochelys imbricate*) are found in tropical, sub-tropical and temperate waters in all the oceans of the world (DoEE, 2017c). The hawksbill turtle is commonly found in the NWMR and NMR, nesting extensively along the coasts and foraging in the region.

As a juvenile, the hawksbill turtle feeds on plankton in the open ocean and then feeds on sponges, hydroids, cephalopods, gastropods, jellyfish, seagrass and algae as an adult (DCCEEW, 2024b). The species is also highly migratory, moving up to 2,400 km between foraging and breeding areas (DSEWPC, 2012). Due to genetic variability, Australia's population is considered to comprise of two distinct stocks; one in WA and the other in the northeast of Australia (DSEWPC, 2012). These distinct populations are also known to have significantly different breeding seasons.

Hawksbill turtles forage in waters ranging from 1.5 m to 84 m deep, and Fossette et al (2021) report that 17% of satellite tagged turtles (total n=42) foraged in waters greater than 20 m. Fossette et al (2021) reported less than a quarter of foraging area overlapped with designated foraging BIAs for hawksbill turtles (within the spill EMBA) and/or Commonwealth and State-managed protected areas.

The northeast sub-population breeds throughout the year with a peak nesting period during July to October (DSEWPC, 2012), while in the WA population breeding peaks around October to January.

The spill EMBA overlaps with foraging, nesting and inter-nesting BIAs for this species (see Table 11.8 and Figure 11.46. The ecological spill EMBA does not overlap with any habitat critical to the survival of the hawksbill turtle. The socio-economic EMBA overlaps habitat critical to the survival of this species on New Year Island, NT and approaches the edge of the Montebello Islands Conservation Park (see Figure 11.46).

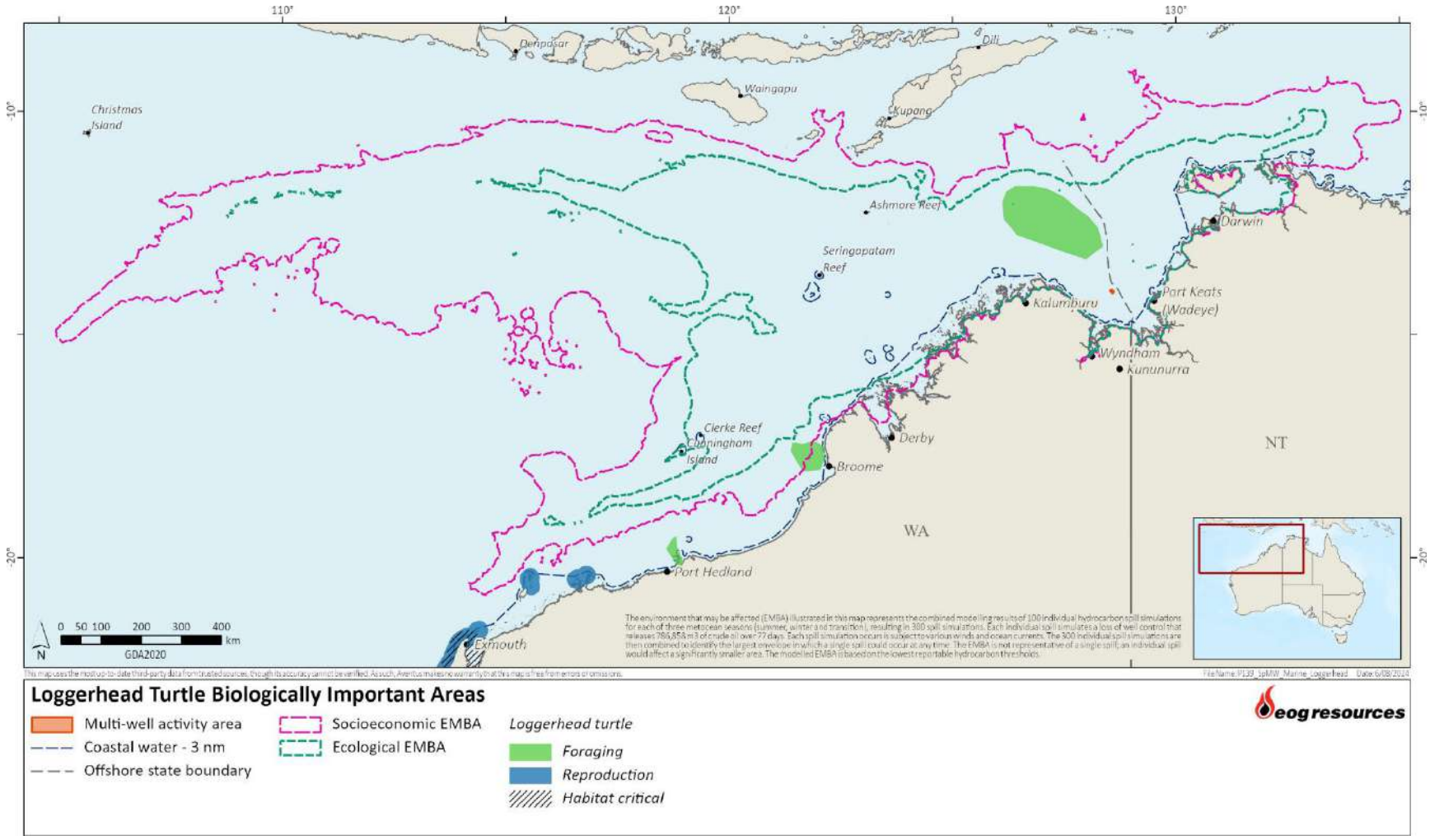


Figure 11.41 Loggerhead turtle BIAs and habitat critical in the spill EMBA

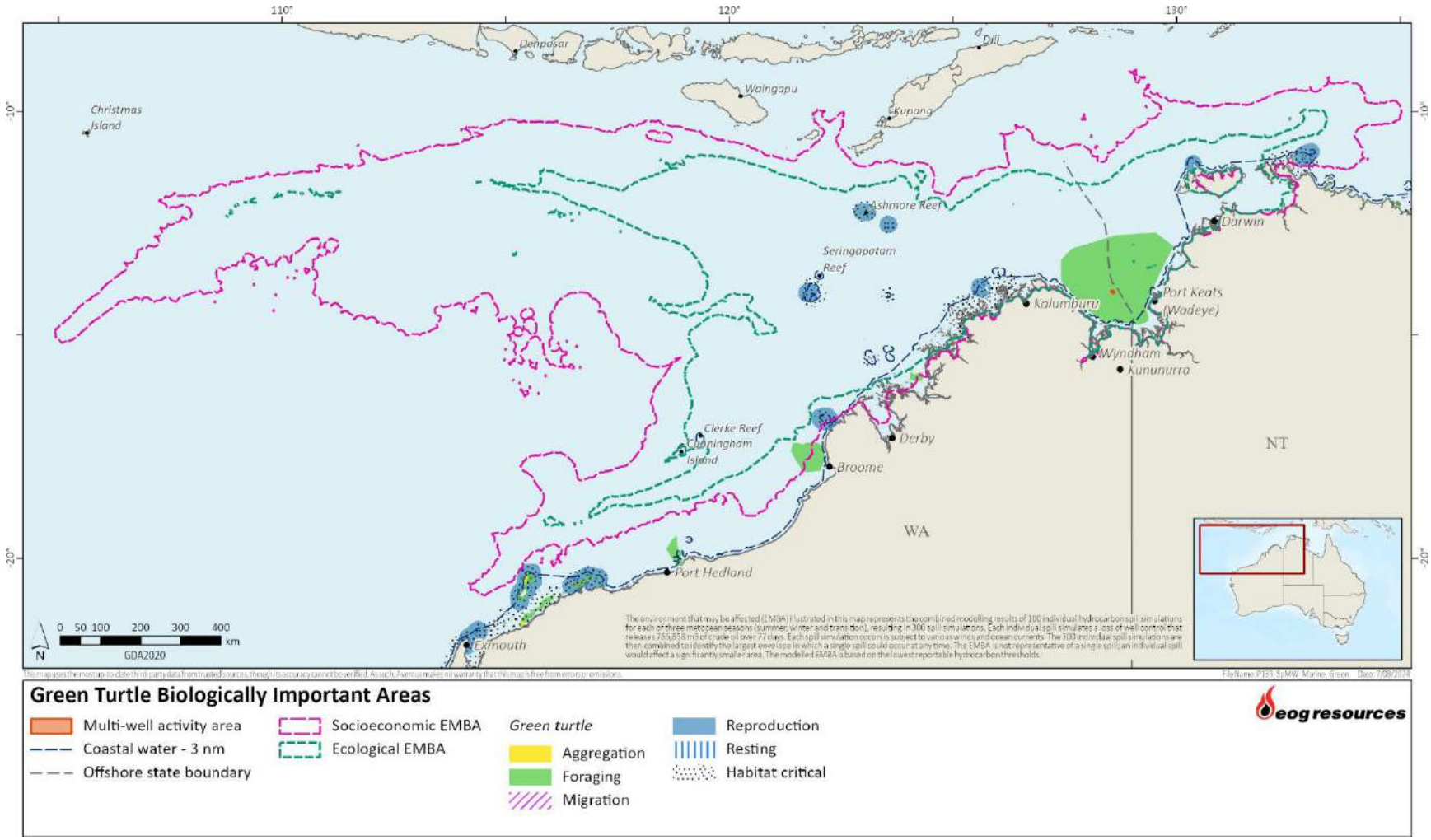


Figure 11.42 Green turtle BIAs and habitat critical in the spill EMBA

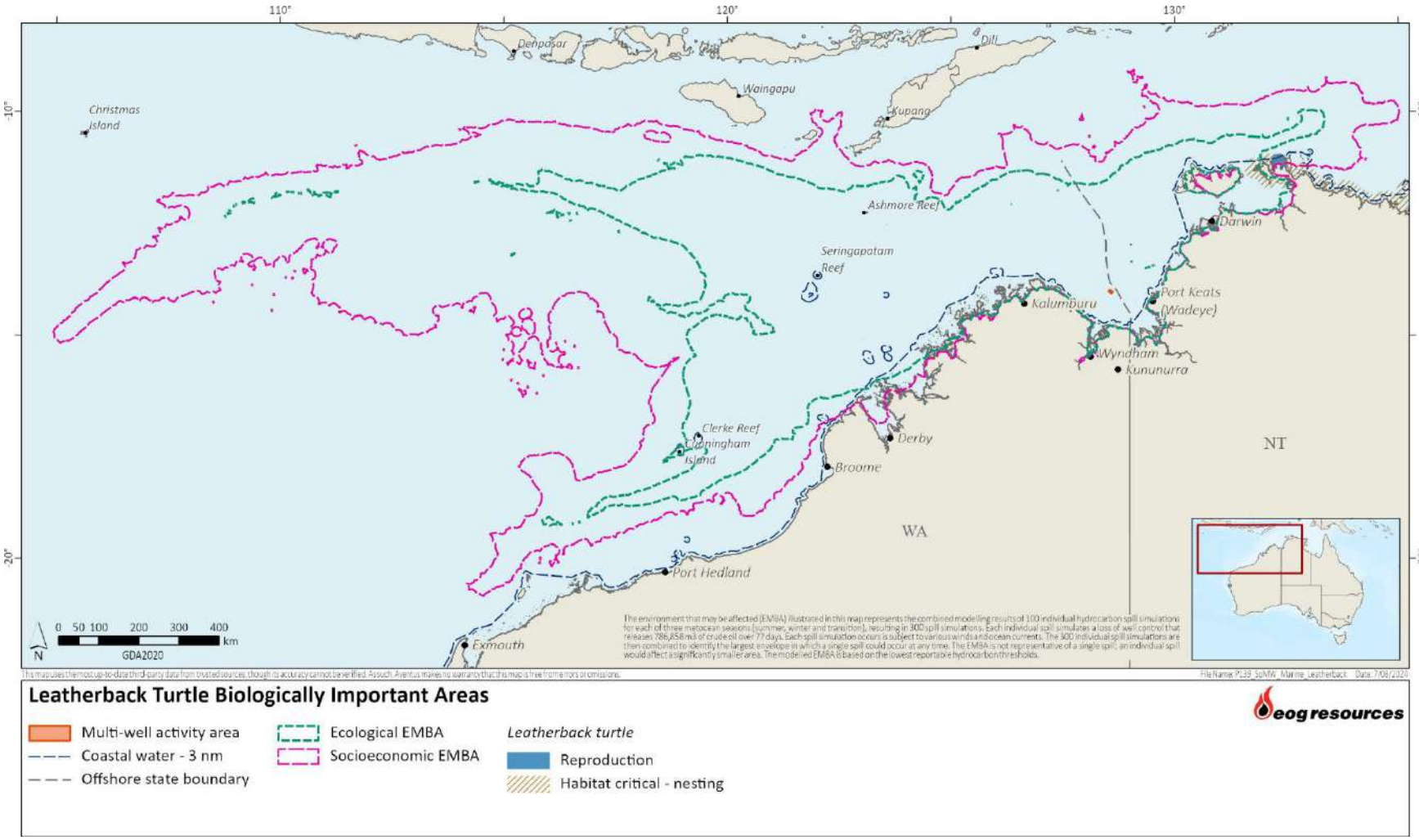


Figure 11.43 Leatherback turtle BIAs and habitat critical in the spill EMBA

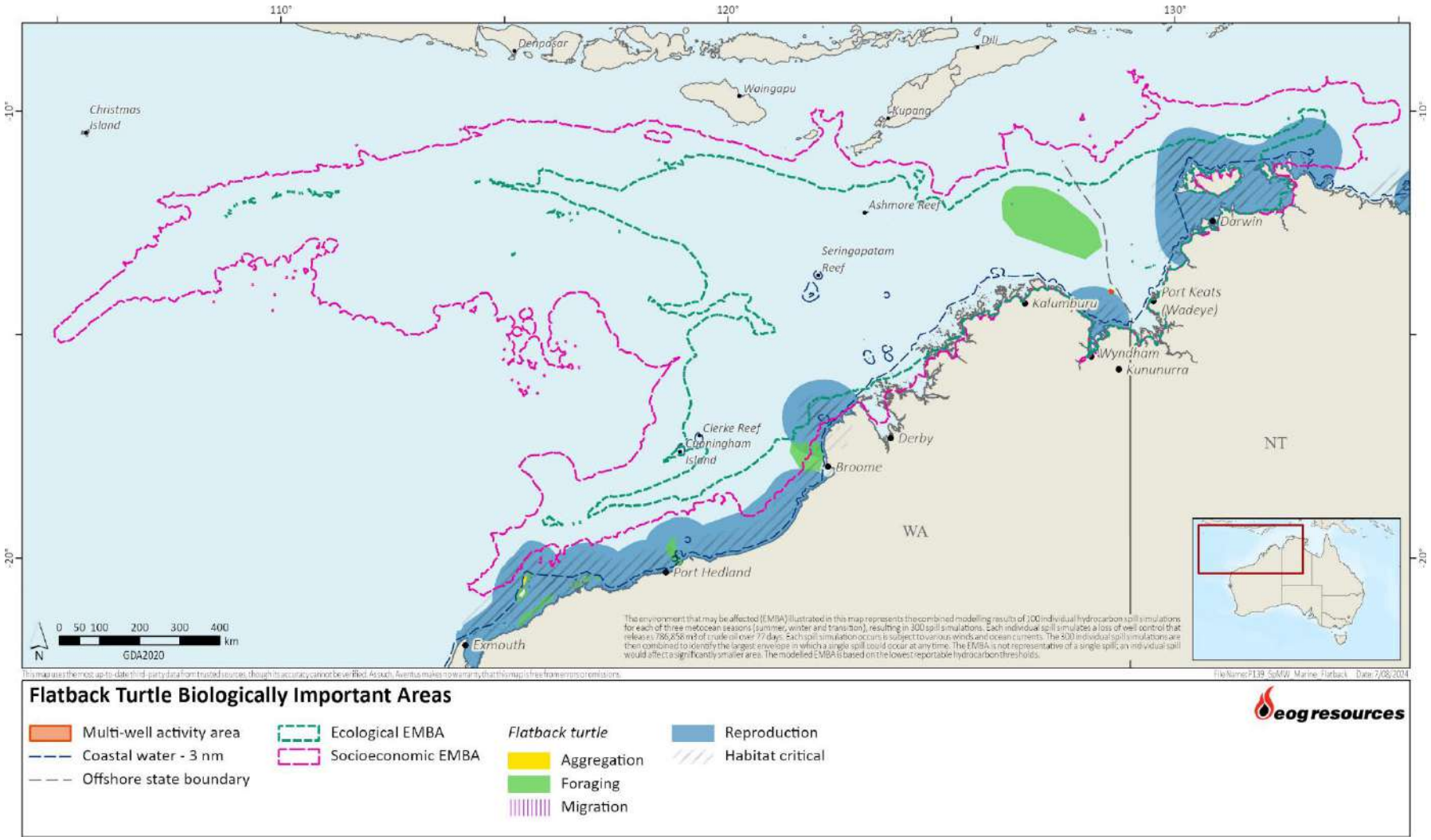


Figure 11.44 Flatback turtle BIAs and habitat critical in the spill EMBA

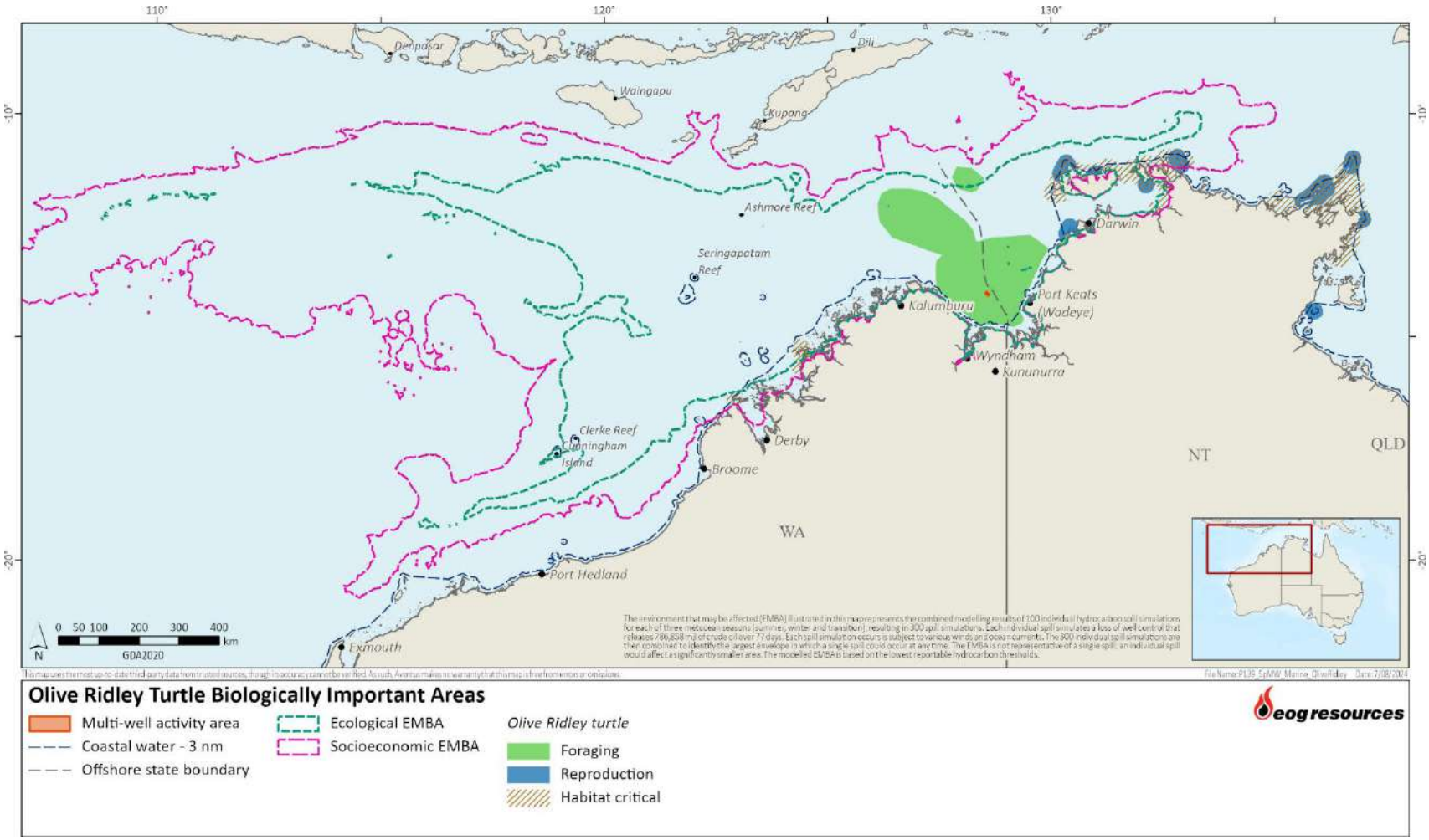


Figure 11.45 Olive Ridley turtle BIAs and habitat critical in the spill EMBA

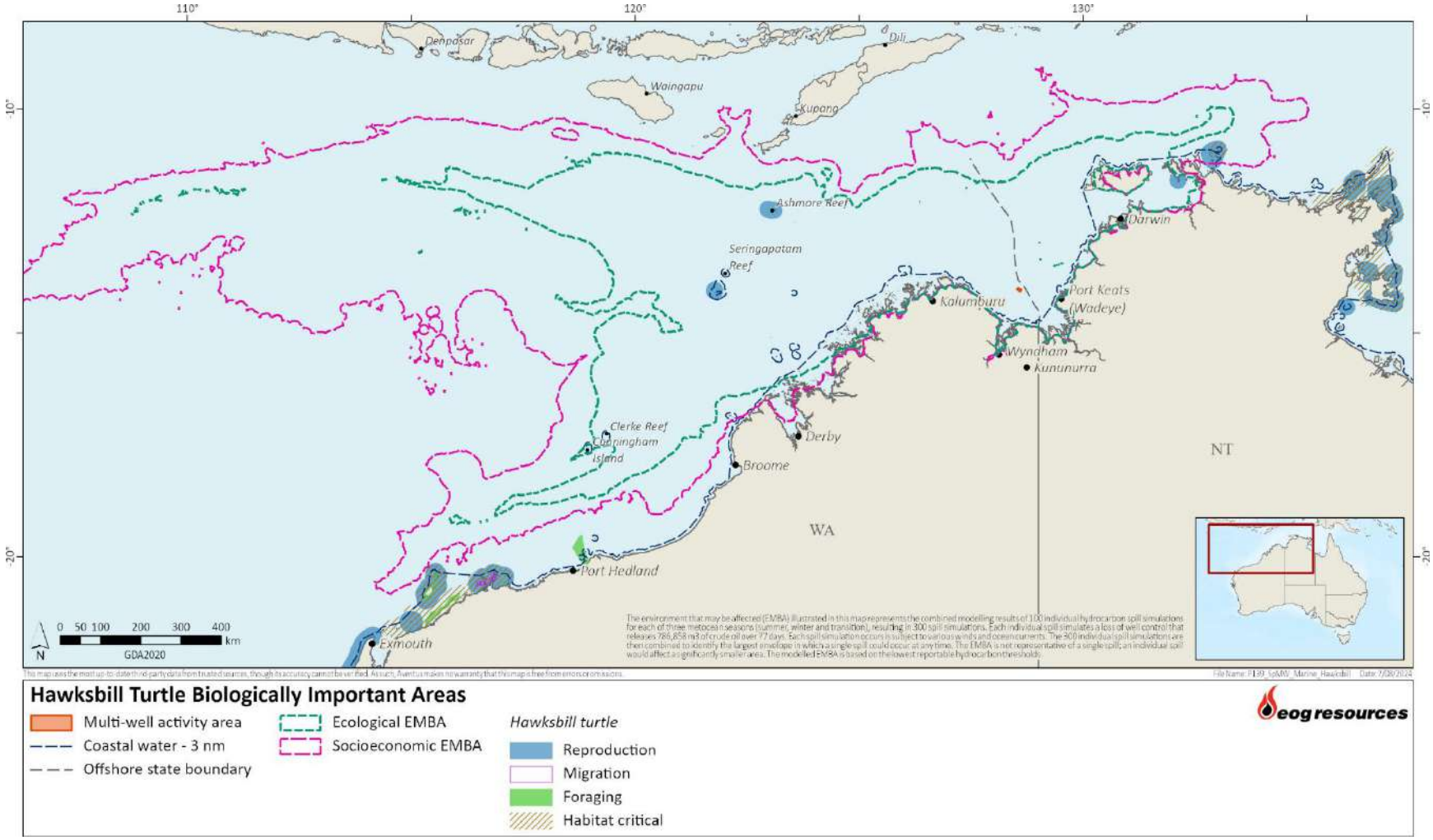


Figure 11.46 Hawksbill turtle BIAs and habitat critical in the spill EMBA

Short-nosed seasnake (EPBC Act: Critically Endangered)

The short-nosed seasnake (*Aipysurus apraefrontalis*) is endemic to WA and occurs throughout the Northwest Shelf and eastern Indian Ocean. This fully aquatic species can grow up to 90 cm in length and prefers shallow coastal reef habitats.

Given the shallow water distribution of the species it is unlikely the species will occur within the activity area, however the species and species habitat may occur in the spill EMBA. Cartier Island and Ashmore Reef are internationally significant sites for their abundance and diversity of seasnakes, both of which are located outside the spill EMBA.

Leaf-scaled seasnake (EPBC Act: Critically Endangered)

The only known populations of the leaf-scaled seasnake (*Aipysurus foliosquama*) species inhabit the shallow reef habitats of the Sahul Shelf and Ashmore Reef (Minton and Heatwole, 1975), which are both located outside the activity area and EMBA.

Given the shallow water distribution, it is unlikely the species will occur within the activity area, but the species and species habitat is known to occur in the spill EMBA.

Saltwater crocodile (EPBC Act: Listed migratory)

The saltwater crocodile (*Crocodylus porosus*) is distributed from King Sound, WA throughout coastal NT to Rockhampton in Queensland, where it can be found in coastal waters, estuaries, lakes, inland swamps and marshes up to 150 km inland from the coast (DCCEEW, 2024b).

Preferred nesting habitat of the saltwater crocodile includes elevated, isolated freshwater swamps that do not experience the influence of tidal movements. Floating rafts of vegetation also provide important nesting habitat. In the NT, most nest sites are found on the north-west banks of rivers (DCCEEW, 2024b). The species nest during the wet season with peak nesting during January and February. Whilst sightings of saltwater crocodiles far out to sea have been recorded, it is more likely to be encountered in the coastal areas of the socio-economic EMBA than in the activity area.

Arafura snake-eyed skink (EPBC Act: Endangered)

The Arafura snake-eyed skink (*Cryptoblepharus gurrmul*) is a small, slender, relatively long-limbed, shallow-headed species of snake-eyed skink. The Arafura snake-eyed skink is endemic to the NT, where it is found only on three islands: North Goulburn Island (36 km^2), and two small (about 2 km^2) islands, New Year Island and Oxley Island, north-east of Croker Island (DEPWS, 2021b). Some individuals, when trapped on rocks, surrounded by water, will escape by swimming rapidly to a nearby rock or shore.

The Arafura snake-eyed skink is an agile and fast-moving terrestrial species, and are found in littoral habitats, including beach sands, rocks and coral rubble, on the three islands (DEPWS, 2021b). They forage amongst rocks in the intertidal zone, and retreat to fringing vegetation when confronted by an incoming tide. They feed on both terrestrial and small marine invertebrates, such as amphipods and polychaete worms (DEPWS, 2021b).

Threats to the Arafura Snake-eyed Skink are poorly understood due to insufficient information on the ecology of the species. Nonetheless, its highly restricted distribution presents a substantial risk. The coastline habitat of these islands may be exposed to periodic storm surges associated with cyclones and will be reduced in size with any rise in sea level: the highest points on Oxley and New Year Islands are about 12 m above sea level, but most of each island is <5 m above sea level (DEPWS, 2021b). The socio-economic EMBA intersects with the littoral zones of the three islands where the Arafura snake-eyed skink lives and forages.

Northern blue-tongued skink (EPBC Act: Endangered)

The northern blue-tongued skink (*Tiliqua scincoides intermedia*) became threatened in December 2023. The northern blue-tongue skink is a large, robust, short-limbed lizard that can reach up to 37 cm. the species is widely distributed in northern parts of Australia ranging from Eighty Mile Beach in WA to the Cloncurry area in western Queensland. The northern blue-tongue skink occurs in a wide variety of ecosystems from dissected sandstone plateaus and gorges, limestone ranges, granite, basalt and dolerite hills, glacial shale undulations, sand plains, sandy waterways, swamps, cracking clay floodplains and coastal flats. The species feeds on diverse diet of plants, insects, and other invertebrates (DCCEEW, 2023d).

Considering the northern blue-tongued skink is terrestrial, it is unlikely thy will be encountered within the spill EMBA, however, suitable habitat such as floodplains and coastal flats will be intercepted by the spill EMBA.

Water monitors (EPBC Act: Endangered and Critically Endangered)

Two species of water monitors were detected by the PMST, the Mertens' water monitor (*Varanus mertensi*) and the Mitchell's water monitor (*Varanus mitchelli*). Both species became threatened in December 2023 as Endangered and Critically Endangered respectively. The Mertens' water monitor is relatively large, robust lizard reaching up to 1.5 m in length (DCCEEW, 2023f), on the contrary the Mitchell's water monitor is a mere 70 cm length (DCCEEW, 2023e). Both species have a patchy distribution across tropical northern Australia, from the west Kimberley across the Top End of the Northern Territory. The Mertens' water monitors distribution extends further into QLD. Both species of water monitors feed on freshwater crabs, fish, insects, amphipods, insects and frogs (DCCEEW. 2023e, 2023f).

Mertens' water monitor is a highly aquatic lizard that rarely ventures more than 5–10 m from the edge of (fresh) water sources. Suitable habitat includes perennial and semi-permanent pools in upper catchment areas, including springs, seeps, swamps, creeks and gorges, the margins of permanent streams, rivers and lakes in lower catchment areas, gloodplain billabongs, lagoons, swamps and soaks, perennial waterholes in woodlands, and man-made irrigation channels and the margins of dams (DCCEEW, 2023f). The Mitchell's water monitor inhabits freshwater and saline wetlands that range from seasonal gorges in upper catchments to large rivers and coastal floodplains. It is recorded from rivers, creeks, riffle zones, gorges, springs, lagoons, swamps, mangroves, and foreshores (DCCEEW, 2023e).

Due to habitat preferences, it is unlikely that the Mertens' water monitor will be encountered in the spill EMBA. However, the Mitchell's water monitor may be present.

Plains death adder (EPBC Act: Vulnerable)

The plains death adder (*Acanthophis hawkei)* is a relatively short (70 cm long on average) stout snake with a triangular head and narrow neck. They have a disconnected and poorly defined distribution in the NT and western Queensland (DEPWS, 2021a). In NT, the species occurs on cracking soil floodplains of the Adelaide, Mary and Alligator Rivers. It is more widely distributed on the cracking black soils of the Barkly Tableland on the NT/QLD border and the Mitchell Grass Downs of western QLD. The plains death adder is highly venomous and feeds on frogs, reptiles, rodents and other small to medium sized mammals (DEPWS, 2021a).

The primary threat to the plains death adder is the advance of cane toads in the NT. Death adders are naive to toads and their toxins, but because of their specialised ambush foraging tactics they successfully attract and catch toads. As a consequence, plains death adders die in large numbers when toads arrive in an area (DEPWS, 2021a). Due to the habitat preferences of the plains death adder being

cracked floodplain soils, it may occur within coastal areas of the spill EMBA where they intersect with floodplains that connect to the ocean.

11.3.7 Avifauna

There are 84 bird species (32 seabirds and 52 shorebirds) listed under the EPBC Act with potential to occur in the spill EMBA (DCCEEW, 2024a).

The majority of these are listed as migratory and marine species, with four listed as critically endangered, 12 as endangered and 11 as vulnerable. The PMST results also includes terrestrial species of birds that are protected under the EPBC Act. Any terrestrial bird species detected by the PMST search that do not occur or migrate through coastal areas are not presented in Table 11.9 or discussed further. The bird species listed as both threatened and are marine or coastal, (Table 11.9) or with a BIA intersected by the spill EMBA (see Table 11.10) are described in this section.

Figure 5.25 in Section 5.4.7 of Chapter 5 illustrates the likely temporal presence and absence and ecological stages of these bird species in the activity area and EMBA.

Many of the birds listed in Table 11.9 are listed in the following international conventions that aim to protect the birds themselves and their habitat:

- Republic of Korea Migratory Birds Agreement 2006 (ROKAMBA);
- Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment 1986 (CAMBA);
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979;
- Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment 1974 (JAMBA); and
- Convention on Wetlands of International Important especially as Waterfowl Habitat 1971 ('Ramsar Convention', see also Section 11.4.5).

Table 11.9 EPBC Act-listed bird species that may occur in the spill EMBA

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Seabirds								
Anous stolidus	Common noddy	-	Yes	Yes	Yes	Yes	No	-
Anous tenuirostris melanops	Australian lesser noddy	V	-	Yes	Yes	Yes	No	CA
Anous minutus	Black noddy	-	-	Yes	Yes	Yes	No	No
Anseranas semipalmata	Magpie goose	-	-	Yes	Yes	Yes	No	No
Ardenna pacifica	Wedge-tailed shearwater	-	Yes	Yes	Yes	Yes	Yes	-
Bubulcus ibis	Cattle egret	-	-	Yes	Yes	Yes	No	-
Calonectris leucomelas	Streaked shearwater	-	Yes	Yes	Yes	Yes	No	-
Chalcites osculans	Black-eared cuckoo	-	-	Yes	Yes	Yes	No	No
Fregata andrewsi	Christmas Island Frigatebird	E	Yes	Yes	-	Yes	No	CA, RP
Fregata ariel	Lesser frigatebird	-	Yes	Yes	Yes	Yes	Yes	-
Fregata minor	Greater frigatebird	-	Yes	Yes	Yes	Yes	Yes	-
Haliaeetus leucogaster	White-bellied sea-eagle	-	-	Yes	Yes	Yes	No	-
Hydroprogne caspia	Caspian tern	-	Yes	Yes	Yes	Yes	No	-
Macronectes giganteus	Southern giant petrel	E	Yes	Yes	-	Yes	No	RP

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Onychoprion anaethetus	Bridled tern	-	Yes	Yes	Yes	Yes	No	-
Pandion haliaetus	Osprey	-	Yes	Yes	Yes	Yes	No	-
Papasula abbotti	Abbott's booby	E	-	Yes	Yes	Yes	No	CA
Phaethon lepturus	White-tailed tropicbird	-	Yes	Yes	Yes	Yes	Yes	-
Phaethon lepturus fulvus	Christmas Island white-tailed tropicbird	E	-	Yes	Yes	Yes	No	-
Phaethon rubricauda	Red-tailed tropicbird	E	Yes	Yes	Yes	Yes	No	-
Sterna bengalensis	Lesser crested tern	-	-	Yes	Yes	Yes	Yes	-
Sterna bergii	Crested tern	-	Yes	Yes	Yes	Yes	Yes	-
Sterna caspia	Caspian tern	-	Yes	Yes	Yes	Yes	No	-
Sterna dougallii	Roseate tern	-	Yes	Yes	Yes	Yes	Yes	-
Sterna fuscata	Sooty tern	-	-	Yes	Yes	Yes	No	-
Sterna nereis	Fairy tern	-	-	Yes	Yes	-	No	-
Sternula nereis nereis	Australian fairy Tern	V	-	-	-	Yes	No	CA, RP
Sternula albifrons	Little tern	-	Yes	Yes	Yes	-	Yes	-
Sula dactylatra	Masked booby	-	Yes	Yes	Yes	Yes	No	-
Sula leucogaster	Brown booby	-	Yes	Yes	Yes	Yes	Yes	-
Sula sula	Red-footed booby	-	Yes	Yes	Yes	Yes	Yes	-

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Thalassarche carteri	Indian yellow-nosed albatross	V	Yes	Yes	-	Yes	No	RP
Shorebirds								
Acrocephalus orientalis	Oriental reed-warbler	-	Yes	Yes	Yes	Yes	No	-
Actitis hypoleucos	Common sandpiper	-	Yes	Yes	Yes	Yes	No	-
Apus pacificus	Fork-tailed swift	-	Yes	Yes	Yes	Yes	No	-
Arenaria interpres	Ruddy turnstone	V	Yes	Yes	Yes	Yes	No	-
Calidris acuminata	Sharp-tailed sandpiper	V	Yes	Yes	Yes	Yes	No	-
Calidris alba	Sanderling	-	Yes	Yes	Yes	Yes	No	-
Calidris canutus	Red knot	E	Yes	Yes	Yes	Yes	No	CA
Calidris ferruginea	Curlew sandpiper	CE	Yes	Yes	Yes	Yes	No	CA
Calidris melanotos	Pectoral sandpiper	-	Yes	Yes	Yes	Yes	No	-
Calidris ruficollis	Red-necked stint	-	Yes	Yes	Yes	Yes	No	-
Calidris subminuta	Long-toed stint	-	Yes	Yes	Yes	Yes	No	-
Calidris tenuirostris	Great knot	CE	Yes	Yes	Yes	Yes	No	CA
Cecropis daurica	Red-rumped swallow	-	Yes	Yes	Yes	Yes	No	-
Charadrius dubius	Little ringed plover	-	Yes	Yes	Yes	Yes	No	-

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Charadrius leschenaultia	Greater sand plover	V	Yes	Yes	Yes	Yes	No	CA
Charadrius mongolus	Lesser sand plover	E	Yes	Yes	Yes	Yes	No	CA
Charadrius ruficapillus	Red-capped Plover	-	-	Yes	Yes	Yes	No	-
Charadrius veredus	Oriental plover	-	Yes	Yes	Yes	Yes	No	-
Epthianura crocea tunneyi	Alligator Rivers Yellow Chat	E	-	-	Yes	Yes	No	CA
Erythrotriorchis radiatus	Red Goshawk	V	-	-	Yes	Yes	No	CA
Gallinago megala	Swinhoe's snipe	-	Yes	Yes	Yes	Yes	No	-
Gallinago stenura	Pin-tailed snipe	-	Yes	Yes	Yes	Yes	No	-
Glareola maldivarum	Oriental pratincole	-	Yes	Yes	Yes	Yes	No	-
Himantopus himantopus	Pied Stilt	-	-	Yes	Yes	Yes	No	-
Hirundo rustica	Barn swallow	-	Yes	Yes	Yes	Yes	No	-
Limicola falcinellus	Broad-billed Sandpiper	-	Yes	Yes	Yes	Yes	No	-
Larus novaehollandiae	Silver gull	-	-	Yes	Yes	Yes	No	-
Limnodromus semipalmatus	Asian dowitcher	V	Yes	Yes	Yes	Yes	No	-

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Limosa lapponica	Bar-tailed godwit	-	Yes	Yes	Yes	Yes	No	-
Limosa lapponica baueri	Nunivak bar-tailed godwit	V	-	-	Yes	Yes	No	CA
Limosa lapponica menzbieri	Northern Siberian bar-tailed godwit	CE	-	-	Yes	Yes	No	CA
Limosa limosa	Black-tailed godwit	E	Yes	Yes	Yes	Yes	No	-
Merops ornatus	Rainbow bee-eater	-	-	Yes	Yes	Yes	No	No
Motacilla cinerea	Grey wagtail	-	Yes	Yes	Yes	Yes	No	-
Motacilla flava	Yellow wagtail	-	Yes	Yes	Yes	Yes	No	-
Numenius madagascariensis	Eastern curlew	CE	Yes	Yes	Yes	Yes	No	CA
Numenius minutus	Little curlew	-	Yes	Yes	Yes	Yes	No	-
Numenius phaeopus	Whimbrel	-	Yes	Yes	Yes	Yes	No	-
Pluvialis fulva	Pacific golden plover	-	Yes	Yes	Yes	Yes	No	-
Pluvialis squatarola	Grey plover	V	Yes	Yes	Yes	Yes	No	-
Rhipidura rufifrons	Rufous fantail	-	Yes	Yes	Yes	Yes	No	-
Rostratula australis	Australian painted snipe	E	-	Yes	Yes	Yes	No	CA

Scientific name	Common name	EPBC Act Status			Presence		BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Ecological EMBA	Socio-economic EMBA		
Rostratula benghalensis (sensu lato)	Painted snipe	E	-	Yes	Yes	Yes	No	CA
Stiltia isabella	Australian Pratincole	-	-	Yes	Yes	Yes	No	-
Thalasseus bergii	Greater crested tern	-	Yes	Yes	Yes	Yes	No	-
Tringa brevipes	Grey-tailed tattler	-	Yes	Yes	Yes	Yes	No	-
Tringa glareola	Wood sandpiper	-	Yes	Yes	Yes	Yes	No	-
Tringa incana	Wandering tattler	-	Yes	Yes	Yes	Yes	No	-
Tringa nebularia	Common greenshank	E	Yes	Yes	Yes	Yes	No	-
Tringa stagnatilis	Marsh sandpiper	-	Yes	Yes	Yes	Yes	No	-
Tringa totanus	Common redshank	-	Yes	Yes	Yes	Yes	No	-
Xenus cinereus	Terek sandpiper	V	Yes	Yes	Yes	Yes	No	-

Table 11.10 BIAs of bird species within the spill EMBA

Species	BIA	Location within the spill EMBA
Wedge-tailed shearwater (Figure 11.47)	Reproduction	Kimberley coastline and islands including Ashmore Reef.
Lesser frigatebird (Figure 11.50)	Reproduction	Kimberley coastline and islands including Ashmore Reef.
Greater frigatebird (Figure 11.51)	Reproduction	Kimberley and Ashmore Reef.
White-tailed tropicbird (Figure 11.57)	Reproduction	Kimberley coastline and islands including Ashmore Reef.
Roseate tern (Figure 11.48)	Reproduction	Kimberley coastline and islands including Ashmore Reef.
Little tern (Figure 11.49)	Reproduction and resting	Kimberley coastline and islands including Ashmore Reef.
Crested tern (Figure 11.53)	Reproduction	No. 2 Sandy Island (Cobourg Peninsula). Seagull Island, off NW of Cape Van Diemen, Melville Island
Lesser crested tern (Figure 11.52)	Reproduction	Kimberley coastline and islands including Ashmore Reef.
Bridled tern (Figure 11.54)	Reproduction	No. 2 Sandy Island (Cobourg Peninsula).
Brown booby (Figure 11.55)	Reproduction	Kimberley and northern Pilbara coasts and islands also Ashmore Reef.
Red-footed booby (Figure 11.56)	Reproduction	Northwest Kimberley and Ashmore reef.

Seabirds

Wedge-tailed shearwater (EPBC Act: Listed Migratory)

The wedge-tailed shearwater (*Ardenna pacifica*) is a medium-sized seabird and inhabits oceanic waters off WA except when roosting in colonies. Foraging at sea, the species feeds mostly on fish, cephalopods, insects, jellyfish and prawns. Ashmore Reef has been identified as an important area for this species (DEWHA, 2008b).

According to AMSIS and as shown in Figure 11.47, the spill EMBA overlaps with the species reproduction BIA located at Ashmore Reef and in waters between Exmouth and Port Headland. It is likely that the species will be present in the spill EMBA (see Table 11.10 and Figure 11.47).

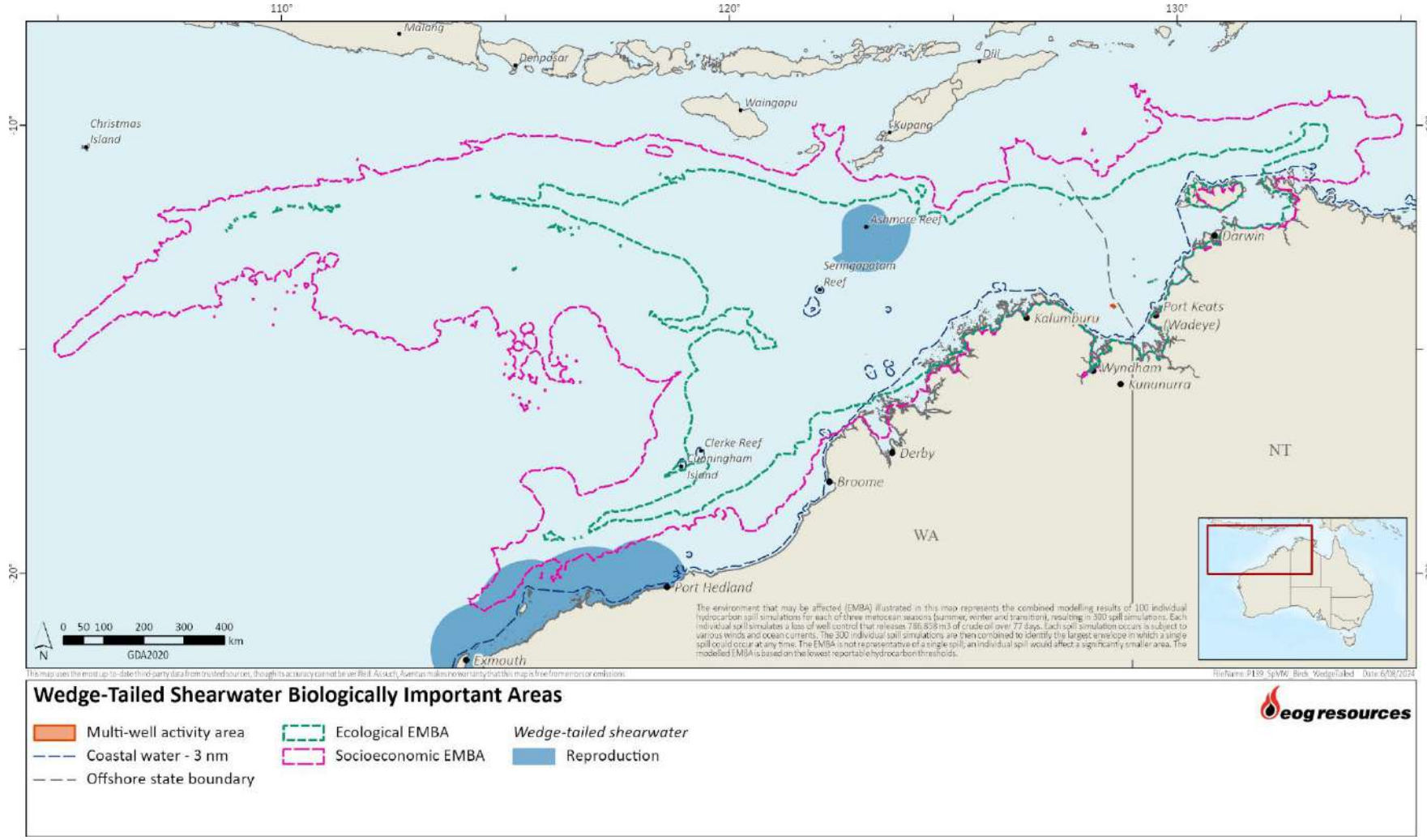


Figure 11.47 Wedge-tailed shearwater BIAs in the spill EMBA

Christmas Island Frigatebird (EPBC Act: Endangered, Listed Migratory)

The Christmas Island frigatebird (*Fregata andrewsi*) is a very large seabird that primarily forages in the ocean for food, scooping marine organisms such as fish and squid (DCCEEW, 2024a). Christmas Island is the only place in the world where the Christmas Island frigatebird breeds and nests in the forest canopy (DCCEEW, 2024a).

Given the distance to breeding and nesting sites, it is unlikely that this species will be present in the activity or spill EMBA.

Southern giant petrel (EPBC Act: Endangered, Listed Migratory)

The southern giant petrel (*Macronectes giganteus*) is the largest of the petrels. They are a highly migratory bird and widespread throughout the Southern Ocean (DCCEEW, 2024a). This species occurs from Antarctic to subtropical waters and breeds on the Antarctic continent, peninsular and islands and on subantarctic islands and South America. Breeding occurs annually between August and March (DCCEEW, 2024a).

All waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is considered to be those waters south of 25 degrees where most species spend the majority of their foraging time. The southern giant petrel is an opportunistic scavenger and predator that scavenge on penguin carcasses and feed on seals and carrions. It also eats a wide variety of seabirds, penguin chicks, crustacean, kelp, fish, jellyfish and rabbits.

Given there are no breeding BIA for this species in the activity area and their preference to forage in southern waters off Australia, it is highly unlikely that the southern giant petrel will be present in the spill EMBA.

Roseate tern (EPBC Act: Listed Migratory)

The roseate tern (*Sterna dougallii*) occurs throughout various coastal habitats including beaches, reefs and sandy/coral islands. It is a specialist forager for small pelagic fish (DCCEEW, 2024b). The terns prefer nesting sites adjacent to clear shallow hunting areas. Nests are generally a bare scrape in sand, shingle or coral rubble. The species breeds in large mixed-species colonies from April to June, with breeding populations located around Ashmore Reef, Cartier Island and Scott Reef (located in the spill EMBA) (DEWHA, 2008b). Little information is available about migratory movements or timing through the northwest of Australia.

A reproduction BIA for the species is intersected by the spill EMBA at coastal islands off the north Kimberley coast (Table 11.10 and Figure 11.48). Foraging, feeding or related behaviours are likely to occur within the offshore and coastal areas of the spill EMBA (Table 11.10).

Little tern (EPBC Act: Listed Migratory)

The little tern (*Sternula albifrons*) is a small and slender tern that is found throughout the coast from Broome extending to the NT. Breeding sites are widely distributed across the northwest of WA, with breeding occurring in late April-July and September to early January. There is a lack of information about their migration however recorded numbers of the species are lowest in the dry season. The spill EMBA overlaps reproduction and resting BIAs for this species along the Kimberley coast and islands including Ashmore Reef (see Table 11.10 and Figure 11.49).

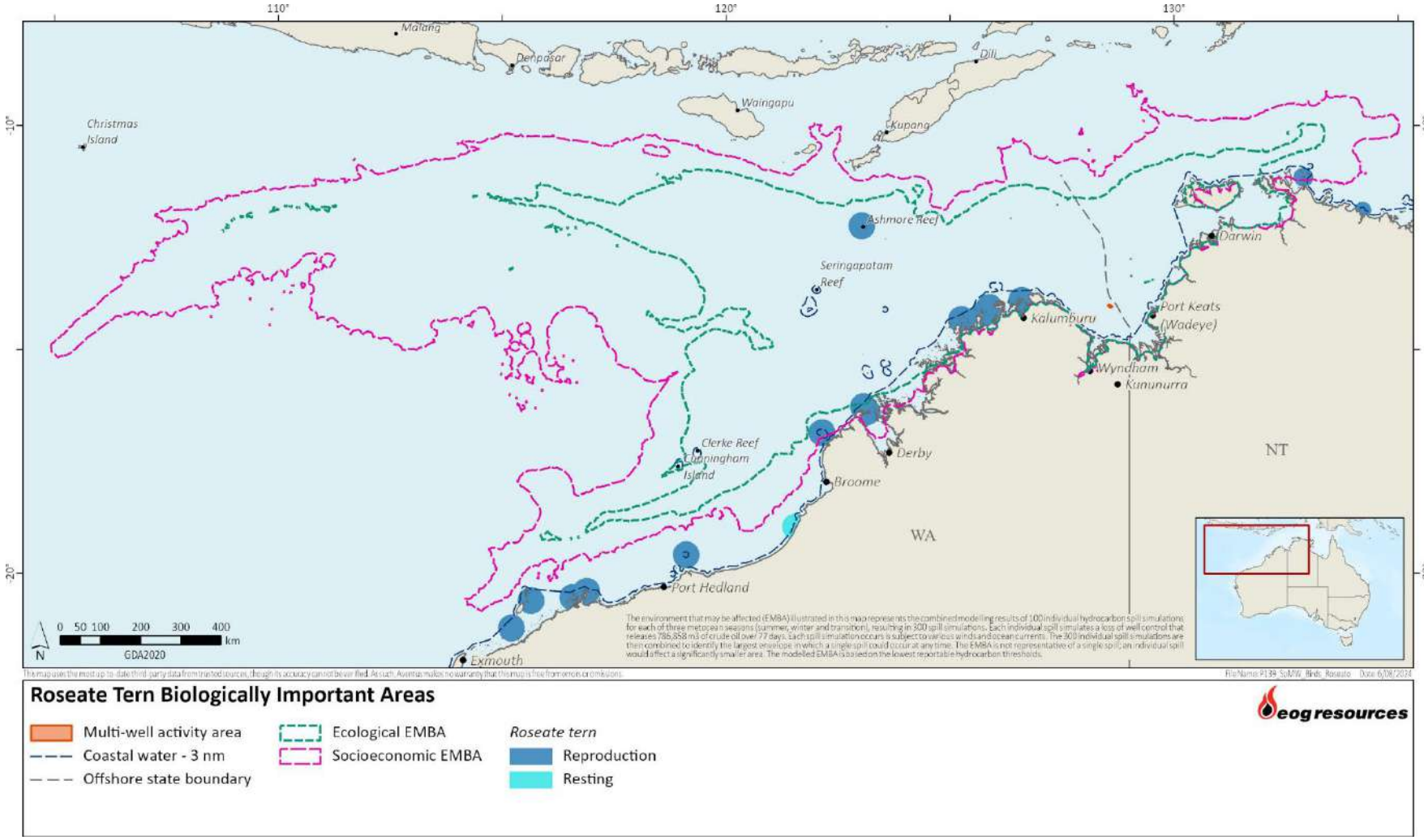


Figure 11.48 Roseate tern BIAs in the spill EMBA

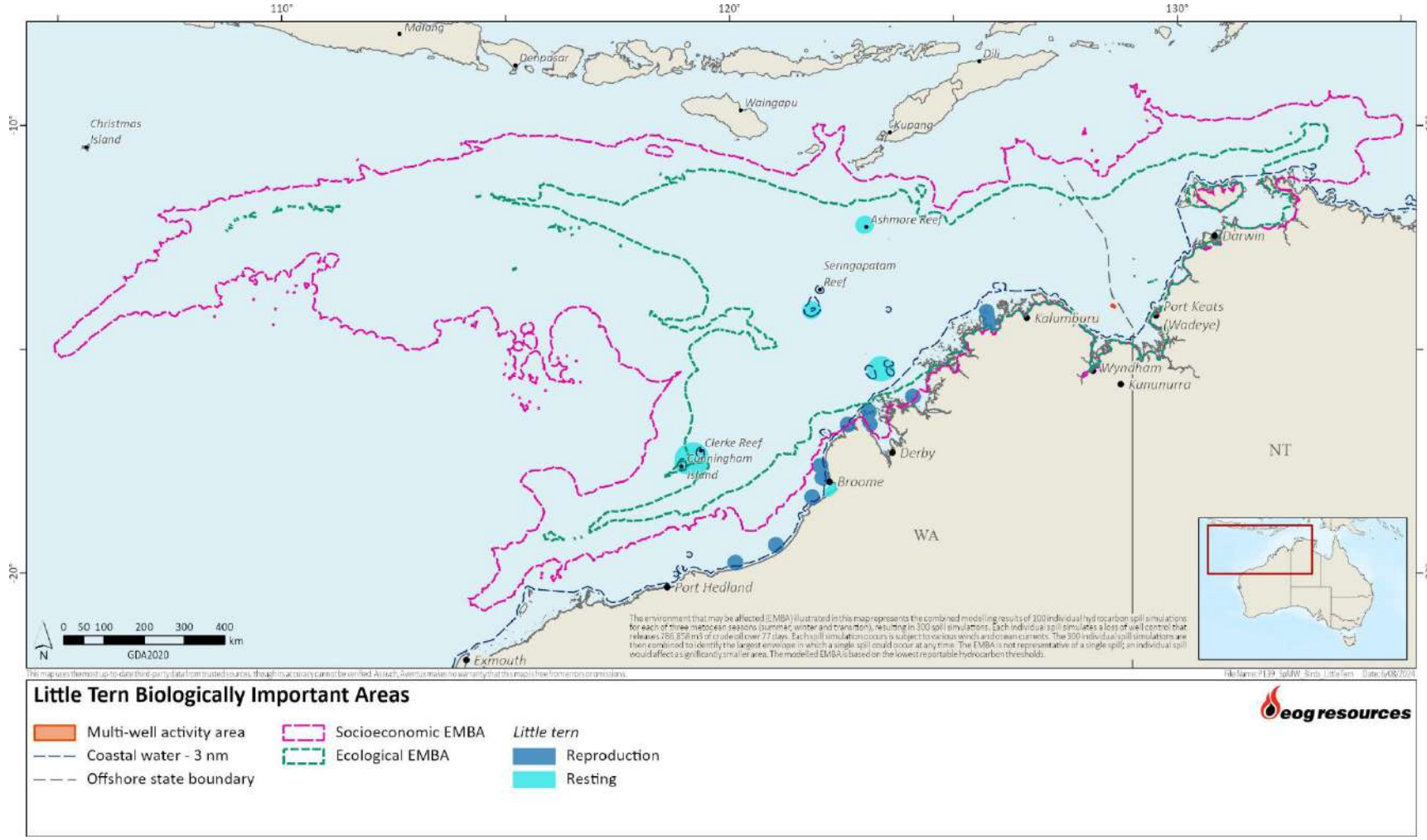


Figure 11.49 Little tern BIAs in the spill EMBA

Lesser frigatebird (EPBC Act: Listed Migratory)

Lesser frigatebirds (*Fregata ariel*) are usually observed in tropical waters around the coast of northern WA, NT, Queensland and NSW (DSEWPC, 2012). They are often found foraging far offshore, especially during the non-breeding season where some large movements have been recorded (DSEWPC, 2012). During the breeding season (March - September), the lesser frigatebird's range remains close to the breeding colonies (DSEWPC, 2012).

Within the NWMR, the lesser frigatebird is known to breed on Adele, Bedout and West Lacepede islands, Ashmore Reef and Cartier Islands (DEWHA, 2008b). Breeding occurs between March and September along the Kimberley and Pilbara coasts and islands (DCCEEW, 2024b). The spill EMBA overlaps the Kimberley and Pilbara coasts and islands (including Ashmore Reef) reproduction BIA for this species as presented in Table 11.10 and Figure 11.50.

Greater frigatebird (EPBC Act: Listed Migratory)

The greater frigatebird (*Fregata minor*) has a global distribution range throughout the world's tropical seas. Greater frigatebirds undertake regular migrations across their range. Breeding occurs from May to June and August, with the closest breeding colonies identified on Ashmore Reef and Adele Island (DCCEEW, 2024b). The greater frigatebird forages in pelagic waters within 80 km of the breeding colony or roosting areas (ALA, 2022).

Greater frigatebrids commonly eat fish species such as flying fish and squid. Prey is snatched while in flight, either from just below the surface or from the air, in the case of flying fish flushed from the water. The spill EMBA overlaps with the Kimberley and Ashmore Reef reproduction BIAs for this species (Table 11.10 and Figure 11.51).

Lesser crested tern (EPBC Act: Listed Migratory)

The lesser crested tern (*Thalasseus bengalensis*) is described in Chapter 5 of the EP.

The spill EMBA overlaps with the Kimberley coast and islands including Ashmore Reef reproduction BIAs for this species (Table 11.10 and Figure 11.52).

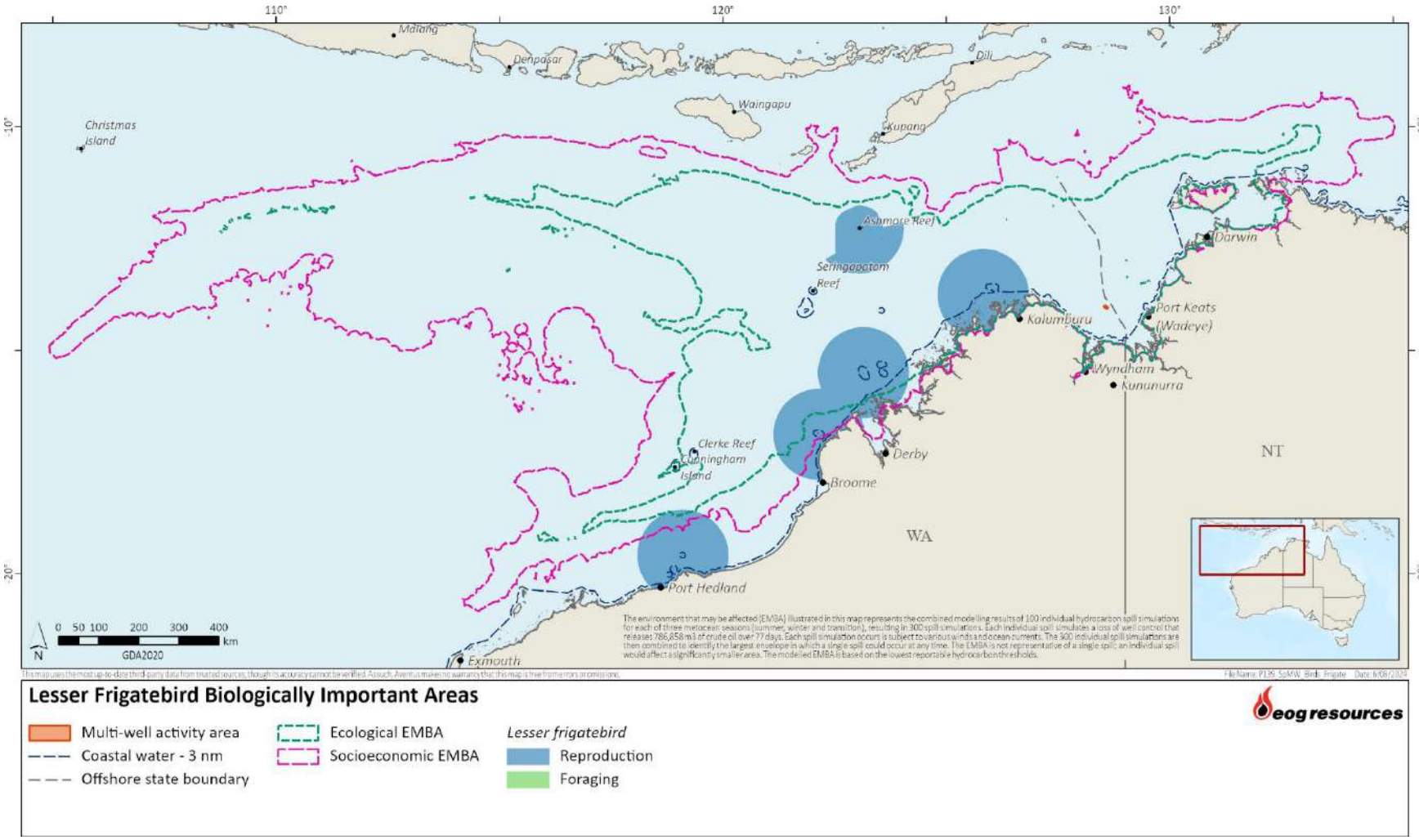


Figure 11.50 Lesser frigatebird BIAs in the spill EMBA

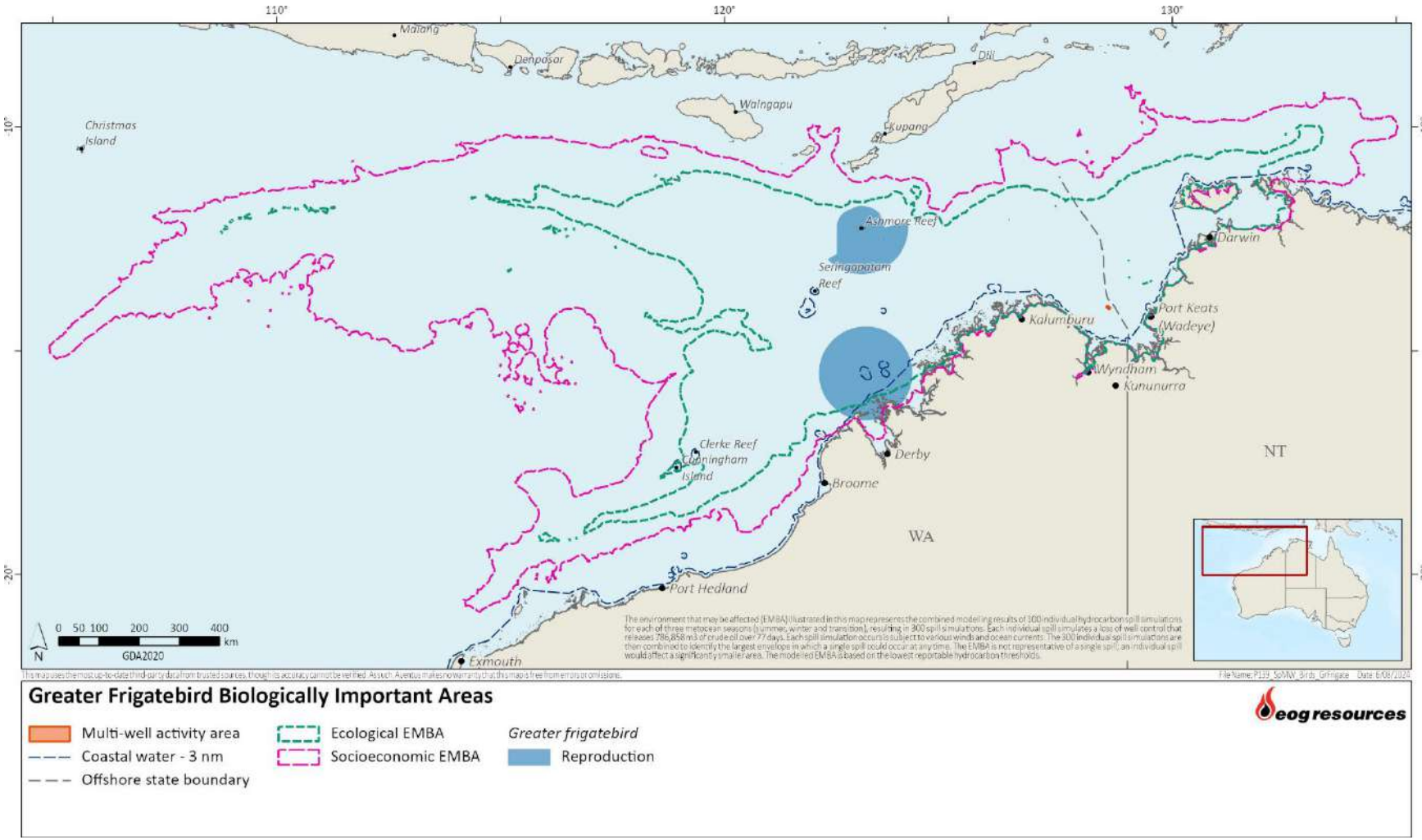


Figure 11.51 Greater frigatebird BIAs in the spill EMBA

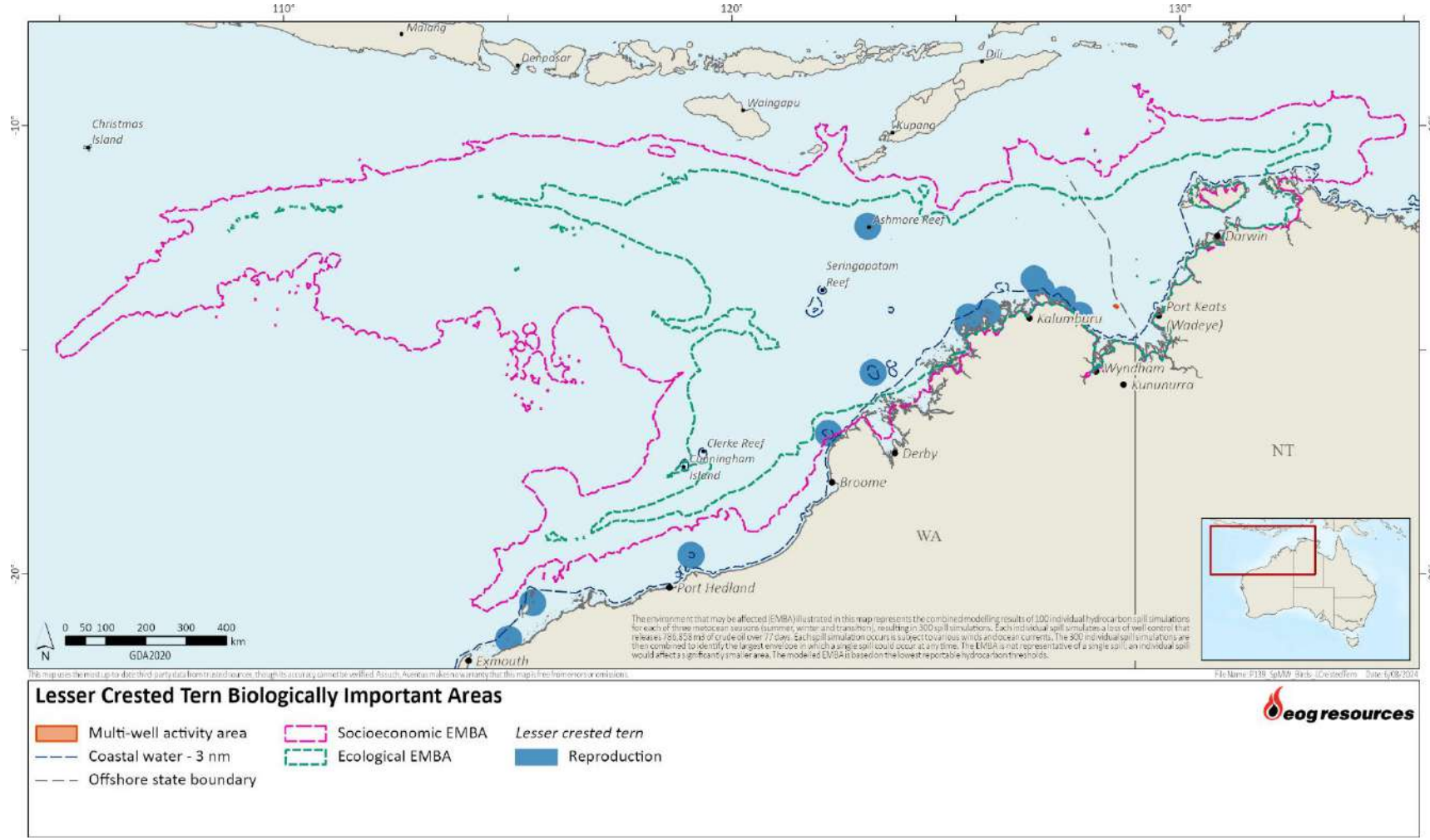


Figure 11.52 Lesser crested tern BIAs in the spill EMBA

Crested tern (EPBC Act: Listed Migratory)

The crested tern (*Thalasseus bergii*) inhabits tropical and subtropical coastlines and forages in the shallow waters of lagoons, coral reefs, bay, harbours, inlets and estuaries; along sandy, rocky, coral or muddy shores; on rocky outcrops in open sea; in mangrove swamps; and in offshore and pelagic waters (Higgins and Davies, 1996). The crested tern usually feeds from the surface of the sea to less than 1 m water depth. Its diet consists predominantly of pelagic fish, although it will also feed on crustaceans, insects and hatchling turtles, opportunistically (Birdlife, 2020). The crested tern shows a preference for nesting on offshore islands, low-lying coral reefs, low-lying coral reefs, sandy or rocky coastal islets, coastal spits and lagoon mudflats (Birdlife, 2020). According to the AMSIS, breeding is known to occur on Seagull Island, off NW of Cape Van Diemen on Melville Island and on the Coburg Peninsula as represented by the 'reproduction' BIA (Table 11.10 and Figure 11.53).

Bridled tern (EPBC Act: Listed Migratory)

The bridled tern (*Onychoprion anaethetus*) is found throughout tropical and sub-tropical regions of Australia (DCCEEW, 2024b). The species is most common on offshore islands as opposed to coastal areas and forages singly or in small flocks, primarily on fish by swooping on schools and dipping only the head in the water (as opposed to plunge diving) (DCCEEW, 2024b). Breeding populations exist at Ashmore Reef and Cartier Island (DEWHA, 2008b). Birds return to breeding colonies at various island locations throughout northern WA between late September and mid-October and leave from early May to mid-September. The spill EMBA overlaps with a reproduction BIA for this species (see Table 11.10 and Figure 11.54).

Australian lesser noddy (EPBC Act: Vulnerable)

The Australian lesser noddy (*Anous tenuirostris melanops*) is endemic to Australia and nests on the Abrolhos Islands, Ashmore Reef and various other islands throughout tropical and sub-tropical northwest Australia (DCCEEW, 2024b). They may forage out to sea or close inshore to breeding islands, including outside fringing reefs, feeding on small squid and fish (DoEH, 2005). They roost mainly in mangroves, and sometimes rest on the beaches (DoEH, 2005). The Australian lesser noddy may occur within the coastal areas of the spill EMBA.

Abbott's booby (EPBC Act: Endangered)

Abbott's booby (*Papasula abbotti*) spend much of their time at sea, but need to come ashore to breed (DCCEEW, 2024b). It is currently known to only breed on Christmas Island (outside the spill EMBA) during the months of March to October, with peak nesting May-July (DCCEEW, 2024b). The species nests in tall rainforest trees, laying a single egg clutch (DAWE, 2021b). Birds are known to travel up to 400 km from nesting locations to forage for fish and squid (DCCEEW, 2024b). The species may occur in the spill EMBA.

Brown booby (EPBC Act: Listed Migratory)

The brown booby (*Sula leucogaster*) is the smallest of the booby family. The species feeds either individually or in flocks, around inshore waters and use both marine and terrestrial habitats. They forage by either plunge diving or by snatching prey from the surface. The spill EMBA overlaps with the Kimberley and northern Pilbara coasts and islands also Ashmore Reef reproduction BIAs for this species (see Table 11.10 and Figure 11.55).

Red-footed booby (EPBC Act: Listed Migratory)

The red-footed booby (*Sula sula*) is a slender bird with conspicuous red feet. Its distribution is confined to tropical waters between 30°N and 30°S in the Indian Ocean. In WA a small breeding population has been recorded on Ashmore Reef (DEWHA, 2008b). It mostly feeds on fish, especially flying fish, including cephalopods, by plunge diving in groups to shallow depths

(DCCEEW, 2024b). The spill EMBA overlaps with the northwest Kimberley and Ashmore Reef reproduction BIAs for this species (see Table 11.10 and Figure 11.56).

White tailed tropicbird (EPBC Act: Listed Migratory)

The white-tailed tropicbird (*Phaethon lepturus*) is a pelagic species that rarely comes ashore, except to breed. The species breeds on islands throughout the tropics of the northern Indian Ocean, including Ashmore Reef and Rowley Shoals off the northern coast of WA (Johnstone and Storr, 1998; Marchant and Higgins, 1993).

The white-tailed tropicbird is a rather scarce breeding species at Ashmore Reef, and it is estimated that up to two pairs nest within the reserve each year (Clarke, 2010). Breeding has been recorded from May through to October, with birds dispersing away from the breeding colonies outside the breeding season.

The species forages in warm waters and over long distances, moving up to 1,500 km from breeding sites when not breeding (DSEWPC, 2012) and up to 89 km from the nest site when breeding. It feeds on fish and cephalopods by plunge-diving (Marchant and Higgins 1993).

The closest reproduction BIA for the white-tailed tropicbird within the spill EMBA is at Ashmore Reef (Table 11.10 and Figure 11.57).

Red tailed tropicbird (EPBC Act: Endangered, Marine and Migratory)

This species is described in Chapter 5 Section 5.4.7.

The closest BIA for this species (according to the AMSIS) is a breeding/foraging BIA located 900 km east of the spill EMBA, near the Great Barrier Reef region.

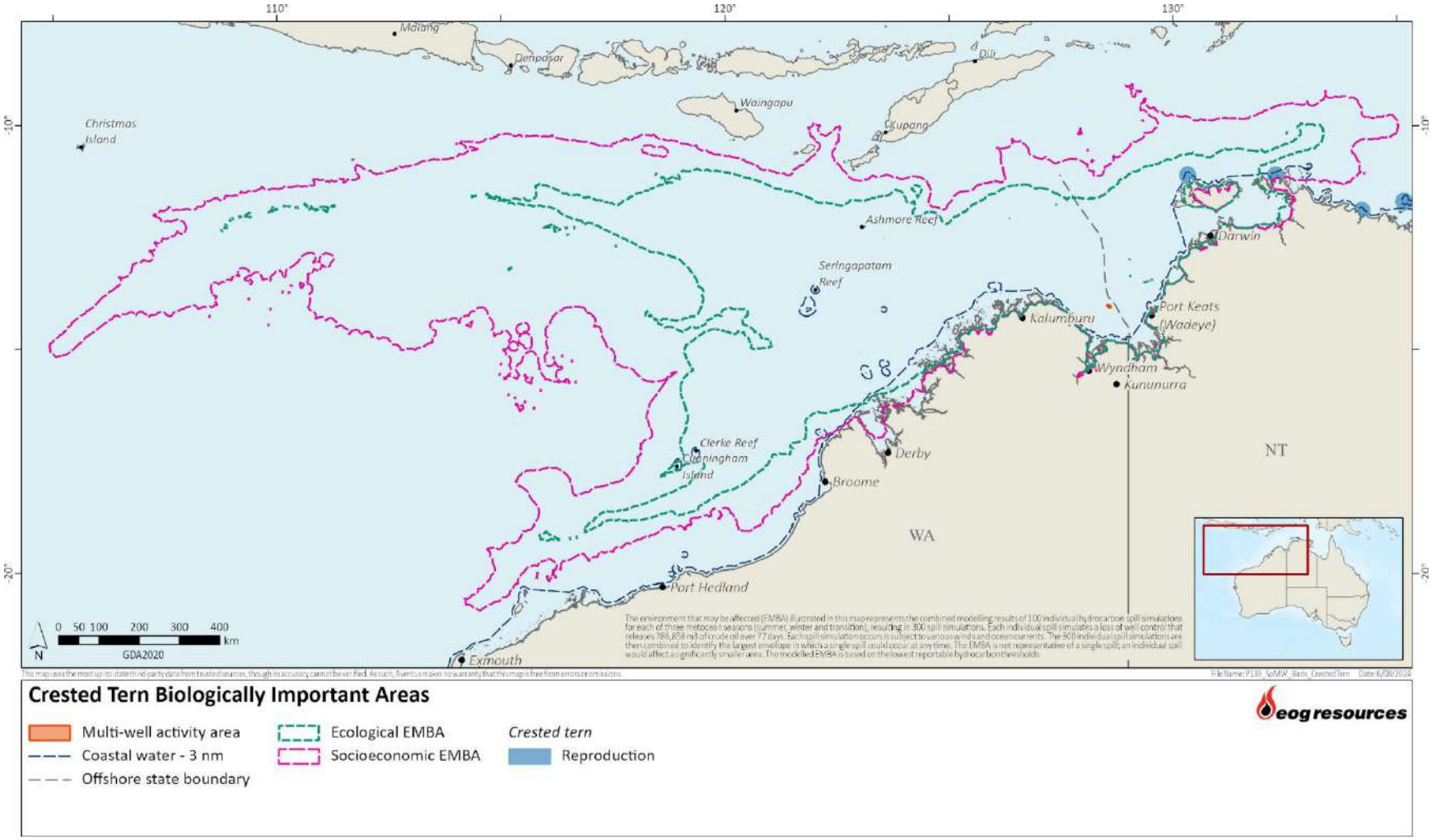


Figure 11.53 Crested tern BIAs in the spill EMBA

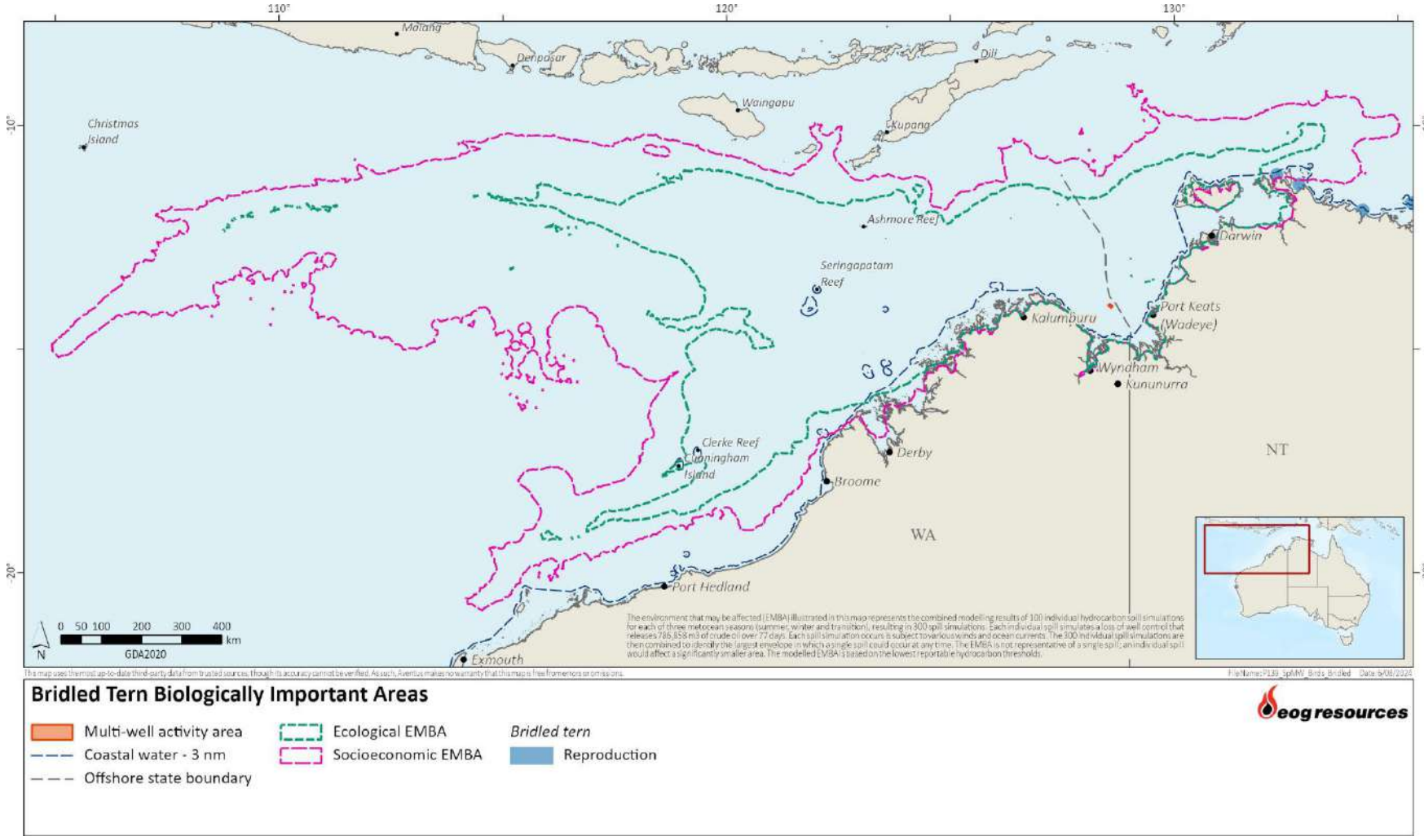


Figure 11.54 Bridled tern BIAs in the spill EMBA

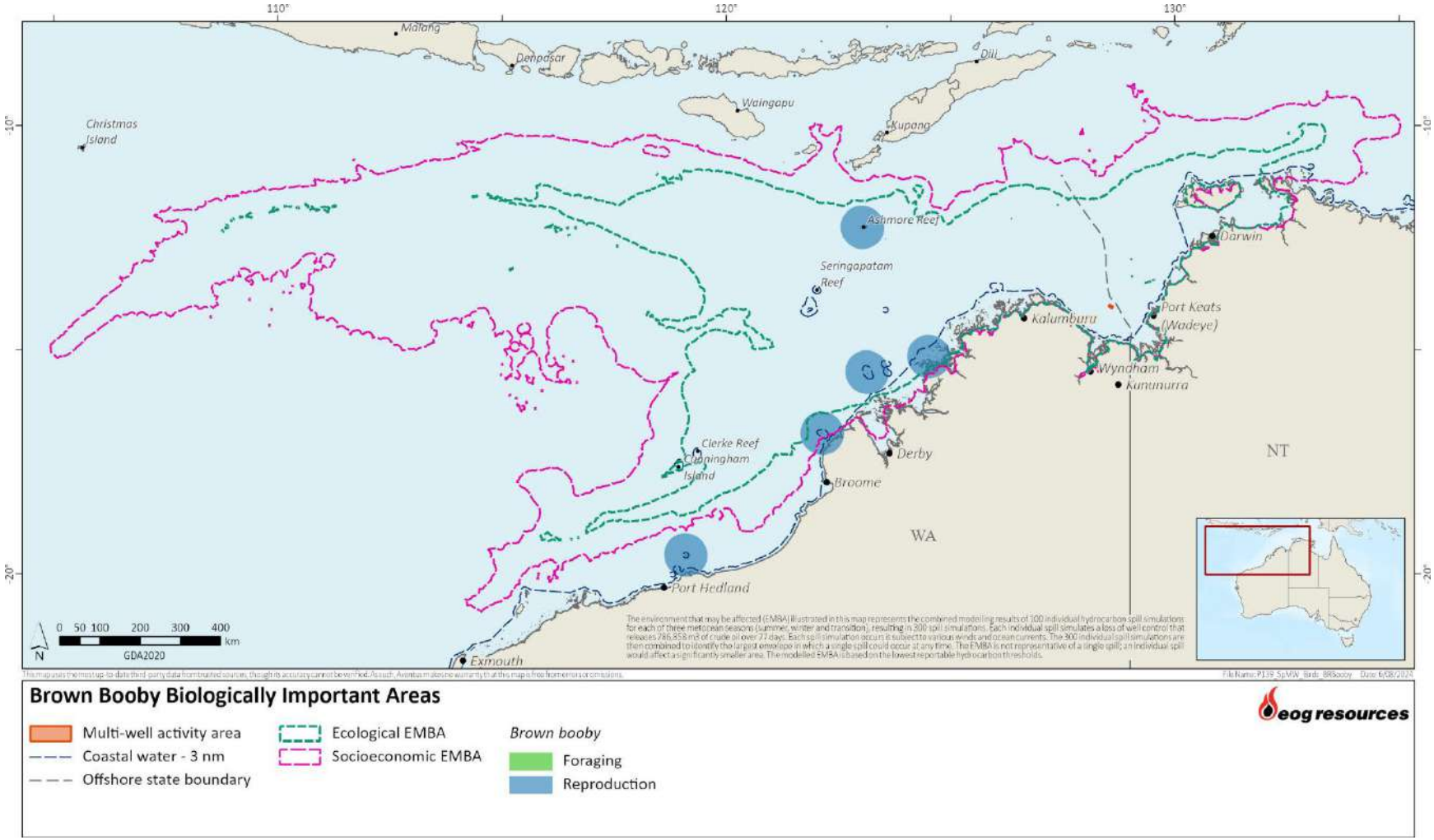


Figure 11.55 Brown booby BIAs in the spill EMBA

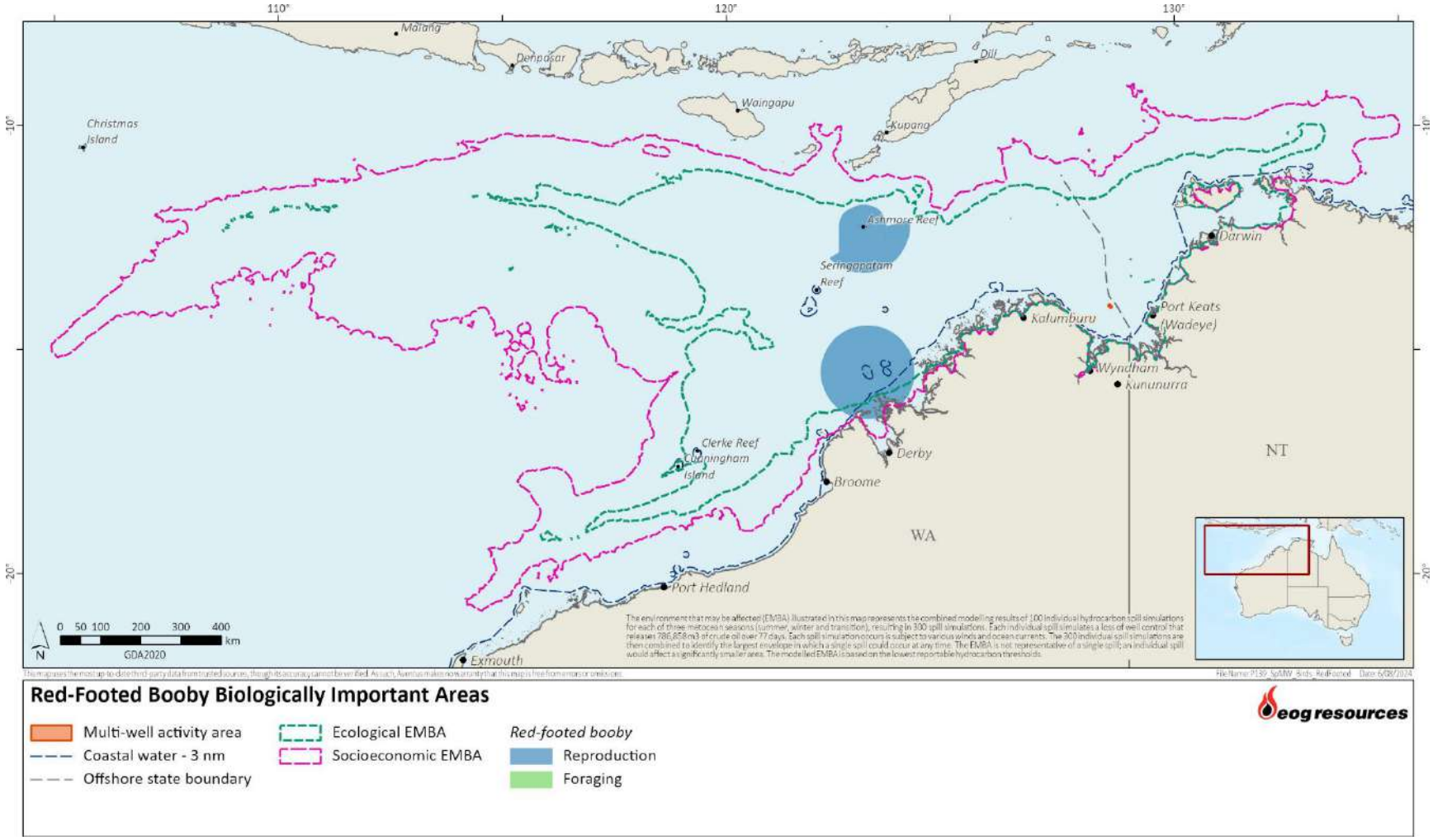


Figure 11.56 Red-footed booby BIAs in the spill EMBA

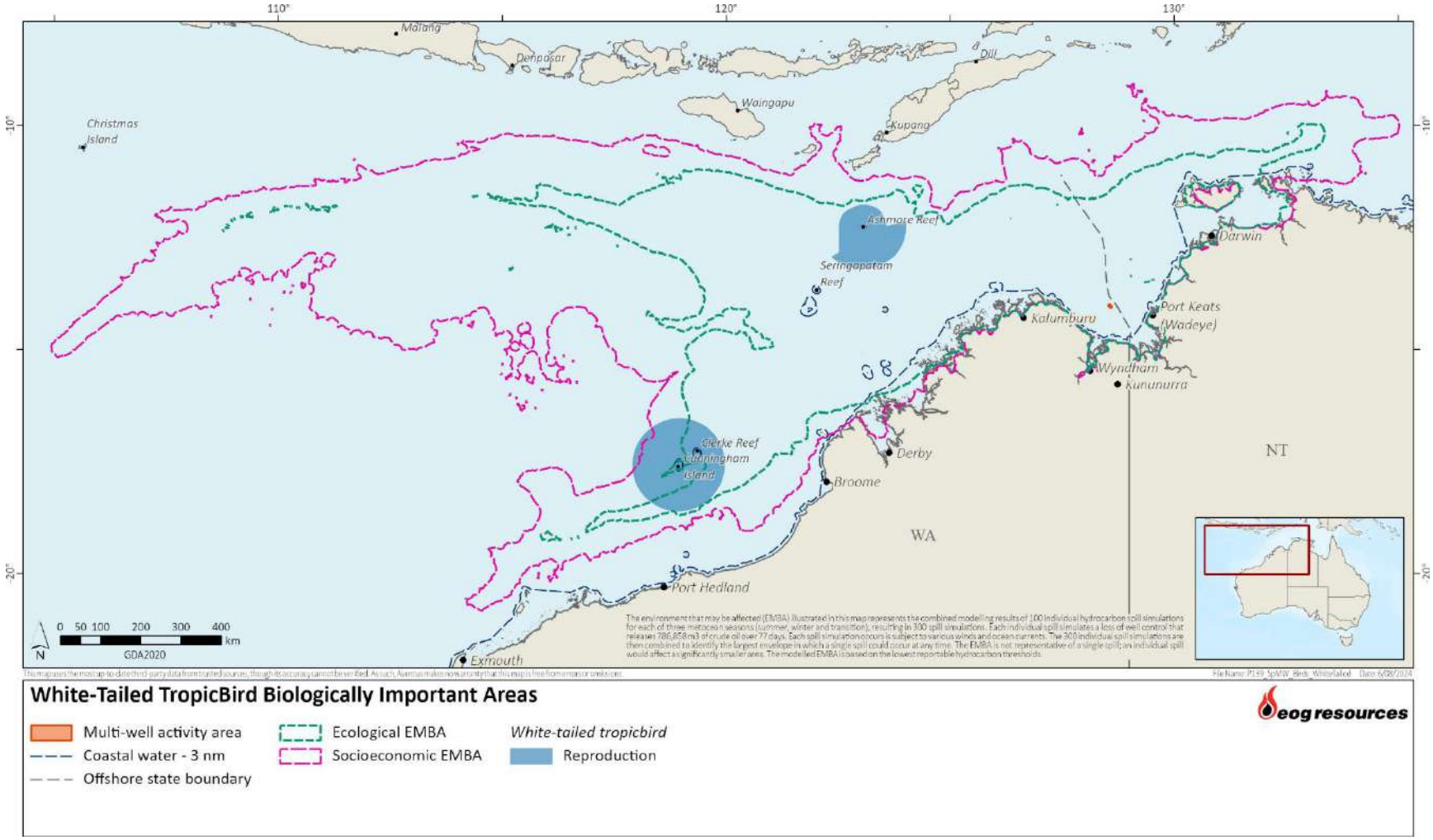


Figure 11.57 White tailed tropicbird BIAs in the spill EMBA

Christmas Island white-tailed tropicbird (EPBC Act: Listed Endangered)

The Christmas Island white-tailed tropicbird (*Phaethon lepturus fulvus*) is endemic to Christmas Island, which is its only known breeding site (DoE, 2014d). It leaves the island to forage in the warm waters of the Indian Ocean (DoE, 2014d) mainly feeding on fish and cephlapods. The white-tailed tropicbird roosts at sea; only incubating or brooding adults remain on nests on the island at night (Stokes, 1988).

The AMSIS does not identify any BIAs for this species within the activity area nor ecological EMBA.

Indian yellow-nosed albatross (EPBC Act: Listed vulnerable)

The Indian yellow-nosed albatross (Thalassarche carteri) is a is a marine bird, located in subtropical and warmer subantarctic waters (Marchant and Higgins, 1993). Foraging BIAs are located throughout the offshore waters of the south-west marine region, north to Shark Bay and extending east into Bass Strait. Although the PMST report identifies this species or its habitat may be present within the spill EMBA, the closest likely habitat is just south of Barrow Island (outside of the spill EMBA). There are no BIAs intersected by the spill EMBA; however, it is likely that individuals may transit through the spill EMBA.

Australian fairy tern (EPBC Act: Vulnerable)

This subspecies of the fairy tern (*Sternula nereis nereis*) is listed as vulnerable as there are less than 5,000 mature individuals remaining and the total population has undergone a substantial decline of approximately 24% (TSSC, 2011). The Australian fairy tern occurs along the coasts of NSW, Victoria, Tasmania, SA and WA in a variety of habitats including offshore, estuarine or lake islands, wetlands, beaches and spits (TSSC, 2011). They are suspected to migrate with southern WA and Tasmania due to their low records during winter months. Within northern WA, SA and Victoria they are more sedentary. Some of the main threats to the subspecies include predation from mammals, human disturbance and high salinity levels within their foraging waters.

The spill EMBA reaches a small area of their distribution (surrounding waters of Barrow Island and coastal waters of Karratha) (DCCEEW, 2024b).

Shorebirds

Ruddy turnstone (EPBC Act: Vulnerable, Migratory and Marine)

The ruddy turnstone (*Arenaria interpres*) became listed as vulnerable in January 2024. They are a stocky, medium-sized wader, with short orange-red legs. During the austral summer non-breeding season, the ruddy turnstone is widespread within Australia. In north Australia, they are known to occur in a wide variety of habitats and may prefer wide mudflats. The species has a preference for areas containing rotting seaweed where they can rummage for maggots, larvae, and other invertebrates. The species has occasionally been recorded chasing small crabs and using their beak to probe crab holes (DCCEEW, 2024j).

The species may be present within the coastal areas of the spill EMBA.

Curlew sandpiper (EPBC Act: Critically Endangered, Listed Migratory)

In Australia, the curlew sandpiper (*Calidris ferruginea*) occurs around the coasts and is also quite widespread inland, though in smaller numbers (DCCEEW, 2024b). They are rarely recorded in the northwest Kimberley, around Wyndham and Lake Argyle (DCCEEW, 2024b).

This species is unlikely to be present in the activity area due to its location offshore but given that the spill EMBA is adjacent to (without intersecting) critical habitat for this species (e.g., wetlands),

it is possible that this species would be present in the coastal sections of the spill EMBA during the summer months.

Sharp-tailed sandpiper (EPBC Act: Critically Endangered, Listed Migratory)

This species is described in Chapter 5 section 5.4.7. There are no BIAs (as defined by the AMSIS) that exist within the spill EMBA.

Terek sandpiper (EPBC Act: Vulnerable, Marine and Migratory)

The terek sandpiper (*Xenus cinereus*) was listed as vulnerable in January 2024. The species has a distinctive long, upcurved bill and weights around 95 g. In Australia, the terek sandpiper has a primarily coastal distribution. The species is more widespread and common in northern and eastern Australia than southern Australia. In the NT, widespread records of the bird occur from Darwin, north to Melville Island, and east to the western section of the Gulf of Carpentaria, around Gove Peninsula, Groote Eylandt, Sir Edward Pellew Island, and the mouth of the McArthur River. Terek sandpipers are typically found in tropical mangrove-lined estuaries and mudflats and feed on crustaceans and insects (DCCEEW, 2024n).

The terek sandpiper may be present within the coastal areas of the spill EMBA, particularly within the NT.

Lesser sand plover (EPBC Act: Endangered, Listed Migratory)

The lesser sand plover (*Charadrius mongolus*) spends non-breeding periods in Australia. The species is widespread in coastal regions and has been recorded in all states within Australia but mainly occurs in northern and eastern Australia (DCCEEW, 2024b).

The species feeds mostly on extensive, freshly-exposed areas of intertidal sandflats and mudflats in estuaries or beaches, or in shallow ponds in saltworks (DCCEEW, 2024b). They also occasionally forage on coral reefs and on sandy or muddy river margins (DCCEEW, 2024b). The lesser sand plover roost near foraging areas, on beaches, banks and spits, banks of sand and shells, and occasionally on rocky spits, isles, or reefs (DCCEEW, 2024b).

This species is not predicted to occur in the activity area due to its distance from shore but may occur within the coastal areas of the spill EMBA and in the Cambridge Gulf.

Common greenshank (EPBC Act: Endangered, Listed Migratory and Marine)

The common green shank was listed as endangered in January 2024. The species is a large and heavily built wader with a long and slightly upturned bill. The common greenshank is widespread in coastal regions, occurs in all types of wetlands, and has one of the widest distributions of any shorebird in Australia. The species is known to occur fragmentedly along the WA and NT coast. The common greenshank forages at the edge of wetlands, in soft mud on mudflats, in channels, or within shallows around the edge of waterbodies. Their consists of insects and their larvae, crustaceans, annelids, molluscs, amphibians.

It is possible that the common greenshank will be encountered within the coastal regions of the spill EMBA.

Asian dowitcher (EPBC Act: Vulnerable, Migratory and Marine)

The Asian dowitcher (Limnodromus semipalmatus) become listed as vulnerable in January 2024. They are a large, distinctive shorebird with a long neck, long legs, and a long, straight, snipe-like bill. Within Australia, this species is only a regular visitor to coastal areas between Broome and Port Hedland. Elsewhere, the species occurrence is sporadic and rare. The species feeds in inter-tidal mudflats on small fish and insect larvae as well as molluscs (DCCEEW, 2024k).

Due to the species limited known range within coastal WA, it is unlikely that the Asian dowitcher will be present within the spill EMBA.

Eastern curlew (EPBC Act: Critically Endangered, Listed Migratory)

The eastern curlew (*Numenius madagascariensis*) has a primarily coastal distribution within Australia (DoE, 2015c). It does not breed in Australia and is found foraging on soft sheltered intertidal sandflats or mudflats, open and without vegetation or covered with seagrass, often near mangroves, on saltflats and in saltmarsh, rockpools and among rubble on coral reefs, and on ocean beaches near the tideline (DoE, 2015c).

Given that the spill EMBA is adjacent to (without overlapping) critical habitat for this species (e.g., wetlands), it is possible that this species occurs in the spill EMBA during the summer.

Black-tailed godwit (EPBC Act: Endangered, Marine and Migratory)

The black-tailed godwit (*Limosa limosa*) was listed as endangered in January 2024. Black-tailed godwits are 40–44 cm long, have a wingspan between 63–75 cm, and weigh between 200–300 g. During the austral summer non-breeding season, black-tailed godwits are found in all states and territories of Australia predominately in coastal regions. The largest populations are found on the north coast between Darwin, NT and Weipa, QLD. Feeding habitat includes areas of mud or soft, wet sand within sandflats, intertidal mudflats, saltmarshes, and the beaches of oceanic coastlines, bays, and estuaries. Their diet consists mainly of insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs, frog eggs and tadpoles, which they probe from soft mud or shallow water (DCCEEW, 2024l).

This species may be present within the coastal regions of the spill EMBA, particularly within the NT.

Nunivak bar-tailed godwit (EPBC Act: Vulnerable)

The Nunivak bar-tailed godwit (*Limosa lapponica baueri*) is a large wader recorded in coastal areas of all states and territories of Australia (DCCEEW, 2024b). The species is found in coastal habitats such as large intertidal sand and mudflats, banks, estuaries, harbours, bays and coastal lagoons where it forages when the tide is out (DAWE, 2021b). Their diet consists of worms, molluscs, crustaceans, insects and some plant material (DCCEEW, 2024b). This species breeds in the northern hemisphere and migrates south for the winter, arriving in northwest Australia from August and departs before the end of April (DCCEEW, 2024b).

This species is not predicted to occur in the activity area due to its offshore location but may be present in the coastal sections of the spill EMBA between August and April.

Northern Siberian bar-tailed godwit (EPBC Act: Critically Endangered)

The northern Siberian bar-tailed godwit (*Limosa lapponica menzbieri*) is a large migratory shorebird (TSSC, 2016b). The northern Siberian bar-tailed godwit spends non-breeding periods in Australia and is found in all Australian states and territories (TSSC, 2016b). Populations have been recorded in northern Australia, from Darwin east to the Gulf of Carpentaria. The species forages near the edge of water or in shallow water, mainly on muddy coastlines, estuaries, inlets and mangroves feeding on worms, molluscs, crustacean, insects and plant material (TSSC, 2016b).

It is unlikely that this species would be present in the activity area due to its offshore location but this species may be present within the coastal sections of the spill EMBA.

Great knot (EPBC Act: Critically Endangered, Listed Migratory)

The great knot (*Calidris tenuirostris*) has been recorded around the entire Australian coast and spends non-breeding periods in Australia (DCCEEW, 2024b). The greatest numbers of this species

are found in northern Australia, and most commonly on the coast of the Pilbara and Kimberley, from the Dampier Archipelago to the NT border, and in the NT from Darwin and Melville Island, through Arnhem Land to the southeast Gulf of Carpentaria (DCCEEW, 2024b). This species typically prefers sheltered coastal habitats with large intertidal mudflats or sandflats (DCCEEW, 2024b). The great knot feeds on snails, worms and crustaceans, and forages on intertidal mudflats, estuaries, and in mangroves.

This species is not predicted to be encountered in the activity area due to its habitat preferences, although it is expected in parts of the coastal areas of the spill EMBA where its preferred habitat is available.

Red knot (EPBC Act: Endangered, Listed Migratory)

The red knot (*Calidris canutus*) is common in all the main suitable habitats around the coast of Australia (DCCEEW, 2024b), and very large numbers are regularly recorded in northwest Australia, with Eighty Mile Beach and Roebuck Bay being particular strongholds (both outside the spill EMBA). In WA, it is widespread on the coast from Ningaloo Reef and Barrow Island to the southwest Kimberley coastline. In the NT it is mainly recorded in Darwin.

The red knot is not predicted to occur within the activity area due to its habitat preferences but is likely to be present in parts of the coastal areas of the spill EMBA.

Alligator Rivers yellow chat (EPBC Act: Endangered)

The alligator rivers yellow chat (*Epthianura crocea tunneyi*) is a small bird that has been recorded from a several sites in the NT on the floodplains of the Adelaide, Mary, Wildman, South Alligator and East Alligator rivers (Garnett *et al.,* 2011). Most records are from within Kakadu National Park, however the relative importance of the different floodplains is unknown (Garnett *et al*., 2011). Occasional records elsewhere, mostly from between Darwin to Oenpelli, are probably dispersive individuals. The subspecies is presumed to be a single a contiguous population (Garnett et al., 2011).

The species is restricted to alluvial coastal and subcoastal grassy floodplains, primarily near floodplain depressions and channels, typically sparsely vegetated and feed mainly on insects (Armstrong, 2004). Given the habitat preference of the alligator rivers yellow chat, the species may be present in the coastal section of the NT. There are no known BIAs intersected by the spill EMBA.

Australian painted snipe (EPBC Act: Endangered)

The Australian painted snipe (*Rostratula australis*) is a wader and is found in wetlands throughout all Australian states and territories (DCCEEW, 2024b). The species generally inhabits freshwater wetlands, although can inhabit brackish water, saltmarshes and claypans (DCCEEW, 2024b). It feeds on vegetation, seeds, insects, worms, molluscs, crustaceans and other invertebrates (DCCEEW, 2024b). The Australian painted-snipe is not predicted to occur within the activity area, but is likely to be present in the spill EMBA.

Red goshawk (EPBC Act: Vulnerable)

The red goshawk is a large, swift and powerful rufous-brown hawk found in patchy, but widespread areas across coastal and sub-coastal regions of northern and eastern Australia. Historically it occurred from the north-east tip of New South Wales, across Queensland and the Northern Territory, to the north of WA (Marchant and Higgins, 1993). The species is thought to consist of two subpopulations, one on the Tiwi Islands containing approximately 200 adults, and a mainland population containing approximately 1200 adults (Garnett *et al.,* 2011). The red goshawk may transient through the coastal areas of northern WA and the NT within the spill EMBA. However, there are no BIAs for this species that overlap the spill EMBA.

Greater sand plover (EPBC Act: Vulnerable, Listed Migratory)

The greater sand plover (*Charadrius leschenaultia*) occurs in coastal areas throughout Australia with the greatest populations between the NW Cape and Roebuck Bay (DCCEEW, 2024b) (both outside the spill EMBA). The plover spends almost all its time in coastal habitats. Their diet consists mainly of molluscs, worms, crustaceans and insects (DCCEEW, 2024b). The species breeds in the northern hemisphere and migrates south for the boreal winter (DCCEEW, 2024b). The greater sand plover is one of the first migratory waders to return to northwest Australia, usually arriving in late July and departing in mid to late April (DCCEEW, 2024b).

The species is not predicted to occur in the activity area due to its habitat preferences, but may occur within the coastal areas of the spill EMBA from July to April.

Grey plover (EPBC Act: Vulnerable, Marine and Migratory)

The grey plover (*Pluvialis squatarola*) was listed as vulnerable in January of 2024. Grey plovers are medium-sized, long-legged plovers with a large head and large, dark eyes. During the austral summer non-breeding season, the grey plover is a regular migrant to Australia but is primarily found along the west and south coasts. Western Australian sites support about 38% of the Australian population. In the Northern Territory, small numbers of grey plovers are regularly recorded in the Top End. The species feeds on marine polychaete worms, molluscs, and crustaceans in mostly in mud or soft, wet sand of sandflats, intertidal mudflats, saltmarshes, and the beaches of oceanic coastlines, bays, and estuaries.

It is possible that the grey plover will be encountered in coastal regions of the spill EMBA, particularly in NT.

11.3.8 Marine Pests

It is widely recognised that marine pests can become invasive and cause significant impacts on economic, ecological, social and cultural values of marine environments. Impacts can include the introduction of new diseases, altering ecosystem processes and reducing biodiversity, causing major economic loss and disrupting human activities (Brusati and Grosholz, 2007).

The Marine Pests Interactive Map (DAFF, 2021) indicates that the major port likely to be used to support the activity (e.g., Darwin) is not known to harbour any marine pests. However, DAFF (2021) notes that the following species are listed to keep watch for in the Port of Darwin due to their high potential for accidental introduction:

- Asian green mussel (*Perna viridis*) – typically inhabits soft sediment bottoms from the low tide mark to shallow waters up to 42 m deep. Juveniles are bright green than turn brown in adults.
- American slipper limpet (*Crepidula fornicate*) – competes with native species for food and space and may alter sediment characteristics by removing suspended sediments from the water column. Its likely habitat includes mud, rocks and sand within shores and shall waters.
- Black striped false mussel (*Mytilopsis sallei*) – affects the productivity of commercial fisheries and aquaculture by competing with native species for food and space. The species usually inhabits shallow waters up to a few metres deep.
- Charru mussel (*Mytella charruana*) – successful invasive species globally due to its great dispersal ability and tolerance for a wide variety of habitats. Typically found on rocky or hard substrates in shallow waters

11.4 Conservation Values and Sensitivities

The conservation values and sensitivities within the spill EMBA are described in this section, with Table 11.11 providing an outline of the conservation categories described.

Table 11.11 Conservation values in the spill EMBA

Category	Conservation classification	Section
MNES under the EPBC Act	Australian Marine Parks (AMP)	Section 11.4.1
	World Heritage-listed properties	Section 11.4.2
	National Heritage-listed places	Section 11.4.3
	Wetlands of international importance	Section 11.4.5
	Nationally threatened species and threatened ecological communities	Throughout Section 11.3 and Section 11.4.6
	Migratory species	Throughout Section 11.3
	Great Barrier Reef Marine Park	Not applicable.
	Nuclear actions	Not applicable.
	A water resource, in relation to coal seam gas development and large coal mining development	Not applicable.
Other areas of national importance	Commonwealth heritage-listed places	Section 11.4.3
	Key Ecological Features (KEF)	Section 11.4.7
	Nationally important wetlands (NIW)	Section 11.4.8
State protected areas	State/territory protected areas	Section 11.4.9

11.4.1 Australian Marine Parks

Australian Marine Parks as proclaimed under the EPBC Act (in 2007 and 2013) are located in Commonwealth waters that start at the outer edge of state and territory waters, generally 3 nm (approximately 5.5 km) from the shore, and extend to the outer boundary of Australia's EEZ, 200 nautical miles (approximately 370 km) from the shore (DNP, 2018).

The AMP Network includes six marine regions being the Coral Sea, South-west, Temperate East, South-east, North and Northwest. The marine park networks applicable to the activity area and spill EMBA are the Northwest Marine Parks Network aligned with the NWMR; and North Parks Marine Network aligned to the NMR. Management plans have been developed and approved for each of these regions including zoning and related rules for managing activities in the marine park to ensure protection of marine habitats and species:

- North Marine Parks Network Management Plan 2018 (DNP, 2018a); and.
- Northwest Marine Parks Network Management Plan 2018 (DNP, 2018b).

The nearest AMPs to the multi-well location is the JBG AMP (located 30 km east) and the Kimberley AMP (located 235 km), described herein. AMPs in the spill EMBA and their zoning (IUCN classification as defined in Table 11.12) are listed in Table 11.13. AMPs within the spill EMBA are shown in Figure 11.58.

Table 11.12 Definition of AMP zones

Special Purpose Zone (IUCN category VI)—managed to allow specific activities though special purpose management arrangements while conserving ecosystems, habitats and native species. The zone allows orprohibits specific activities.
Multiple Use Zone (IUCN category VI)—managed to allow ecologically sustainable use while conserving ecosystems, habitats and native species. The zone allows for a range of sustainable uses, including commercial fishing and mining where they are consistent with park values.
Habitat Protection Zone (IUCN category IV)—managed to allow activities that do not harm or cause destruction to seafloor habitats, while conserving ecosystems, habitats and native species in as natural astate as possible.
Recreational Use Zone (IUCN category IV)—managed to allow recreational use, while conserving ecosystems, habitats and native species in as natural a state as possible. The zone allows for recreationalfishing, but not commercial fishing.
National Park Zone (IUCN category II)—managed to protect and conserve ecosystems, habitats and native species in as natural a state as possible. The zone only allows non-extractive activities unless authorised for research and monitoring.
Sanctuary Zone (IUCN category Ia)—managed to conserve ecosystems, habitats and native species in as natural and undisturbed a state as possible. The zone allows only authorised scientific research and monitoring.

Table 11.13 Australian Marine Parks in the spill EMBA

AMP	Distance and direction to multi-well location	Zone or IUCN Classification	Presence	
			Ecological EMBA	Socio-economic EMBA
North Marine Region (NMR)				
Oceanic Shoals	151 km north	Multiple Use Zone (IUCN VI)	Yes	Yes
Arafura	555 km north northeast	Multiple Use Zone (IUCN VI)	Yes	Yes
		Special Purpose Zone (Trawl) (IUCN VI)	-	Yes

AMP	Distance and direction to multi-well location	Zone or IUCN Classification	Presence	
			Ecological EMBA	Socio-economic EMBA
Arnhem	613 km northeast	Special Purpose Zone (Trawl) (IUCN VI)	-	Yes
Northwest Marine Region (NWMR)				
Argo-Rowley Terrace	885 km west	National Park Zone (IUCN II)	Yes	Yes
		Multiple Use Zone (IUCN VI)	Yes	Yes
		Special Purpose Zone (Trawl) (IUCN VI)	Yes	Yes
Ashmore Reef	602 km northwest	Recreational Use Zone (IUCN IV)	Yes	Yes
		Sanctuary Zone (IUCN 1a)	Yes	Yes
Cartier Island	555 km west	Sanctuary Zone (IUCN 1a)	Yes	Yes
Joseph Bonaparte Gulf	30 km east	Multiple Use Zone (IUCN VI)	Yes	Yes
		Special Purpose Zone (IUCN VI)	Yes	Yes
Kimberley	235 km west	Multiple Use Zone (IUCN VI)	Yes	Yes
		National Park Zone (IUCN II)	Yes	Yes
		Habitat Protection Zone (ICUN IV)	Yes	Yes
Mermaid Reef	1003 km south southwest	National Park Zone (IUCN II)	Yes	Yes
Montebello	1491 km south southwest	Multiple Use Zone (IUCN VI)	-	Yes

Note: Although Oceanic Shoals AMP is part of the North Marine Region, it also overlaps the NWMR, where the spill EMBA extends.

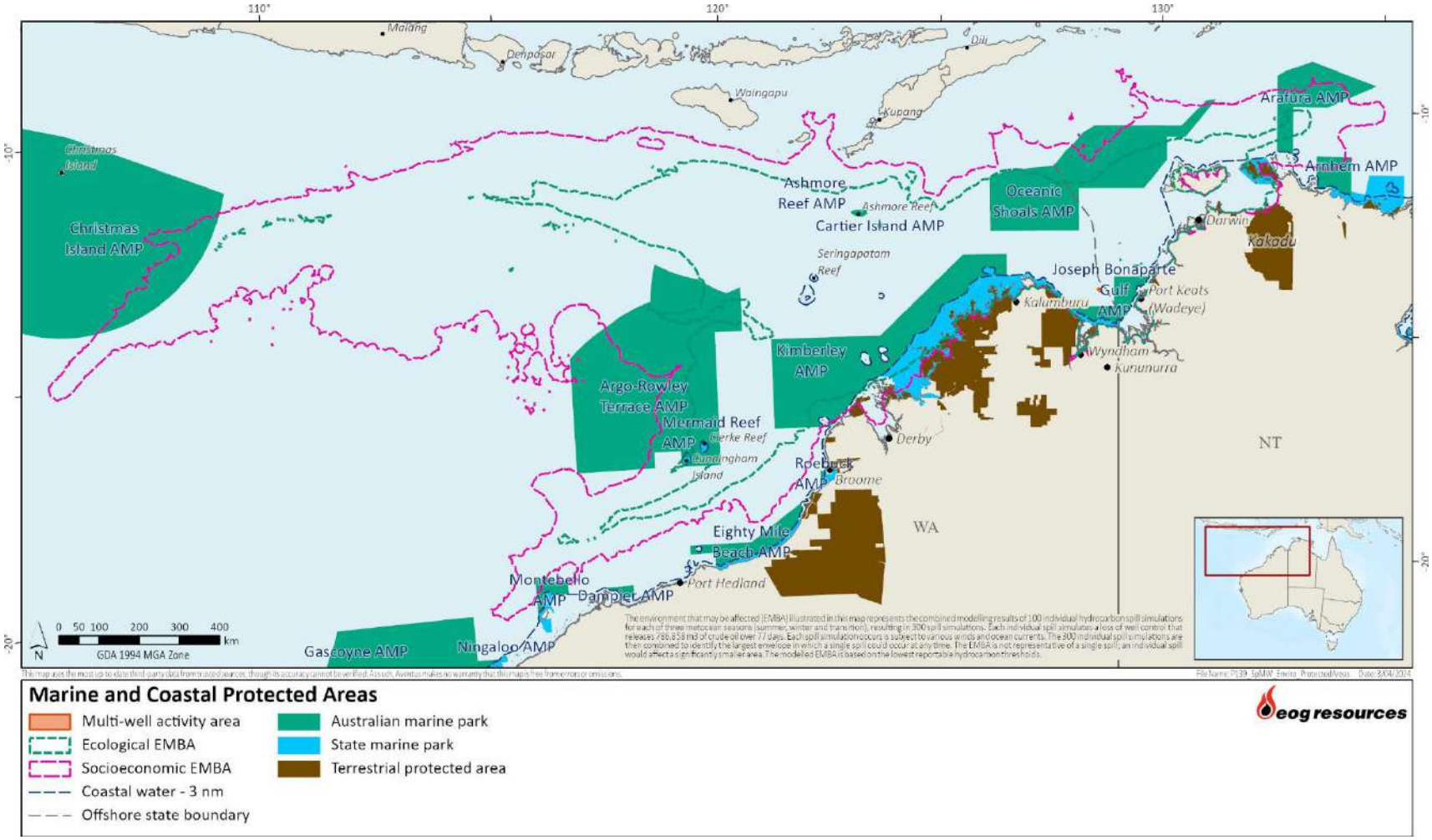


Figure 11.58 Protected areas in the spill EMBA

Oceanic Shoals AMP

The Oceanic Shoals AMP is located west of the Tiwi Islands, approximately 155 km north-west of Darwin, Northern Territory and 305 km north of Wyndham, Western Australia. It extends to the limit of Australia's Exclusive Economic Zone (EEZ). The Oceanic Shoals AMP covers an area of 71,743 km² and water depths from less than 15 m to 500 m and is the largest marine park in the North Marine Parks Network.

The Oceanic Shoals AMP is characterised by:

- Examples of ecosystems representative of the Northwest Shelf Transition. The pinnacles, carbonate banks and shoals within the AMP are sites of enhanced biological productivity.
- Four KEFs (refer to Section 11.4.7), namely:
  - Carbonate bank and terrace systems of the Van Diemen Rise;
  - Carbonate bank and terrace system of the Sahul Shelf;
  - Pinnacles of the Bonaparte Basin; and
  - Shelf break and slope of the Arafura Shelf.
- Foraging and internesting BIA for marine turtles (Section 11.3.6).
- Sea country within the marine park is valued for Indigenous cultural identity, health and wellbeing.
- Commercial fishing and mining are important activities in the AMP.

Arafura AMP

The Arafura AMP covers an area of 22,924 km^2 with depths from less than 15 m to 500 m. It is located approximately 256 km northeast of Darwin. The marine park extends from NT waters to the limit of Australia's EEZ. The Arafura Marine Park is significant because it contains habitats, species and ecological communities associated with the Northern Shelf Province and Timor Transition. It contains one KEF known as the tributary canyons of the Arafura Depression, an area that contains canyons that are approximately 80 to 100 km long and 20 km wide with sediments including sand, mud and rock. The canyons channel deep ocean waters, enhancing productivity and supporting large predatory fish, whale sharks, sawfish and marine turtles, deep sea sponges, and barnacles (DNP, 2018a).

In addition, it is in close proximity to important wetland systems including the Cobourg Peninsula Ramsar site, and provides important foraging habitat for seabirds (DNP, 2018a). Biologically important areas within the marine park include inter-nesting habitat for marine turtles and important foraging and breeding habitat for seabirds. According to the North Marine Parks Network Management Plan 2018, there are no international, Commonwealth or national heritage listings apply to the marine park No international, Commonwealth or national heritage listings apply to the marine park Commercial fishing, tourism, and recreation, including fishing occur in the marine park (DNP, 2018a).

Arnhem AMP

The Arnhem AMP located 60 km southeast of the Arafura Marine Park, is extends from NT waters surrounding the Goulburn Islands, to the waters north of Maningrida. The marine park covers an area of 7,125 km² and water depth ranges from less than 15 m to 70 m. The marine park is significant because it contains habitats, species and ecological communities associated with the Northern Shelf Province. It includes dynamic habitats due to gently sloping shelf topped with a number of pinnacles, at depths ranging from 5 m to 30 m. It is nearby important wetland systems

including the Blyth-Cadell Floodplain and Boucaut Bay Nationally Important Wetland (outside of the spill EMBA, 667 km east of the activity area) and provides important foraging habitat for seabirds (DNP, 2018a).

Internal currents in the region drive a net clockwise movement of nutrient-rich coastal water contributing to high biological diversity. Tidal eddies induce localised upwellings and hotspots of productivity that correspond with aggregations of marine life within the marine park. No international, Commonwealth or national heritage listings apply to the marine park. Commercial fishing, tourism, and recreation, including fishing also occur in the marine park (DNP, 2018a).

Argo-Rowley Terrace AMP

The Argo-Rowley AMP covers an area of 146,003 km^2 and water depths between 220 m and 600 m. It is the largest in the Northwest Network, and is adjacent to the Mermaid Reef Marine Park and the WA Rowley Shoals Marine Park. It includes the deeper waters of the region and a range of seafloor features such as canyons on the slope between the Argo Abyssal Plain, Rowley Terrace and Scott Plateau. These are believed to be up to 50 million years old and are associated with small, periodic upwellings that results in localised higher levels of biological productivity (DNP, 2018b).

The Argo-Rowley Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Transition and Timor Province. It includes two KEFs:

- Canyons linking the Argo Abyssal Plain with the Scott Plateau and Mermaid Reef; and
- Commonwealth waters surrounding Rowley Shoals.

This AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the Marine Park include resting and breeding habitat for seabirds and a migratory pathway for the pygmy blue whale (DNP, 2018b). Commercial fishing and mining are important activities in the marine park (DNP, 2018b).

Ashmore Reef AMP

The Ashmore Reef AMP is in the Australian External Territory (AET) of Ashmore and Cartier Islands, approximately 630 km north of Broome, WA. It covers 583 km², with depths less than 15 m to 500 m. The Ashmore Reef AMP is comprised of three small islands, lagoons, sand flats, reef flats with a high diversity of hard and soft corals and sponges, and large seagrass meadows. The AMP is a Sanctuary Zone with a small Recreational Use Zone allowing access to the most westerly island.

The Ashmore Reef AMP is characterised by:

- The presence of around 100,000 seabirds than come to breed each year, including greater crested terns, white-tailed tropicbirds and greater frigatebirds, and tens of thousands of migratory shorebirds that forage in the surrounding waters, such as curlew sandpipers, bar-tailed godwits and great knots. It is also a breeding site for green turtles.
- Sea country within the AMP is valued for Indigenous cultural identity, health and wellbeing.
- Tourism, recreation and scientific research are important activities in the Marine Park.
- Two KEFs, namely:
    - The continental slope demersal fish communities KEF; and
    - The Ashmore Reef and Cartier Island and surrounding Commonwealth waters KEF.
- The presence of the Ashmore Reef National Nature Reserve Ramsar site.

Further information on KEFs and Ramsar sites is provided in Section 11.4.7 and Section 11.4.5 respectively.

Cartier Island AMP

The Cartier Island AMP lies in the Timor Sea within the AET of Ashmore and Cartier Islands, approximately 600 km north of Broome, WA. It covers 172 km², with water depths from less than 15 m to 500 m. The south-flowing Leeuwin Current originates in this region, and transports marine life southwards.

The entire Carter Island AMP is characterised by:

- Important habitat for seasnakes, turtles, whale sharks, corals, sea fans and sponges. This marine park and the nearby Ashmore Reef AMP are marine biodiversity hotspots, supporting a rich diversity of species and high numbers of individuals.
- Sea country within the marine park is valued for Indigenous cultural identity, health and wellbeing.
- Scientific research is an important activity in the AMP.
- Two KEFs, namely:
    - The continental slope demersal fish communities KEF, characterised by high levels of endemic fish; and
    - The Ashmore Reef and Cartier Island and surrounding Commonwealth waters KEF characterised by enhanced primarily productivity and aggregations of marine life.

Joseph Bonaparte Gulf AMP

The JBG AMP covers an area of 8,597 km^2 and water depths within the AMP range from less than 15 m to 75 m (Galaiduk *et al*., 2018). The JBG AMP is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Transition provincial bioregion and the Oceanic Shoals meso-scale bioregion (Galaiduk *et al*., 2018). The AMP contains a number of prominent shallow seafloor features including an emergent reef system, shoals and sand banks (Galaiduk *et al*., 2018). It also includes one key ecological feature, the Carbonate Bank and Terrace System of the Sahul Shelf, which is valued as a unique seafloor feature with ecological properties of regional significance (Galaiduk, *et al*., 2018). The Miriuwung, Gajerrong, Doolboong, Wardenybeng and Gija and Balangarra people have responsibilities for sea country in this AMP (DNP, 2018a).

Ranger led marine ecological surveys were conducted at the Joseph Bonaparte Gulf Marine Park (JBGMP) in 2021 and 2022. Results of the survey were released in 2023 (Udyawer et al., 2023). Overall, the surveys conducted at Emu Reefs, Emu Break and Howland Shoal highlighted the rich and diverse fish fauna within the JBGMP. The project established a baseline dataset of at least 59 species recorded within the JBGMP, including 10 species with threatened status (according to the IUCN). The BRUVs biodiversity data corroborates previous information from fisheries assessments on the common occurrence of Emperor and Snapper species (*Lutjanus spp. and Lethrinus spp.)*. The sightings of a large number of threatened species which include reef sharks, rays and wedgefish within the region highlights the healthy ecosystem within the Marine Park (Udyawer et al., 2023).

Kimberley AMP

The Kimberley AMP is located approximately 100 km north of Broome, WA and the central part of the Kimberley AMP is adjacent to the WA Camden Sound State Marine Park. It covers 74,469 km^2, with depths from less than 15 m to 800 m.

The Kimberley AMP is characterised by:

- High numbers of marine mammals such as dolphins, whales and dugong. The humpback whale breeds and calves in the Kimberley AMP annually after undertaking an extensive migration from Antarctica. Three dolphin species (Australian snubfin dolphin, Australian humpback dolphin and spotted bottlenose dolphin) use the Kimberley AMP to forage within and travel to coastal waters to calve and raise their young in inshore, protected waters.
- Important foraging rounds for seabirds and shorebirds known to breed on Adele Island (outside of the spill EMBA), including critically endangered eastern curlews and curlew sandpipers.
- Sea country within the AMP is valued for Indigenous cultural identity, health and wellbeing.
- Tourism, commercial fishing, mining, recreation (including fishing) and traditional use are important activities in the AMP.

There are no KEFs within the Kimberley AMP.

Mermaid Reef AMP

The Mermaid Reef AMP adjacent to the Argo–Rowley Terrace Marine Park, is located 280 km northwest of Broome and approximately 13 km from the Rowley Shoals Marine Park which falls under WA state jurisdiction. The Mermaid Reef Marine Park covers an area of 540 km² and water depths from less than 15 m to 500 m (DNP, 2018b).

It is significant because it contains habitats, species and ecological communities associated with the Northwest Transition. It includes the Mermaid Reef and Commonwealth waters surrounding Rowley Shoals KEF, and is one of three reefs forming the Rowley Shoals. The other two are Clerke Reef and Imperieuse Reef, to the southwest of the marine park, which are included in the WA Rowley Shoals Marine Park (DNP, 2018b).

Ecosystems of the Marine Park are associated with emergent reef flat, deep reef flat, lagoon, and submerged sand habitats. The marine park supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. Biologically important areas within the marine park include breeding habitat for seabirds and a migratory pathway for the pygmy blue whale. Important activities in the marine park include marine tourism, recreation, and scientific research (DNP, 2018b).

Montebello AMP

The Montebello AMP covers an area of 3,413 km² and water depths from less than 15 m to 150 m. It is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province. It includes one KEF: the ancient coastline at the 125-m depth contour. When tides are low, two coral reefs called Tryal Rocks emerge above the water (DNP, 2018b)

The marine park supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the marine park include breeding habitat for seabirds, internesting, foraging, mating, and nesting habitat for four species of marine turtles, a migratory pathway for humpback whales and foraging habitat for whale sharks (DNP, 2018b).

Tourism, commercial fishing, mining and recreation are important activities in this AMP (DNP, 2018b).

AMP Pressures

Section 2.4 of the North Marine Parks Network Management Plan 2018 (DNP, 2018a) and Section 2.4 of the North-west Marine Parks Network Management Plan 2018 (DNP, 2018b) identify pressures relevant to the marine park networks. Pressures are defined as human-driven processes, events and activities that may detrimentally affect the values of the reserves network. Table 11.14 summarises the pressures and sources of pressure on the conservation values of the of the NMR and NWMR Reserves Network.

Table 11.14 Summary of environmental pressures in the NWMR and NMR

Pressure	Description
Climate change	Climate change impacts on marine environments are complex and interrelated and may include changes in sea temperature, sea level, ocean acidification, sea currents, increased storm frequency and intensity and species range extension or local extinction. Examples of features and species vulnerable to climate change impacts include submerged coral reefs, sawfish, sharks, dolphins, seabirds and marine turtles.
Changes in hydrology	Coastal developments and agriculture have the potential to discharge increased sediment loads and pollutants to rivers, estuaries and nearshore coastal environments. This can result in increased turbidity and siltation, which in turn impacts species that spawn or inhabit coastal, nearshore or offshore waters. Habitats and species vulnerable to changes in hydrology include seagrass meadows, reefs, sawfish, shark and dugong.
Extraction of living resources	Sustainable fishing as well as illegal or unregulated fishing can modify natural populations and disproportionately target select valuable species. Species vulnerable to extraction include shark, sawfish, turtles, sea snakes, fish and dugong.
Habitat modification	Offshore infrastructure developments can impact habitat within marine parks through physical disturbance and indirectly through the physical presence of infrastructure. Benthic habitats may be impacted by direct discharges to the seabed resulting in smothering or a reduction in the quantity of light reaching the seabed. Habitats and species vulnerable to habitat modification include reefs, shoals and pinnacle habitats, turtles, fish, sea snakes, dolphins and dugong.
Human presence	Wildlife watching, camping, boating, diving and snorkelling are drawcard activities for people to the region and have the potential to impact natural wildlife behaviour or result in damage to fragile marine environments. Habitats and species vulnerable to these impacts include reefs, turtles and seabirds.
Invasive species	Accidental introduction and establishment of invasive species can have potentially debilitating impacts on island, reef or shallow-water marine ecosystems. Direct impacts from predation or damage to important habitat and indirect impacts from competition for food resources can affect native populations. Habitats and species vulnerable to invasive species include reefs, turtles, seabirds and saltwater crocodiles.
Marine pollution	Land-based and marine activities that result in pollution have the potential to impact marine park values. Discharges of emissions including light, marine debris, noise, oil and chemicals can be detrimental to marine life and cause contamination of ecosystems and entanglement of marine fauna. Habitats and

Pressure	Description
	species vulnerable to marine pollution include islands, reefs, shallow-water habitats, dolphins, whales, turtles, sawfish, sharks and seabirds.

11.4.2 World Heritage-Listed Properties

World Heritage-Listed properties are examples of sites that represent the best examples of the world's cultural and heritage values, of which Australia has 19 properties (DCCEEW, 2024e). In Australia, these properties are protected under Chapter 5, Part 15 of the EPBC Act.

The spill EMBA overlaps with the coastal areas of Kakadu National Park as well as Djidbordu (Barron Island) and Gardangarl (Field Island). This World Heritage-listed property is described below and illustrated in Figure 11.59.

Kakadu National Park

Kakadu's natural formations and wildlife habitats are one of the primary contributors to its listing as a UNESCO world heritage site. Over 100 reptiles inhabit the park, the saltwater crocodile being the most renowned (Kakadu Tourism, 2024). Kakadu also has its own flatback turtle population that nest on Field Island (within the spill EMBA) and a few beaches near West Alligator Head. Green turtles (*Chelonia mydas*) are seen swimming around the Kakadu coastline. The hawksbill turtle (*Eretmochelys imbricata*) feed in Kakadu, however, they do not nest in the area. There are very few reliable sightings of loggerhead turtles (*Caretta caretta*) in Kakadu as the water is not deep enough for their preferred habitat. The olive ridley turtle (*Lepidochelys olivacea*) has few remaining nesting sites in the world and there is one unconfirmed record of a nest in Kakadu (O'Dea, 2014).

Other threatened marine species that reside in the park include the Indo-Pacific humpback dolphin (*Sousa chinensis*), snubfin dolphin (*Orcaella heinsohni*), dugong (*Dugong dugon*), largetooth sawfish (*Pristis pristis*), dwarf sawfish (*Dwarf sawfish*), northern river shark (*Glyphis garricki*), and the speartooth shark (*Glyphis glyphis*) (O'Dea, 2014).

Several shorebirds including the eastern curlew (*Numenius madagascariensis*), Asian dowitcher (*limnodromus semipalmatus*), great knot (*Calidris tenuirostris*), red knot (*Calidris canutus*), bar-tailed godwit (*Limosa lapponica*), lesser sand-plover (*Charadrius mongolus)*, greater sand-plover (*Charadrius leschenaultii leschenaultia*) and the curlew sandpiper (*Calidris ferruginea*) feed on the well protected coast of Kakadu's mainland and Field and Barren islands (within the spill EMBA) (O'Dea, 2014). The Australian painted snipe (*Rostratula australis*) has only been recorded once within the park.

Kakadu National Park is also a recognised as a RAMSAR wetland and is described in Section 11.4.5.

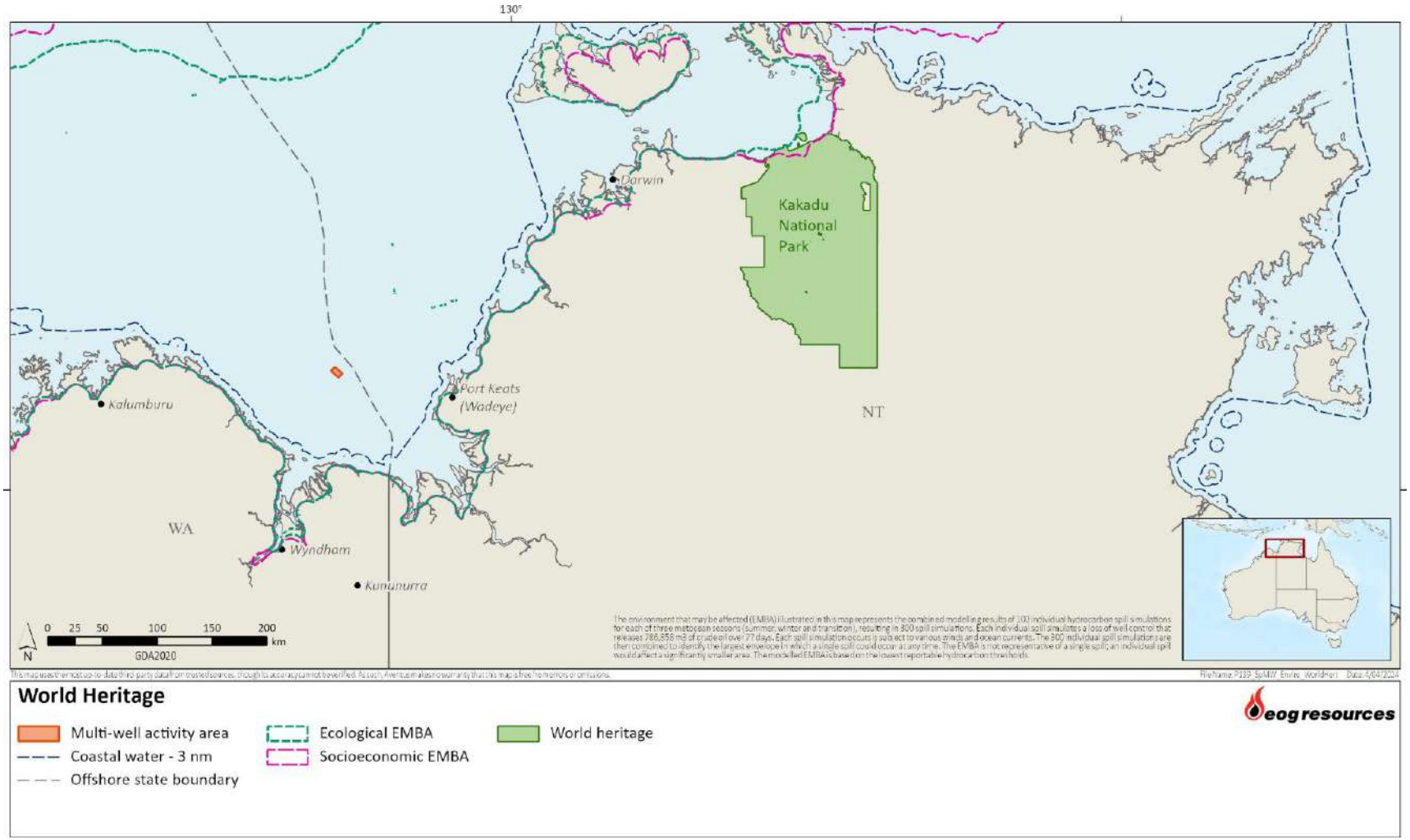


Figure 11.59 World heritage-listed Properties in the spill EMBA

11.4.3 Commonwealth Heritage-Listed Properties

Commonwealth Heritage Listed places are Indigenous, historic, and natural heritage places owned or controlled by the Australian Government. These include places connected to defence, maritime safety, communications, customs, and other government activities that also reflect Australia's development as a nation (DCCEEW, 2024h).

Several Commonwealth Heritage Listed properties were detected by the PMST (see Figure 11.60). Only properties that are marine/coastal and classed as 'natural' are discussed in this section.

Mermaid Reef – Rowley Shoals

Mermaid Reef is an AMP and described in section 11.4.1, Mermaid Reef - Rowley Sholas is also a KEF which is described in section 11.4.7.

Ashmore Reef Nature Reserve

Ashmore Reef is an AMP and NIW and described in section 11.4.1, 11.4.8 and Section 11.3.1.

Scott reef and surrounds

Scott Reef is described in in section 11.3.1.

Yampi Defence Area

Yampi Defence Area located on Koolan Island, WA displays a complex mosaic of landforms in the transition from the sandstone plateaux of the north-west Kimberley, to the broad plains and pindan scrub of the south-west Kimberley (DCCEEW, 2024h).The diversity of landforms results in a high concentration of small refugial habitats supporting regionally rich vertebrate as well as supporting several fauna and flora species that are listed as specially protected, threatened or having priority status in WA.

Bradshaw Defence Area

Bounded by the Fitzmaurice and Victoria Rivers on the shores of the JBG, Bradshaw Defence Field Training Area comprises a vast and rugged habitat endowed with a diverse array of plants and animals (DCCEEW, 2024h). Bradshaw has an unusually rich vertebrate fauna, second only to Kakadu National Park a total of 377 vertebrate species are known to occur within the place, comprising 22 frog, 77 reptile, 212 bird, 50 mammal species and 26 fish species.

11.4.4 National Heritage-Listed Properties

The National Heritage List is Australia's list of natural, historic and Indigenous places of outstanding significance to the nation (DCCEEW, 2024f). These places are protected under Chapter 5, Part 15 of the EPBC Act.

The socio-economic EMBA intersects the West Kimberley National Heritage Place and Kakadu National Park (which is described in section 11.4.2) as illustrated in Figure 11.60. This West Kimberley National Heritage Place is described below.

West Kimberley National Heritage Place

The West Kimberley was included on the National Heritage List in 2011 and has numerous values which contribute to the significance of the property, including indigenous, historic, aesthetic, cultural and natural heritage values (DCCEEW, 2024f). The West Kimberley National Heritage place covers a vast area that is characterised by a diversity of landscapes and biological richness found in its cliffs, headlands, sandy beaches, rivers, waterfalls and islands.

The values most relevant to the marine environment is Roebuck Bay as a migratory hub for shorebirds (Roebuck Bay does not fall within the spill EMBA).

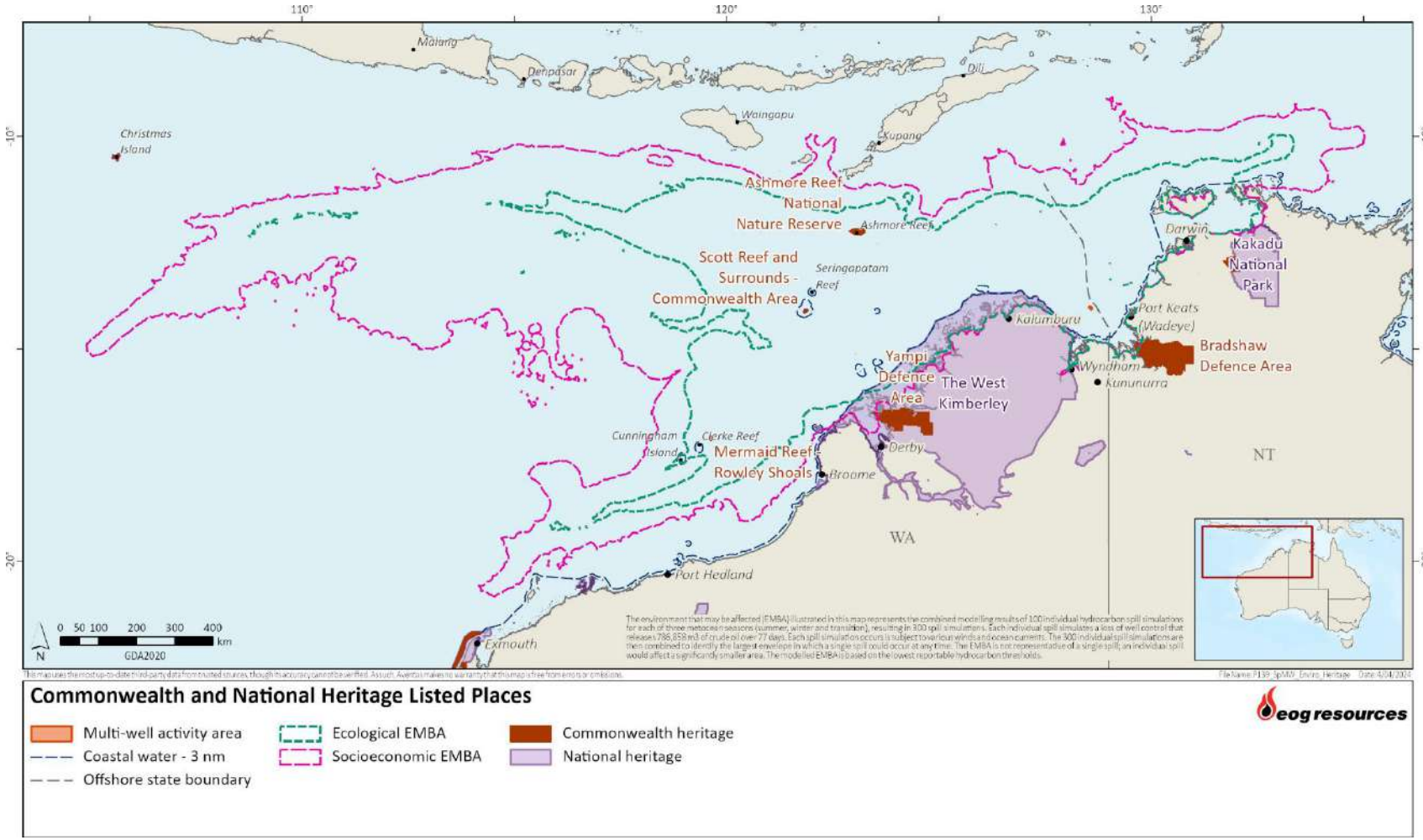


Figure 11.60 National Heritage and Commonwealth Heritage-listed Places in the spill EMBA

11.4.5 Wetlands of International Importance

Australia has 66 wetlands of international importance ('Ramsar wetlands') that cover more than 8.3 million hectares (as of September 2021) (DCCEEW, 2024g). Ramsar wetlands are those that are representative, rare or unique wetlands, or are important for conserving biological diversity, and are included on the List of Wetlands of International Importance developed under the Ramsar Convention. These wetlands are protected under Chapter 5, Part 15 of the EPBC Act.

There are four Ramsar-listed wetlands intersected by the spill EMBA (Figure 11.61), described here.

Ord River Floodplain

The Ord River Floodplain Ramsar site is a floodplain and estuarine wetland system located 87 km south of multi-well location. North of the lagoons, the site includes the Ord River Estuary leading into the Cambridge Gulf while the northeast end of the site heads around the coast to include a series of extensive intertidal creeks and flats known as the False Mouths of the Ord. The upstream portion of the floodplain and river tends to be freshwater and becomes more saline as the river approaches the Cambridge Gulf and falls under tidal influence (DCCEEW, 2024g).

Mangroves are the most common vegetation in the site, extending from the False Mouths of the Ord to the upstream sections of the estuary. The mangroves form narrow fringes along the intertidal areas, with saltmarsh on higher ground. The intertidal mangroves support many species of birds and bats and are a breeding area for banana prawns (DCCEEW, 2024g).

Over 200 species of birds have been recorded within the site including waterfowl, migratory shorebirds, mangrove birds and terrestrial species. The site supports the nationally threatened Australian painted snipe. The wetlands are habitat for many fish species that require migration between marine and more freshwater environments during their life, including the nationally threatened species largetooth sawfish, green sawfish and northern river shark. Reptiles that use the site include the freshwater crocodile and saltwater crocodile (DCCEEW, 2024g).

The Ord River Floodplain Ramsar site lies within the boundaries of six Indigenous language groups: Miriuwung, Gajerrong, Dulbung, Guluwaring, Djangade and Biambarr. The site contains Indigenous burial sites, artefact scatters, quarries, paintings and ceremonial sites (DCCEEW, 2024g). The Ord River Nature Reserve is gazetted for the conservation of flora and fauna. The Lower Ord River and the False Mouths of the Ord are popular destinations for locals and visitors for recreational fishing, crabbing and boating (DCCEEW, 2024g).

The *Ord River and Parry Lagoons nature reserves management plan 77 2012* (DEC 2012) is the approved management plan for the Ord River Floodplain Ramsar Site.

Ashmore Reef National Nature Reserve

The Ashmore Reef National Nature Ramsar site (Ashmore Reef Ramsar site) is located in the Indian Ocean approximately 840 km west of Darwin, 610 km north of Broome and 602 km northwest of multi-well location.

There are a number of other coral atolls and reefs within the Timor Province including Cartier Island, Seringapatam Reef and Scott Reef. These contain some of the same types of wetlands and habitats as Ashmore Reef Ramsar site, notably coral reefs, intertidal sand flats and sub-tidal beds (Hale and Butcher, 2013). However, Ashmore is the largest of the atolls in the region and has been managed for the purposes of conservation for three decades. Each of the wetland types present at Ashmore Reef Ramsar site is in near natural condition, with low densities of coral predators and disease (Hale and Butcher, 2013). The Ashmore Reef Ramsar site also has the highest seagrass

cover in the bioregion (Hale and Butcher, 2013). In addition, the three islands at Ashmore Reef Ramsar site (West, Middle and East) represent the only vegetated islands within the Timor Province bioregion (DEWHA 2008a). Thus, by definition the site contains bioregionally unique examples of wetland type E (sand, shingle or pebble shores) (Hale and Butcher, 2013).

Cobourg Peninsula

The Cobourg Peninsula Ramsar site is located approximately 163 km northeast of Darwin and 458 km northeast of multi-well location .

This Ramsar site occupies the entire peninsula and several nearby islands including the Sir George Hope Islands group, Sandy Island, Allaru Island, High Black Rock and Burford Island (BMT WBM, 2011) with the offshore islands (Figure 11.22). consisting of sandy shores, and the latter consisting of rocky shores; and tidal flats (sand, mud, sediment) and mangroves respectively. The Cobourg Peninsula Ramsar site is composed of a diversity of coastal and inland wetland types. Wetland types present include intertidal forested wetlands and salt flats, seasonal freshwater marshes and permanent freshwater pools. Using the Ramsar typology, there are ten coastal types and ten inland types within the site.

Cobourg Peninsula supports populations of threatened species including support for key life-cycle functions such as marine turtle breeding, waterbird breeding fish nursery and spawning habitats. The critical component of the site is the diversity and connectivity of a wide range of wetland habitat types, and is supported by populations of waterbirds, terrestrial ecosystems and freshwater fish and invertebrates (BMT WBM, 2011). Recent or continuing threats that are notable in the context of the site that may affect future ecological character include invasive species, climate change, tourism, marine debris, and resource extraction.

Kakadu National Park

The Kakadu National Park Ramsar site is located approximately 200 km east of Darwin and 422 km northeast of multi-well location. This Ramsar site is mainly an inland wetland ranging from intertidal forested wetlands and mudflats to seasonal freshwater marshes and permanent freshwater pools (BMT WBM, 2010). The socio-economic EMBA only intersects the coastal section of the Kakadu Park Ramsar site. The shoreline in this area consists of tidal flats (sand, mud, and sediment) and mangrove habitat.

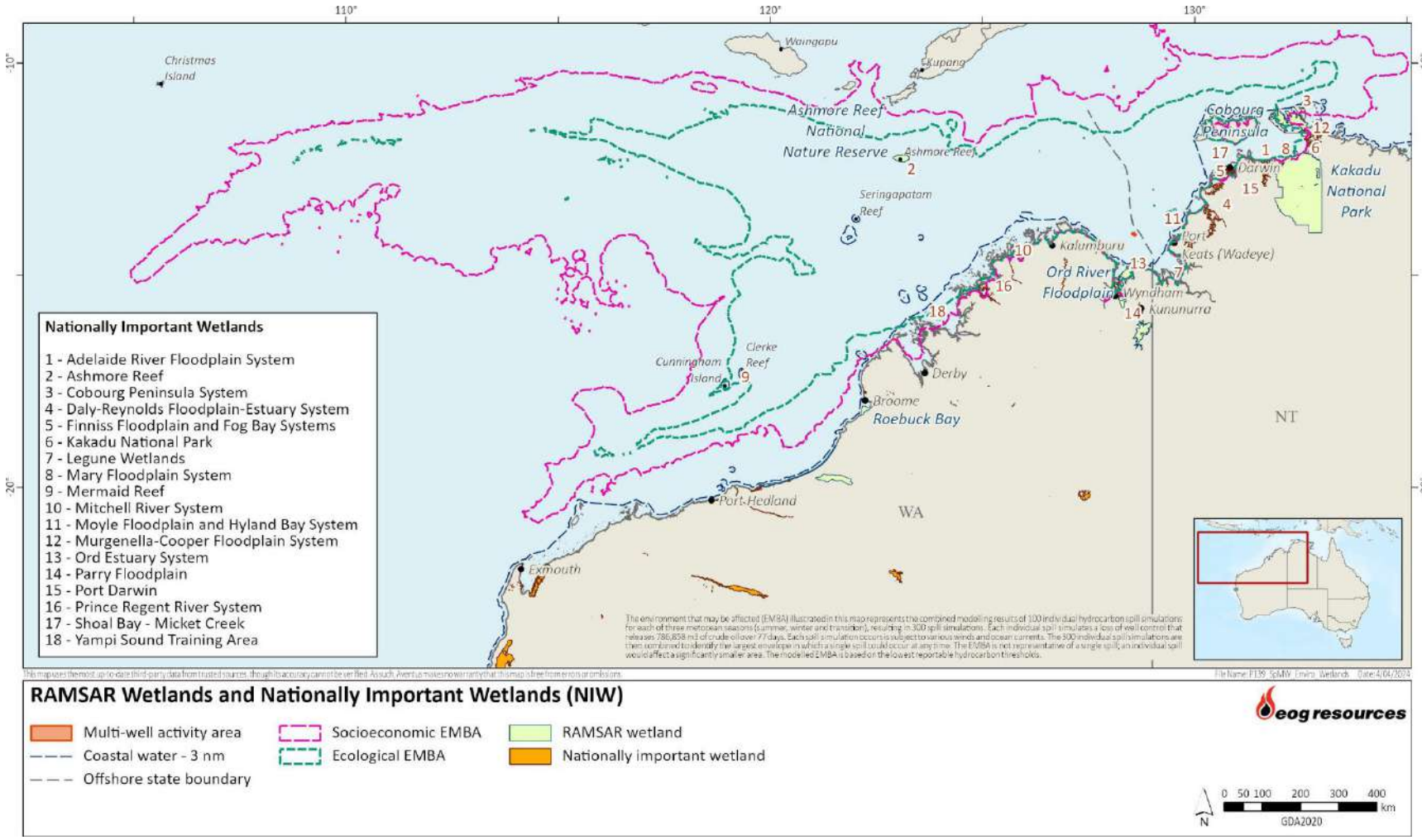


Figure 11.61 Wetlands of international importance and NIWs in the spill EMBA

11.4.6 Threatened Ecological Communities

The Australian Government is responsible for identifying and protecting MNES through the EPBC Act. Threatened Ecological Communities (TECs) are a MNES under the EPBC Act. TECs provide wildlife corridors and/or habitat refuges for many plant and animal species, and listing a TEC provides a form of landscape or systems-level conservation (including threatened species).

One TEC is identified in the spill EMBA, which is described below.

Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula

The vine thickets of the Dampier Peninsula are a very distinctive type of rainforest in the Kimberley region. This TEC is located about 641 km southwest of multi-well location.

This type of vine thicket is confined to the Peninsula between Broome and Derby, along with the coastal dune formations on which it occurs. Vine thickets occur as discrete areas of dense vegetation and can occur as a stand of a few trees or as larger patches. The 90 known occurrences vary in size from about 0.3 ha up to 507 ha, with a mean size of about 33 ha. They can occur as clumps or narrow linear stands (Black *et al*., 2010). The vine thicket community contains many plants with fleshy fruits that provide important food sources for fauna such as agile wallabies, bats, bower-birds and fruit-doves. They are also an important traditional resource for Indigenous people.

11.4.7 Key Ecological Features

KEFs are components of the marine ecosystem that are considered to be important for biodiversity or ecosystem function and integrity of the Commonwealth Marine Area.

There are several KEFs in the spill EMBA, which are illustrated in Figure 11.62 and described herein.

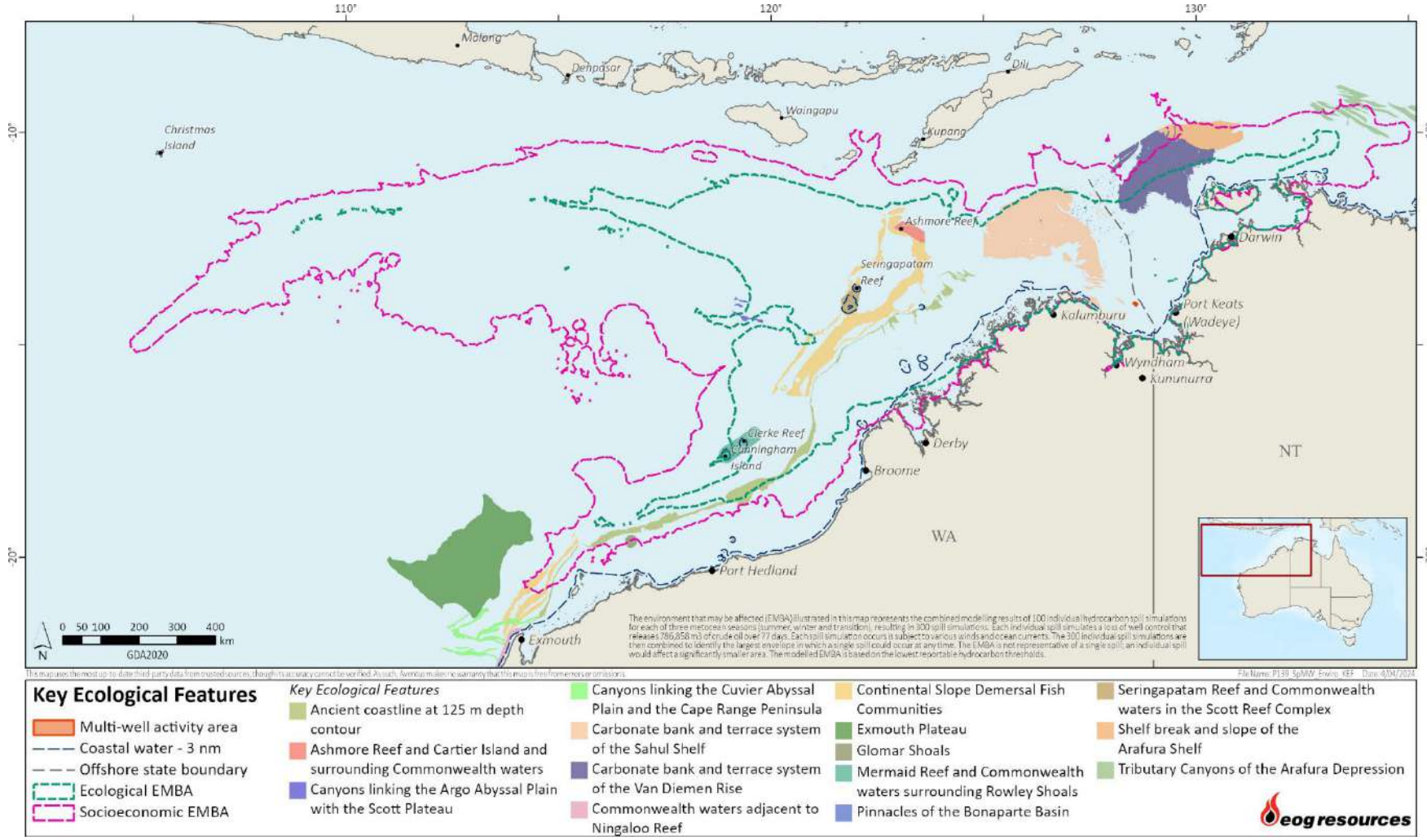


Figure 11.62 KEFs in the spill EMBA

Carbonate bank and terrace system of the Sahul Shelf

The carbonate bank and terrace system of the Sahul Shelf KEF is located in the western JBG and to the north of Cape Bougainville and Cape Londonderry. It is located 21 km west of multi-well location at its closest point.

The carbonate banks and terrace system of the Sahul Shelf is defined as a KEF for its role in enhancing biodiversity and local productivity relative to its surrounds as it is a unique seafloor feature supporting relatively high species diversity, making it regionally significant.

The KEF provides areas of hard substrate in an otherwise soft sediment environment, which is important for sessile species. Banks rise from depths of approximately 80 m to within 30 m of the surface. Banks that rise to within 45 m water depth support more biodiversity, such as communities of sessile benthic invertebrates including hard and soft corals, sponges, whips, fans and bryozoans (Brewer *et al*., 2007; Nichol *et al*., 2013). Brewer et al (2007) also noted that banks within the KEF support aggregations of demersal fish species such as snappers, emperors and groupers.

The banks are recognised as a biodiversity hotspot for sponges with more species and different communities than the surrounding seafloor (DCCEEW, 2024b). The KEF is also known as a foraging area for flatback, olive ridley and loggerhead turtles (DSEWPC, 2012).

Threats to the KEF include changes in sea temperature and ocean acidification, both resulting from climate change, as well as extraction of living sources from illegal, unreported and unregulated fishing (Brewer *et al*., 2007; Nichol *et al*., 2013).

Pinnacles of the Bonaparte Basin

The limestone pinnacles of the Bonaparte Basin lie on the mid-outer shelf in the western JBG. It is located 116 km northwest of multi-well location at its closest point. The pinnacles are defined as a KEF because they are a unique seafloor feature with ecological properties of regional significance.

The pinnacles provide areas of hard substrate in an otherwise soft sediment environment and are therefore important for sessile species. Pinnacles typically rise steeply from depths of about 80 m and emerge to within 30 m of the water surface, allowing light dependent organisms to thrive. Pinnacles that rise to within at least 45 m of the water surface support more biodiversity. Communities include sessile benthic invertebrates including hard and soft corals, sponges, whips, fans, bryozoans and aggregations of demersal fish species such as snappers, emperors and groupers (Brewer *et al*., 2007; Nichol *et al*., 2013). The pinnacles are also recognised as a biodiversity hotspot for sponges as they are home to more sponge species and different communities than the surrounding seafloor.

Carbonate bank and terrace system of Van Diemen Rise

The carbonate bank and terrace system of the Van Diemen Rise KEF is located on the north-eastern side of the JBG and partially overlaps with the north-east of the spill EMBA. It is located 229 km north of multi-well location at its closest point.

The KEF is considered important for its role in enhancing biodiversity and local productivity relative to its surrounds and for supporting relatively high species diversity. The KEF covers an area of 31,278 km^2.

The KEF is characterised by banks, ridges and terraces with relatively high proportions of hard substrate (DCCEEW, 2024b). Channel systems between the banks range from approximately 60–150 m to 10–40 m in depth (Anderson *et al.,* 2011) and supports sponge and octocoral gardens by providing epifauna habitat in an otherwise flat environment (Przeslawski *et al*., 2011). Whilst reef-

forming corals are rare throughout the JBG, some locally dense hard corals were found on the banks of the Van Diemen rise during marine surveys in 2009 and 2010 (Przeslawski *et al*., 2011).

A study of the sponge diversity and ecology of the Van Diemen Rise identified the region as a sponge biodiversity hotspot (Przeslawski *et al*., 2014). Sponges were collected with a benthic sled from five geomorphic features (banks, terrace, ridge, plain and valley), resulting in the identification of 283 species. The study found that sponge diversity was generally highest further offshore and on raised geomorphic features, particularly banks. Pelagic fish such as mackerel, red snapper and a distinct gene pool of goldband snapper are found in the Van Diemen Rise (Blaber *et al*., 2005; Salini *et al*., 2006). Olive ridley turtles, seasnakes and sharks have also been reported to occur in the area (DCCEEW, 2024b).

Ancient Coastline at 125 m depth contour

The ancient coastline at 125 m depth contour KEF comprises a series of several steps and terraces that form an escarpment along north-west WA centred around the 125 m isobath, although this feature is not continuous. It is located 410 km west of multi-well location at its closest point.

The KEF is an important divide between carbonate, cemented sands and the fine, less cemented slope materials found offshore. It is valued as a unique seabed feature with ecological properties of regional significance. Hard substrate areas of the ancient coastline are thought to provide biologically important habitat in an area predominantly made up of soft sediment (DCCEEW, 2024b).

Continental slope demersal fish communities

The continental slope demersal fish communities KEF is considered important due to its high levels of endemism (DEWHA 2008b). It is located 528 km west of multi-well location at its closest point.

The diversity of demersal fish assemblages on the continental slope in the Timor Province, the Northwest Transition and the Northwest Province is high compared to elsewhere along the continental slope (DEWHA 2008b). The KEF supports two distinct demersal community types (biomes) associated with the upper slope (water depth of 225–500 m) and the mid-slope (750–1,000 m) (DCCEEW, 2024b). Although poorly known, demersal-slope communities are thought to rely on bacteria and detritus-based systems comprised of infauna and epifauna, which in turn become prey for a range of teleost fish, molluscs and crustaceans (Brewer *et al*., 2007). Higher-order consumers may include carnivorous fish, deep water sharks, large squid and toothed whales (Brewer *et al*., 2007).

Glomar Shoals

The Glomar Shoals are a submerged littoral feature located approximately 150 km north of Dampier on the Rowley shelf at water depths of 33 m to 77 m (Falkner *et al.,* 2009). The shoals are defined as a KEF primarily due to their high productivity and aggregations of marine life.

The shoals consist of a high percentage of marine-derived sediments with high carbonate content and gravels of weathered coralline algae and shells (McLoughlin and Young, 1985). The area's higher concentrations of coarse material in comparison to surrounding areas are indicative of a high-energy environment subject to strong sea-floor currents (Falkner *et al.,* 2009).

While the biodiversity associated with the Glomar Shoals has not been studied, the shoals are known to be an important area for a number of commercial and recreational fish species such as rankin cod, brown striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish (Falkner *et al.,* 2009; Fletcher and Santoro, 2009). These species have recorded high catch rates associated with the Glomar Shoals, indicating that the shoals are likely to be an area of high productivity.

Mermaid Reef and Commonwealth waters including Rowley Shoals

The Mermaid Reef and Commonwealth waters surrounding Rowley Shoals is defined as a KEF for its enhanced productivity and high species richness and benthic and pelagic habitats within the feature. The Rowley Shoals are a collection of three atoll reefs, Clerke, Imperieuse and Mermaid, which are located about 300 km northwest of Broome. This KEF encompasses Mermaid Reef Commonwealth Marine Reserve as well as waters from 3 nm out to 6 nm surrounding Clerke and Imperieuse reefs (DCCEEW, 2024a). Mermaid Reef lies 29 km north of Clerke and Imperieuse reefs and is totally submerged at high tide. Mermaid Reef falls under Commonwealth jurisdiction. Clerke and Imperieuse reefs constitute the Rowley Shoals Marine Park, which falls under WA Government jurisdiction (DCCEEW, 2024a).

Mermaid Reef and Commonwealth waters surrounding Rowley Shoals are regionally important in supporting high species richness, higher productivity and aggregations of marine life associated with the adjoining reefs themselves (Done *et al.,* 1994). The reefs provide a distinctive biophysical environment in the region as there are few offshore reefs in the northwest. They have steep and distinct reef slopes and associated fish communities. In evolutionary terms, the reefs may play a role in supplying coral and fish larvae to reefs further south via the southward flowing Indonesian Throughflow. Both coral communities and fish assemblages differ from similar habitats in eastern Australia (Done *et al.,* 1994).

Ashmore Reef and Cartier Island and surrounding Commonwealth waters

The Ashmore Reef and Cartier Island and surrounding Commonwealth waters KEF is regarded as a biodiversity hotspot which supports a diverse array of pelagic and benthic marine species. It is located 557 km northwest of multi-well location. The KEF is considered important due to its aggregations of marine life and enhanced primarily productivity in an otherwise low-nutrient environment.

Ashmore Reef and Cartier Island are situated on the shallow upper slope of the Sahul Shelf, north of Scott and Seringapatam reefs. They form part of a series of submerged reef platforms along the outer edge of the continental slope of the NWMR. Localised upwelling and turbulent mixing in the surrounding Commonwealth waters provide nutrients to support the reef structure and ecology (DEWHA 2008b).

Ashmore Reef and Cartier Island and the surrounding Commonwealth waters are regionally important for feeding and breeding aggregations of birds and other marine life, including an unusually high diversity of sea snakes, a genetically distinct breeding population of green turtles and foraging grounds for green, loggerhead and hawksbill turtles (Limpus, 2008). The reef system is an important staging post for seabirds and migratory shorebirds and the area is home to some of the most important seabird colonies in the NWMR (Milton, 2005). Ashmore Reef supports the highest number of coral species of any reef off the WA coast.

Canyons linking the Argo Abyssal Plain with the Scott Plateau

The canyons linking the Argo Abyssal Plain with the Scott Plateau is defined as a KEF for their high productivity and aggregations of marine life (DCCEEW, 2024a). These values apply to both the benthic and pelagic habitats within the feature.

The spatial boundary of this KEF includes three canyons, adjacent to the south-west corner of Scott Plateau. The canyons cut deeply into the south-west margin of the Scott Plateau at an approximate depth of 2,000 m to 3,000 m, and act as conduits for transport of sediments to depths of more than 5,500 m on the Argo Abyssal Plain. The water masses at these depths are deep Indian Ocean water on the Scott Plateau and Antarctic bottom water on the Argo Abyssal Plain. Both water masses are cold, dense and nutrient-rich (DCCEEW, 2024a).

Seringapatam Reef and Commonwealth waters in the Scott Reef complex

The Seringapatam reef and Commonwealth waters in the Scott reef complex are defined as a KEF as they support diverse aggregations of marine life, have high primary productivity relative to other parts of the region, are relatively pristine and have high species richness, which apply to both the benthic and pelagic habitats within the feature (DCCEEW, 2024a).

Scott and Seringapatam reefs are part of a series of submerged reef platforms that rise steeply from the sea floor between the 300–700 m contours on the northwest continental slope and lie in the Timor Province (Falkner *et al.,* 2009). Scott and Seringapatam reefs provide an important biophysical environment in the region as one of few offshore reefs in the northwest. The spatial boundary of this KEF includes both reefs plus the adjacent apron/fan features, and the canyon approximately 10 km to the west of Scott Reef. The southern edge of the KEF is defined by the state water boundary around Scott Reef (DCCEEW, 2024a).

As two of the few offshore reefs in the north-west, they provide an important biophysical environment in the region (DCCEEW, 2024a). The coral communities at Scott and Seringapatam reefs play a key role in maintaining the species richness and subsequent aggregations of marine life. Scott and Seringapatam reefs and the waters surrounding them attract aggregations of marine life including humpback whales and other cetacean species, whale sharks and several species of sea snake. Two species of marine turtle nest and forage during the summer months, and this KEF also provides foraging areas for various seabird species (DCCEEW, 2024a).

Shelf break and slope of the Arafura Shelf

The shelf break and slope of the Arafura Shelf is located north of the Tiwi Islands, near the edge of the Australian EEZ. It is defined as a KEF for its ecological significance associated with productivity emanating from the slope and forms part of a unique biogeographic province (Last *et al.,* 2005). The spatial boundary of this KEF includes the area of slope north of the Van Diemen Rise, an adjacent area of shelf, extending south to the terrace edge of the Van Diemen Rise in the western part and bounded by the 100 m depth contour in the east. At the eastern end, the area of shelf included extends to approximately the eastern extent of the slope. The slope and shelf areas contain pinnacles and reefs (DCCEEW, 2024a).

Phytoplankton and invertebrates have been sampled in the area (Hallegraeff and Jeffrey 1984; Wilson, 2005), and primary production of phytoplankton is thought to form the basis for offshore food webs (DEWHA, 2007). Fish communities that occur in this key ecological feature represent the break between the Timor Province provincial bioregion and the Timor Transition provincial bioregion (Last *et al*., 2005). Records show at least 284 demersal fish species are found in the area (Last *et al.,* 2005), including commercially fished red snapper species. The area is also likely to support whale sharks, sharks and marine turtles (DEWHA, 2007).

Tributary canyons of the Arafura Depression

The Tributary canyons of the Arafura Depression are defined as a KEF for their high productivity and high levels of biodiversity and endemism, in both the benthic and pelagic habitats within this feature (DCCEEW, 2024a).

Nearly all the canyons in the NMR are located within this KEF in which endemic benthic species are thought to occur (Wilson, 2005). Primary productivity in this feature is likely to be associated with movements of water through the canyons and surface water circulation driven by seasonal north-west monsoon winds.

Biological diversity and ecosystem processes in the area are influenced by the state of the canyon habitats. The steep topography of the canyons, their diverse current regimes, nutrient enrichment

and entrapment, detritus funnelling and diverse substrate types form widely divergent ecosystems (McClain and Barry 2010; Vetter, 1994; Vinogradova, 1959), coupled with the regional setting and geological origins of the area, strongly influence species biodiversity (Kloser *et al.,* 2010).

At least 245 macroscopic species, including a diverse variety of invertebrates (e.g. sponges, corals, sea anemones, tunicates, worms, crustaceans, brittle stars, feather stars) and six small fish species have previously been sampled (Wilson, 2005). It is estimated that a further 500 species could be identified from post-survey analysis of grab and dredge samples (Wilson, 2005). Marine turtles, likely to be olive ridleys, have been reported to feed in the vicinity of the canyons (Whiting *et al.,* 2007).

11.4.8 Nationally Important Wetlands

NIWs are considered significant for a variety of reasons, including their importance for maintaining ecological and hydrological roles in wetland systems, providing important habitat for animals at a vulnerable or particular stage in their life cycle, supporting 1% or more of the national population of any native plant or animal taxa or for its outstanding historical or cultural significance (DCCEEW, 2024i).

There are 18 NIWs that are intersected by the spill EMBA, as illustrated in Figure 11.61 and described in Table 11.15. Information provided in Table 11.15 is sourced from DAWE's online Directory of Important Wetlands (DCCEEW, 2024i). Noting there are NIWs shown in Figure 11.61 that are in close proximity and/or outside of the spill EMBA, these are not discussed further in this section.

Table 11.15 Nationally important wetlands in the spill EMBA

Name	Distance from multi-well location	Description
WA		
Ord Estuary	88 km south	The Ord River system is a floodplain and estuarine wetland system consisting of broad floodplains known to periodically flood and dry out; and permanent waterholes (known as the Parry Lagoons) (DCCEEW, 2024i). The wetlands are a habitat for many diadromous fish species (that migrate between salt water and freshwater environments), including nationally threatened species such as freshwater sawfish, green sawfish and the northern river shark. Freshwater and saltwater crocodiles are also known to use the wetland (DCCEEW, 2024i).
Mitchell River System	317 km southwest	The Mitchell River system consists of a relatively small river system and estuary, with an of escarpment of vertical multi-stage waterfalls (e.g., Mitchell Falls). Tributaries of the system are Camp Creek (off Mitchell Plateau), Youngs Creek and Leichardt Creek. The creeks and upper reaches of Mitchell River are seasonal; the entrenched lower reaches are permanent or near-permanent; twice-daily tides occur in the estuary. At least 10 species of freshwater fish are known to inhabit the waters of the Mitchell River. Seven waterbird species have been recorded in the system (DCCEEW, 2024i).
Parry Floodplain	133 km south	The Parry floodplain is a good example of a tropical floodplain with permanent billabongs, seasonal marshes and wooded swamp (one of the few such floodplains of substantial area in WA). The site comprises the lower reaches and floodplain of Parry Creek including Parry Lagoons and numerous other lagoons, billabongs including claypans. The floodplain is 5 km southwest of the Ord River and

Name	Distance from multi-well location	Description
		adjoins tidal wetlands of the Ord estuary system in the north. Surface water flows in the floodplain from upper Parry Creek, originating 25 km south of the site in disturbed (fire and grazing) catchment, and from several short creeks; and occasionally from the Ord River. Seventy-seven waterbird species (including 24 shorebirds and four terns) are recorded in this system (one of the highest totals in the Kimberley); with 22 listed under treaties. Both freshwater crocodile and saltwater crocodile occur in the permanent billabongs (DCCEEW, 2024i).
Prince Regent River System	393 km southwest	The Prince Regent River System is a tropical estuary and river system incised in a plateau. There are nine major tributaries to this river, originating 11 km to 32 km from their junctions with the river (e.g., Youwanjela Creek from north-east, Cascade Creek from south southwest). The water catchments are relatively undisturbed and the only known habitat of two freshwater fishes; habitat to 15 waterbird species and an important breeding and non-breeding area for saltwater crocodile (DCCEEW, 2024i). The area is nominated as an IBA (Birdlife International, 2022)
Yampi Sound Training Area	576 km southwest	The Yampi Sound Training Area contains large areas of coastline. The central and southwestern region is flat, consisting of the low lying flood plains of the Robinson River and its tributaries. The average annual rainfall in the training area is approximately 1,000 mm, which falls almost entirely during the summer wet season from November to April. During this time numerous permanent and semi-permanent pools along both major and minor watercourses are maintained. The Robinson River is tidal, with extensive tidal flats bordering King Sound. Tides are up to 11 m (DCCEEW, 2024i). Threatened species such as the Little Tern, Gouldian Finch and Western Partridge Pigeon have been recorded in the area (DCCEEW, 2024i).
Mermaid Reef	1,020 km southwest	Mermaid reef is the most north-easterly atoll of the Rowley Shoals, which comprises three distinct reef systems arising from depths of between 300 and 700 m along the edge of the continental shelf. The reef experiences a semi-diurnal tidal cycle with a spring range of about 4.5m (DCCEEW, 2024i). Fauna surveys indicate the reef has a rich and diverse fauna which is regionally important, which includes some endemics and species not occurring elsewhere in Western Australia (Berry ,1986; Done *et. al.,* 1994). In addition to the diverse range of coral species, other benthic groups include sponges, bryozoans, ascidians (sea squirts) polychaetes, molluscs, echinoderms, crustaceans and cnidarians (jellyfish) (DCCEEW, 2024i).
Ashmore Reef	621 km northwest	Ashmore Reef is described in Section 11.3.1 and 11.4.1. Ashmore Reef is one of only three emergent oceanic reefs in the north eastern Indian Ocean, and the only one having vegetated islands (DCCEEW, 2024i). Some 95 species of bird have been recorded from the reef and its adjacent waters. Forty-three of these species are listed on the Japan-Australia and China-Australia Migratory Birds Agreements. The islets are an important staging point for wading birds migrating between Australia and the northern hemisphere. The islands are major seabird nesting sites with 20 breeding species

Name	Distance from multi-well location	Description
		recorded to date. The total bird population has been estimated to exceed 100,000 during the peak breeding season (DCCEEW, 2024i).
NT		
Legune (JBG) Wetlands	128 km southeast	The Legune wetlands are floodplain including meso and microscale pools and channels. The Legune Homestead Swamps are regionally significant Eleocharis-dominated wetland supporting significant waterbird numbers in the dry season, and breeding magpie geese in the wet season. The Osmans Lake System is the main area of open shallow wetland in the Keep River drainage. In combination the swamps and lake systems provide a good diversity of wetland habitat in a relatively small area. Forty-seven species of waterbirds have been recorded in the wetlands, 14 of them listed under treaties (JAMBA/CAMBA) (DCCEEW, 2024i). The wetlands are also nominated as an IBA (Birdlife International, 2022)
Moyle Floodplain and Hyland Bay System	119 km east	Located in the Bonaparte Gulf Basin, the Moyle Floodplain and Hyland Bay System is classed as a megascale irregular floodplain with mesoscale sinuous channel and several mesoscale sumplands. Water supply to the floodplain is from surface inflow from creeks originating 10 km to 22 km southwest and southeast, with surface inflow to the east and north from the Moyle River. Forty-seven bird species known to occur on floodplain and adjacent coast, with 26 listed under treaties (JAMBA, CAMBA, BONN). The floodplain is a significant breeding area for magpie geese, with especially large breeding populations in drier years. The mudflats of Hyland Bay support relatively high numbers of migrant shorebirds. There are at least two significant waterbird breeding rookeries in the area which include darter and cormorant species (BirdLife, 2022; Whitehead *et al.,* 1992) and the area is nominated as an IBA. The tidal estuary and creeks support a particularly high density of Saltwater Crocodiles, that also breed on the floodplain channel (DCCEEW, 2024i).
Daly-Reynolds Floodplain Estuary System	187 km northeast	One of the largest floodplains in the NT with the largest catchment of any major freshwater floodplain system. Water supply to the floodplain esturary is primarily from the Daly River, originating 275-300 km east north-east to south-south-east (catchment area of 49 000 km^2), and the Reynolds River, originating 60 km south-east (catchment area of 10 000 km^2); with substantial inflow from from Hermit-Door Creek system, Kilfoyle, Lookout, Woomeroo and unnamed Creeks. More than 80 fauna species, with at least 30 species listed under treaties (JAMBA/CAMBA), are known to occur within the site and is an IBA (Birdlife International, 2022). The system supports a large number of magpie geese. Reptiles (frogs, freshwater turtles) are known to occur in areas of the system, which also acts as an important breeding area for saltwater crocodile (in swamps and billabongs) and habitat for freshwater crocodiles (further upstream) (DCCEEW, 2024i).
Finniss Floodplain and Fog Bay Systems	205 km northeast	A megascale irregular floodplain, with a network of microscale irregular creeks and a series of mesoscale (almost closed loop) irregular channels, also several microscale irregular estuaries and a macroscale embayment (mudflats part, up to 1.5 km wide). Surface

Name	Distance from multi-well location	Description
		water inflow is mainly from the Finniss river originating 50 km southeast (catchment area exceeds 110 000 ha), and several creeks. This system supports a major breeding area for magpie geese, at times a significant dry season refuge area for waterbirds (whistling-ducks); a major migration stop-over area for shorebirds; and a major breeding area for saltwater crocodile (DCCEEW, 2024i). The site is nominated as an IBA (Birdlife International, 2022).
Port Darwin	291 km northeast	A shallow branching embayment supporting one of the largest discrete areas of mangrove swamp in the NT. The wetland acts as a major nursery area for estuarine and offshore fish and crustaceans in the Beagle Gulf area. At least 48 bird species occur, 25 listed under treaties (JAMBA, CAMBA, BONN); including four cormorants, nine herons and allies, three rails, 23 shorebirds and six gulls and terns. Dolphins and turtles are commonly observed (DCCEEW, 2024i).
Adelaide River Floodplain System	350 km northeast	A major floodplain-tidal wetland system typical of the Top End region, consisting of the largest blocks of mangrove associated with a floodplain, a tightly meandering major tidal river, and several marginal lakes and swamps including the largest floodplain lake (Lake Finniss), and near-permanent marsh (Fogg Dam, Melacca Swamp), considered a rare wetland type in NT. Records indicate there are 88 waterbird species, 43 of them listed under treaties (JAMBA/CAMBA). Saltwater crocodiles, freshwater crocodiles, freshwater turtles, water python, snakes, frogs and numerous fish species are associated with the floodplain, fringing billabongs and swamps. Dolphins and dugongs occur in the lower part of the estuary (DCCEEW, 2024i). The area is nominated as an IBA (Birdlife International, 2022).
Shoal Bay - Micket Creek	312 km northeast	The Shoal Bay – Micket creek is a spring fed coastal freshwater floodplain consisting of wetland marshes, mangrove woodlands, beaches, mudflats, creeks and estuaries. The wetland area stretches from Lee Point, which is outside Defence property, around the coast to Gunn Point. Micket Creek is a tidal estuary flowing into Shoal Bay. King creek, other smaller creeks, and water from Noogoo Swamp flow into Shoal Bay. The Micket Creek area is a significant bird habitat with over 200 species of birds recorded and is an IBA (Birdlide International, 2022). It is also a dry season refuge for waterfowl and birds of prey. High numbers of migratory shorebirds regularly use the areas' mudflats with counts of more than 15,000 waders. The estuary creeks provide a significant nursery for Barramundi. Twenty-five migratory birds listed on international agreements with Japan and China (JAMBA/CAMBA) have been recorded from intertidal feeding sites, saline flats and local sewage ponds. The most common of these birds are the greenshank, sharp-tailed sandpiper, bar-tailed godwit, black-tailed godwit, great knot, large sand plover and red-necked stint. The area is also notable for the nationally endangered little tern (DCCEEW, 2024i).
Mary Floodplain System	362 km northeast	A major floodplain-tidal wetland system typical of the Top End region, however unusual due to a lack of coherent river channel or major river estuary. The Mary Floodplain adjoins the Adelaide River Floodplain System located in the northwest. The site includes some of

Name	Distance from multi-well location	Description
		the largest areas of wooded swamp (apart from Arafura Swamp) in the NT and featuring a complex network of channels and billabongs. At least 75 bird species have been recorded, 33 listed under treaties (JAMBA, CAMBA, BONN. The site is one of the two to three most important breeding areas for magpie goose in part due to an abundance of nesting sites and feeding habitat (DCCEEW, 2024i).
Kakadu National Park	415 km northeast	Kakadu National Park is a Ramsar site of contiguous wetlands comprising the catchments of two large river systems, the East and South Alligator rivers, seasonal creeks and the lower reaches of the East Alligator River. It also includes the Magela Creek floodplain, the lower South Alligator floodplain, the entire West Alligator River system and nearly all the Wildman River system. During the dry season water contracts into lagoons and billabongs and up to two million waterbirds frequent the floodplains. At least 53 species of waterbirds use the Ramsar site including large concentrations of magpie geese and wandering whistling-duck. These and many other species breed in the wetlands but most species are dry season migrants (DCCEEW, 2024i). Both freshwater and saltwater crocodiles are known to breed within the Ramsar site. Fifty-nine fish species are known from the wetland, including eight with narrowly restricted ranges (DCCEEW, 2024i).
Murgenella-Cooper Floodplain System	487 km northeast	A good example of a floodplain-tidal wetland system of the Top End region, with relatively low volume of freshwater inflow. Surface water flows into the system mainly from Cooper Creek, originating 70 km east south-east (catchment area of 165 000 ha), and several unnamed creeks including minor creeks. At least 71 bird species have been recorded in the area, 26 on treaties (JAMBA, CAMBA, BONN). Magpie geese breed extensively on both Murgenella and Cooper Floodplains. Although, the Murgenella floodplain is not known as a breeding area for saltwater crocodile, Cooper creek swamps are thought to have high numbers (DCCEEW, 2024i).
Cobourg Peninsula System	453 km northeast	The Coburg Peninsula system is a good example of mangrove swamp occurring around tidal channels and islands not associated with substantial riverine inflow. It is has one of the largest discrete blocks of mangroves in the NT. Most of the site's wetlands are tidal, with numerous creeks flowing into the tidal areas. 58 species of bird species have been recorded, at least 21 listed under treaties (JAMBA/CAMBA); includes four darters and cormorants, 12 herons and allies (e.g., eastern reef egret), 23 shorebirds (e.g., eastern curlew) and six gulls and terns. Saltwater crocodile are present in the tidal areas (e.g., south ends of Port Bremer and Raffles Bay) but densities are relatively low. At least 13 frog species occur on the peninsula. Marine turtles (green and hawksbill turtles) occur at most of the islands and headlands, with all species known to breed in the NT. Dugong occur in the Minimini channels and widely in adjacent shallow seas, with high densities in some northern embayments (DCCEEW, 2024i).

11.4.9 State/Territory Protected Areas

There are several WA and NT managed marine protected areas intersected by the spill EMBA, (see Figure 11.58) and described in Table 11.16.

Table 11.16 Marine protected areas in the spill EMBA

Name	Distance from multi-well location	Description
WA		
North Kimberley Marine Park	66 km south	The North Kimberley Marine Park is the largest state marine park in WA, covering an area of approximately 18,450 km^2. The park is located in state waters and extends from York Sound to Cape Londonderry, to the JBG and up to the WA/NT border (DPW, 2016). The park is managed under a joint management plan between the Department of Parks and Wildlife (DPW) and the Uunguu, Balangarra, Miriuwung Gajerrong and Wilinggin traditional owners (DPW, 2016). The coastline of this marine park (from west coast of Cambridge Gulf) is a National Heritage Place (Indigenous). The North Kimberley Marine Park covers a large variety of marine habitats including sub-tidal and inter-tidal (fringing) coral reefs, seagrass, mangroves and macroalgal communities. More than 1,000 islands and associated intertidal and subtidal habitats are contained within its boundaries. Seagrass beds found around Cape Londonderry (162 km west of the activity area) provide foraging areas for dugong and marine turtles (DPW, 2016). The marine park surrounds thousands of islands with diverse and rich habitats. Marine turtle nesting sites and breeding sites for seabirds and migratory shorebirds have been identified within the marine park, and fringing reefs line the shores of almost all of the islands (DPAW, 2016). Fringing reefs occur along sectors of the mainland coast (Elsie Island to Cape Talbot, Cape Bougainville) (Christiansen *et al*., 2010). The productive deep waters that surround the islands and open sea reefs provide foraging habitat for marine mammals and pelagic fish, such as mackerel (DPW, 2016). The complex coastline of the mainland also creates a variety of habitats and communities, including important areas for dugongs, Australian snubfin dolphins and Australian humpback dolphins (DPW, 2016). Hotspots for dugongs occur to the northeast of Bigge Island to the Maret and Montalivet Islands and around the Anjo Peninsula in Vansittart and Napier Broome Bays (DPW, 2016). The MP is a globally significant area for sawfish, with finfish targeted by commercial and recreational fishermen (DPW, 2016). The marine park also contains many places of cultural and spiritual importance to traditional owners (DPW, 2016). Environmentally significant areas with the marine park include: • King Shoals Sanctuary Zone – supports a wide diversity of organisms including corals and other reef dwelling species. The area is likely to be foraging grounds for flatback turtles and sawfish. King Shoals falls within the critical habitat zone for flatback turtles (all year) (DoEE, 2017).

Name	Distance from multi-well location	Description
		• Cape Domett Special Purpose Zone – is a globally significant nesting area for flatback turtles, and the surrounding waters provide habitat for sawfish, Australian snubfin dolphins and include mangroves. Cape Domett is nominated as a critical habitat for the flatback turtle (all year, peaking July to September) (DoEE, 2017). Social values (recreation, tourism and community values) within the park include nature-based, cultural and recreational activities and tourism experiences. Tourism is a significant industry for the Kimberley, estimated to directly employ 2,500 people (DPW, 2016). The expedition cruise boat industry operates in the dry season (April to October) between Broome and Wyndham/Darwin (estimated to be valued at $63 million). Visitors also access the coast by road with more than 1,000 visitors (2016) to the coast near Kalumburu each year (DPW, 2016).
Malaya Marine Park	586 km southwest	The Mayala Marine Park is located in the west Kimberley region of WA, within the Mayala people's Native Title determination area. The park has remained a place of exceptional value for the Mayala people for tens of thousands of years. The Mayala Marine Park makes up 315,000 hectares of the Kimberley marine reserves (DBCA, 2022a). The marine park is managed under the Mayala Marine Park joint management plan, which was released in July of 2022. The plan represents the joint management of the park between the Mayala Traditional Owners and the DBCA and their shared vision to preserve the natural, recreational, commercial, cultural and heritage values of the park for future generations (DBCA, 2022a). The Mayala Marine Park is home to an array of biocultural and ecological values and features including coral and reef communities, mangroves, seagrass and macroalgae communities, high water and sediment quality, geomorphology (including beaches), subtidal filter feeding communities, intertidal sand and mudflat communities, turtles (all six species described in this EP), fish, sharks and rays, dugongs, whales and dolphins, saltwater crocodiles, sea and shore birds and invertebrates. The majority of the listed values are known to be in good or undisturbed condition or are assumed to be, with management strategies highlighting the need for further research, monitoring and reporting (DBCA, 2022a).
Bardi Jawi Gaarra Marine Park	626 km southwest	The Bardi Jawi Gaarra Marine Park is located in the west Kimberley region of WA within the Bardi and Jawi Native Title determination area. The park has remained a place of exceptional value for the Bardi and Jawi people for tens of thousands of years. The Bardi Jawi Gaarra Marine Park makes up 204,000 ha of the Kimberley marine reserves (DBCA, 2022b). The marine park is managed under the Bardi Jawi Gaarra Marine Park joint management plan, which was released in July 2022. The plan represents the joint management of the park between the Bardi and Jawi Traditional Owners and the DBCA and their shared vision to preserve the natural, recreational, commercial, cultural and heritage values of the park for future generations (DBCA, 2022b).

Name	Distance from multi-well location	Description
		The Bardi Jawi Gaarra Marine Park is home to an array of biocultural and ecological values and features including coral and reef communities, mangroves, creeks and saltmarsh communities, seagrass and macroalgae communities, high water and sediment quality, geomorphology (including beaches), subtidal filter feeding communities, intertidal sand and mudflat communities and freshwater soaks, turtles (all six species described in this EP), fish, sharks and rays, dugongs, whales and dolphins, saltwater crocodiles, sea and shore birds and invertebrates. The majority of the listed values are known to be in good or undisturbed condition or are assumed to be, with management strategies highlighting the need for further research, monitoring and reporting (DBCA, 2022b)
Lalang-gaddam Marine Park	397 km southwest	The Lalang-gaddam Marine Park has been formed from the amalgamation of four marine parks: the Lalang-garram/Camden Sound Marine Park, the Lalang-garram/Horizontal Falls Marine Park, the North Lalang-garram Marine Park and the Maiyalam Marine Park (DBCA, 2022c). This Marine Park is located in the Kimberley region of WA and covers approximately 1,308,500 ha within the Dambimangari Native Title determination area adjacent to the Shire of Derby-West Kimberley and the Shire of Wyndham East Kimberley. For tens of thousands of years, Dambeemangarddee people have depended on and looked after their traditional land and Sea Country and the area remains one of the last relatively undamaged coastal areas left in the world (DBCA, 2022c). The marine park is managed under the Lalang-gaddam Marine Park Joint Management Plan which was released in July 2022. The plan represents the joint management of the park between the Dambeemangarddee Traditional Owners with input from stakeholders and the DBCA and their shared vision to preserve the natural, recreational, commercial, cultural and heritage values of the park for future generations (DBCA, 2022c). The Lalang-gaddam Marine Park is home to an array of biocultural and ecological values and features including coral and reef communities, mangroves and saltmarsh communities, seagrass and macroalgae communities, high water and sediment quality, geomorphology, subtidal filter feeding communities, intertidal sand and mudflat communities, turtles (all six species described in this EP), fish, sharks and rays, dugongs, whales and dolphins, saltwater crocodiles, sea and shore birds and invertebrates. The majority of the listed values are known to be in good or undisturbed condition or are assumed to be, with management strategies highlighting the need for further research, monitoring and reporting (DBCA, 2022c).
Rowley Shoals Marine Park	1,040 km southwest	The Rowley Shoals Marine Park is a WA managed marine park adjacent to Mermaid Reef, Commonwealth managed Marine Park . The Rowley Shoals Marine Park protect a chain of three coral atolls at the edge of Australia's continental shelf. The atolls have shallow lagoons inhabited by diverse corals and abundant marine life. Each cover around 80km-

Name	Distance from multi-well location	Description
		90km, rising with near-vertical sides from very deep water. At low tide the water becomes ponded within the reef walls, and gushes over the edge like waterfalls. At high tide, the reefs disappear beneath the sea, with only the sandy islands of Clerke and Imperieuse visible (DBCA, 2017). Corals form a spectacular chain of reef systems, each covering about 80km2. Shallow lagoons within the reefs provide sheltered waters that are inhabited by diverse and abundant tropical marine life. Further offshore, the seafloor slopes away to the abyssal plain, some 6000m below. Undersea canyons slice the slope: these features are commonly associated with diverse communities of deep-water corals and sponges and create localised upwellings that aggregate pelagic species like tunas and billfish (DBCA, 2017).
Montebello Islands Marine Park	1,493 km southwest	Refer to previous information provided in Section 11.4.1.
Ord River Nature Reserve (R 31967)	85 km southwest	Section 11.4.5 describes the Ord River in the context of its Ramsar listing. The following description has been extracted from the Ord River and Parry Lagoons Nature Reserves Management Plan 77 2012 (DEC, 2012). The Ord River Nature Reserve covers an area of 79,842 ha and is comprised of the False Mouths of the Ord, featuring vast areas of mudflats, mangrove communities and a maze of tidal creeks (DEC, 2012). Of the 18 species of mangrove found in WA, 16 have been recorded within the reserve. The wetland areas of the reserve regularly support more than 20,000 waterbirds at a time and provides important breeding habitat for 16 species of wetland dependent birds as well as supporting mangrove dependent bird species. Lands within the reserve are also considered important habitat and breeding sites for the saltwater crocodile (DEC, 2012). The nature reserve also includes nurseries, foraging and breeding areas for at least 50 species of fish and supports the migratory route between marine and freshwater habitats for 15 species of fish (DEC, 2012). Ord River Nature Reserve also holds significant heritage and cultural values to First Nations people and the wider community as well as recreational value.
NT		
Garig Gunak Barlu National Park	456 km northeast	Garig Gunak Barlu National Park is a protected area on the Cobourg Peninsula and some adjoining waters approximately 216 km northeast of Darwin. It covers an area of 4,500 km^2 and is one of only two areas in the NT which contains adjoining land and marine parks. The national park includes the entire Cobourg Peninsula, the surrounding waters of the Arafura Sea and Van Diemen Gulf, including some of the neighbouring islands (e.g., Burford Island) (NT Government, 2020b).

Name	Distance from multi-well location	Description
		The protected area was established by joining the former Gurig National Park and the Cobourg Marine Park. Garig Gunak Barlu is Aboriginal owned land, jointly managed by a Board consisting of Iwaidja speaking peoples of the Cobourg Peninsula and NT Government representatives (NT Government, 2020b). The Park consists of sandy beaches, dunes and associated coastal grasslands, mangroves, rainforest patches, swamps, lagoons, coral reefs, sea grass meadows and rich marine life. The park supports rare species such as dugong and marine turtles as listed under the EPBC Act (Table 11.5). In addition, the park is home to the largest wild herd of Banteng (Indonesian cattle) which are an endangered species in their native habitat park (NT Government, 2020b).
Charles Darwin National Park	301 km northeast	Charles Darwin National Park is located in proximity to Darwin. The Park comprises of extensive littoral and estuarine vegetation communities, a large portion which are undisturbed mangrove forests with expansive mudflats. The intertidal mudflats are rich in birdlife, many protected under international agreements and are listed as a NIW. The park also supports 21 reptile, 17 mammal and 9 amphibian species (DEPWS, n.d.). Several aboriginal shell middens and a number of World War II bunkers of cultural and historic significance are located in the park (DEPWS, nd).
Casuarina Coastal Reserve	302 km northeast	Casuarina Coastal Reserve is a protected area in the northern area of Darwin. It offers 8 km of unspoilt beaches and is fringed by cliffs and casuarina trees. Wading and migratory birds together with nesting turtles occur at this location (NT Government, 2022). This is a significant area for the Larrakia people. Darriba Nunggalinya (Old Man Rock) can be seen at low tide. In addition, heritage ruins from World War II are scattered through the reserve (NT Government, 2022).
Vernon Islands Conservation Reserve	338 km northeast	The Vernon Islands are located in the Clarence Strait between the mainland and Melville Island. There are three major islands in the group plus a large reef, numerous lesser reefs and sand islands. The islands are generally fringed with mangroves and surrounded by mudflats and rocks/reef at low tide (TLC, 2013). The natural values of the islands include extensive and species rich mangrove forests, rich coral reef system, rocky shelves and stacks and seagrass and algal beds. The waters surrounding the Vernon Islands support dugong and turtles (TLC, 2013). Recreational values relate to fishing and boating which shipwrecks in the area popular for divers (TLC, 2013).

11.5 Cultural Heritage Values and Sensitivities

Cultural heritage includes both tangible and intangible values, and the definition of cultural heritage has evolved in recent decades as non-tangible cultural heritage continues to develop. Non-tangible cultural heritage includes oral traditions, performing arts, social practices, rituals, festive events, knowledge, and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts (UNESCO, 2022). Tangible cultural heritage includes artefacts, monuments, a group of buildings and sites and museums that have a diversity of values including symbolic, historic, artistic, aesthetic, ethnological or anthropological, scientific, and social significance. Cultural heritage also captures natural heritage such as culturally significant landscapes (UNESCO, 2009).

Underwater cultural heritage is defined in Section 5.6.1 of the EP.

During the relevant persons consultation process for the Beehive-1 EP, EOG consulted with the NT Department of Territory Families, Housing & Communities (TFHC) heritage branch in an effort obtain cultural heritage data specific to the spill EMBA. The TFHC were unable to provide specific cultural heritage data relating to the spill EMBA due to its size and because many sites are unlocated. Given the spill EMBA is exactly the same for this EP, this comment relating to cultural heritage values within the spill EMBA remains applicable.

This section describes the cultural heritage values of the spill EMBA (which includes the coastline up to the high-water mark).

Table 11.17 outlines the cultural heritage sites identified by the WA inHerit cultural heritage database (Government of Western Australia, 2021) and the NT Heritage Register (NT Heritage Council, 2023) within the spill EMBA moving from east to west.

Table 11.17 Cultural heritage sites within the spill EMBA

Site No.	Site name	Local Government Area	Description
NT			
-	Hope Inlet Archaeological Sites, Shoal Bay	Litchfield	The Hope Inlet Archaeological Sites are an exceptional group of over 200 sites that represent a period of Aboriginal coastal occupation from 2,500 years ago to 500 years ago. During this period the inhabitants built many large mounds of shell and earth, the largest of which rises seven metres above the surrounding landscape. These sites are the remains of subsistence and ceremonial activities, which include shellfish gathering, fishing, hunting, stone artefact manufacture, large gatherings of people and the use of ochre. Hearth stones, charcoal, and faunal remains indicate that a variety of resources such as fish, shellfish, crabs, kangaroos, possums, snakes, and birds were cooked in these shell and earth mounds.
WA			
9609	Seaplane Bay	Wyndham-East Kimberley	Seaplane Bay is the location where two German aviators were forced to land due to a fuel shortage on a journey from Timor to Darwin in 1932. The pair were found 38 days after the landing by an Aboriginal from Drysdale River Mission. Seaplane Bay is situated near Cape Bernier, called Quourmayer by the Aboriginal meaning "two fella German".

9613	Koolama Bay	Wyndham-East Kimberley	Koolama Bay is named after the Koolama 1 state passenger ship that was bombed by the Japanese 25-40 miles off the coast near Cape Rulhieres in 1942. The vessel was abandoned by 160 passengers and crew at Koolama Bay. 93 men walked overland to Drysdale River Mission, and the women and children were taken to safety by Captain Crave of the MV Kimberley.
18783	B24 Liberator Submerged Aircraft Crash Site	Wyndham-East Kimberley	Located in Vansittart Bay (off Truscott Airbase) in crocodile infested waters the B24 Liberator Submerged Aircraft Crash Site is a submerged World War II aircraft crash site. The plane is broken into three main sections and is believed to be in a pristine condition. Nothing besides the easily accessible human remains were recovered at the time of the accident, and there has been none of the customary scavenging by treasure hunters, suggesting the site holds a high level of integrity and authenticity.
9621	Swift Bay	Wyndham-East Kimberley	Swift Bay is the landing site of 56 Chinese refugees on 31 December 1992 in an Indonesian boat. The first two refugees walked into King Edward River Station the 16th of January 1992. This began what was probably the biggest search and rescue operation Australia has ever seen. By the 25th of January 55 of the refugees had been found, and the search was then scaled down. "Mrs Lucky" was found, thin and weak, dragging himself along a path on his knees on the same day having walked in excess of 200 kilometres.
9558	Careening Bay & Boab Tree	Wyndham-East Kimberley	Philip Parker King staggered the ship *His Majesty's Cutter (HMC) Mermaid* on the beach in Careening Bay in 1820, whilst on one of its journeys to complete Matthew Flinders' task of mapping Australia. The crew inscribed the date and name of the ship on a large boab tree which is situated approximately 60 metres from the high-water mark. Parker King and his crew camped here for 17 days to repair the ship.
4155	Camden Harbour	Wyndham-East Kimberley	Camden Harbour is known for the rise and fall of early settlement between 1864-1865. In 1864 a group of interested settlers from the east of Australia formed the Camden Harbour Pastoral Association. They arrived in December with a small amount of breeding stock, ample provisions, and farming equipment. The first settlers faced horrendous conditions. The second ship arrived with a load of settlers and supplies on Christmas Day 1864. The settlement limped on, continuing to face many difficulties. Problems, including insects, heat, humidity, tropical ulcers, sharks, and crocodiles made life difficult for the people and the stock. The settlers did not have any knowledge of local food sources and their relations with the local Aboriginals was not cordial. All the people of Camden Harbour had withdrawn from the settlement by October 1865. In the ten months of the Association, nine people died. Six of which are buried on Sheep Island. A quarter of all stock brought to Camden harbour had also died.
26353	Dampier Coast - Broome Sandstone	Broome	The Broome Sandstone is exposed discontinuously for over at least 100 km of coastline from Gulbunwilla on Roebuck Bay east of Broome north to Minarriny (Coloumb Point), and possibly as far north as Cape Leveque. At most places

	Dinosaur Footprints		where this rock formation has been uncovered, whether by gradual erosion or the pounding of cyclonic seas, dinosaur footprints have been found. At least 21 different types of footprints are recognised, making this the most diverse collections of dinosaurian trace fossils in the world. Over 70 discrete track sites have been identified. The tracks are also linked to the Dreamtime stories of the indigenous people along the Dampier Peninsula coastline.

Source: Government of Western Australia, 2021 & NT Heritage Council, 2023

11.5.1 Aboriginal Heritage Sites

Indigenous Australian people have a strong continuing connection with the area that extends back some 50,000 years. The existence of any unknown Aboriginal sites or artefacts of significance within the offshore waters of northern Australia is considered highly unlikely.

The Kimberley coastline between King Sound and the western shoreline of Cambridge Gulf (including State waters) is listed as a National Heritage Place ('The West Kimberley') (DCCEEW, 2024f). The area contains dramatic and relatively undisturbed landscapes that have great biological richness and provide important geological and fossil evidence of Australian history. The indigenous values of the West Kimberley National Heritage Place are not definitively mapped. Indigenous people are the primary source of information on the value of their heritage in this region (DCCEEW, 2024f).

A search of the WA Department of Aboriginal Affairs' Aboriginal Heritage Inquiry System (AHIS) indicates there are approximately 473 registered Aboriginal sites within the spill EMBA. The majority of the registered sites are located along the coastline between the Derby-West Kimberley, Mitchell River and Wyndham-East Kimberley shoreline sectors which are considered to be remote unpopulated areas in northern WA (see Figure 11.9). Figure 11.63 displays the sites identified by the AHIS that are intersected by the spill EMBA.

During the relevant persons consultation process for the Beehive-1 EP, EOG made an application to the Aboriginal Areas Protection Authority (AAPA) for an abstract of records under regulation 7 of the *Northern Territory Aboriginal Sacred Sites Regulations 2004* (NT) (the Regulations). The returned abstract advised that for the application area:

i. *there are registered sacred sites located on the spill EMBA;*

ii. *there are recorded sacred sites located on the spill EMBA;*

iii. *there are restricted work areas in the spill EMBA which are provided for in a previously issued Authority Certificate.*

The information relating to i, ii and iii is restricted and confidential in nature and is excluded from information published for public exhibition but has been submitted to NOPSEMA as sensitive information. It is an offence under s38 of the *Sacred Sites* Act to permit access to, or furnish a document produced for a purpose of the Act without the written permission of the Authority. Given the spill EMBA is exactly the same for this EP, this information regarding Aboriginal heritage sites within the spill EMBA remains appliable.

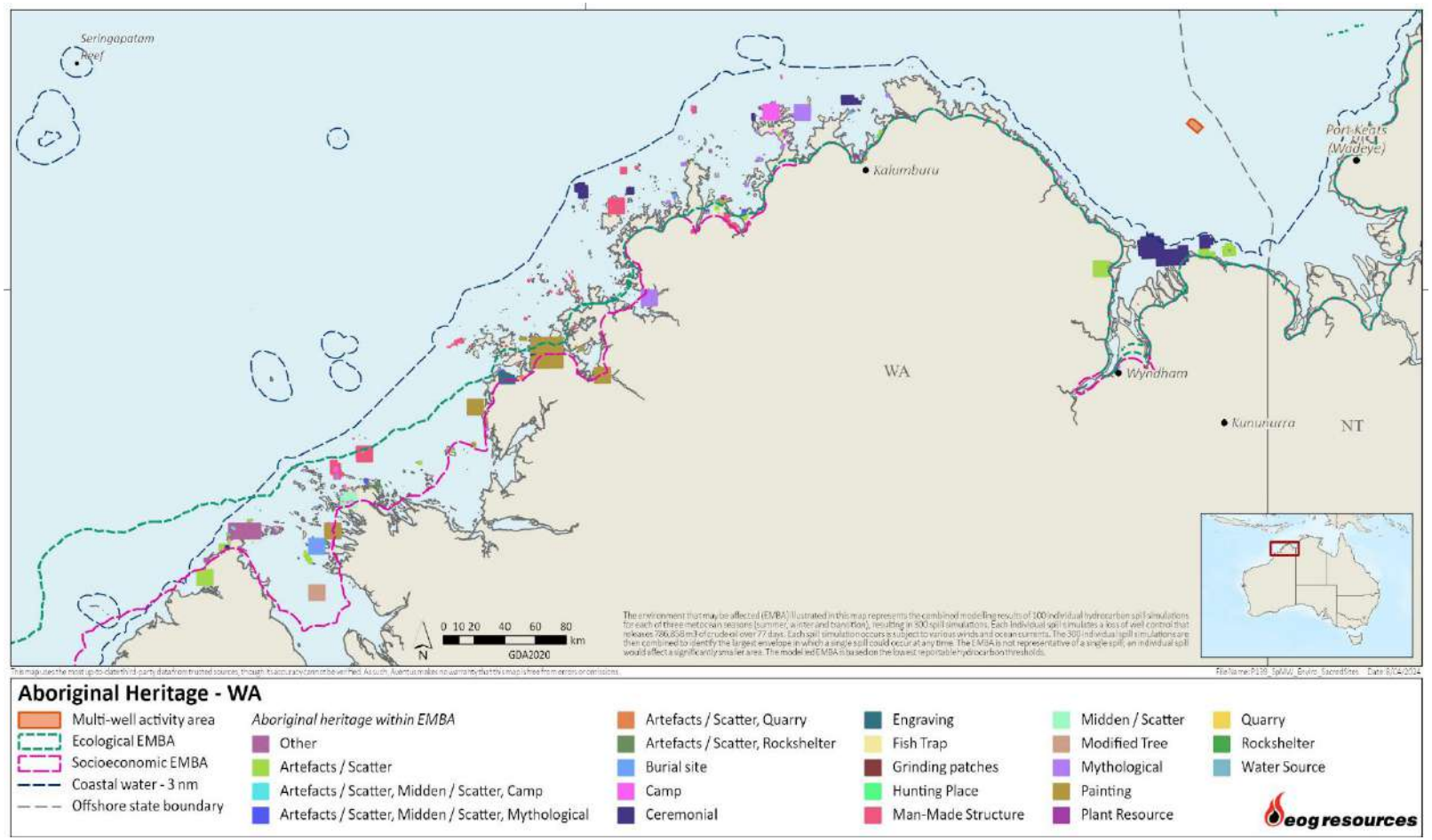


Figure 11.63 Registered Aboriginal heritage sites within the spill EMBA

11.5.2 Information from Consultation

This section draws on information derived from the relevant persons consultation process undertaken for the Beehive-1 EP. Given the multi-well activity area encompasses the Beehive-1 location, the information gathered regarding cultural heritage values remains applicable to this activity.

Consultation specifically undertaken during the development of the Beehive-1 EP included several in-person information sessions, as listed in Table 4.6 of the EP. These meetings identified a number of particular values and sensitivities, and concerns relevant to this EP.

The Broome meeting (7 June 2023) identified that:

- Introduced species pest management (particularly example of cane toads) is an issue of importance.
- Turtle and dugong are migratory species and important cultural animals to manage in the project area.

The Ardyaloon meeting (8 June 2023) did not identify any concerns with this activity but did identify concerns related to offshore oil and gas in general, including:

- Hunting resources – Could an event impact freshwater hunting resources - “this is our food bowl”. This includes sea country - fishing and dugong and turtle (including cultural significance of the resources).

The Kalumburu meeting (13 June 2023) identified:

- Important fishing areas for oysters, scallops, fish, crabs and sting rays.
- That marine life needs to be protected, particularly turtles, whales and mangroves.
- There are important cultural heritage resources in the area, including rock art, marine resources and camping locations along the shore.
- That EOG should ensure that there are no negative impacts on tourism.
- The Aboriginal Sea Company requested information on the processes of reporting:
    - Accidental waste discharges.
    - Damage to sea life on the sea floor, such as, giant clam and any other protected or endangered species.

During the relevant persons consultation for the Beehive-1 EP, a Tiwi Islands Land Council anthropologist confirmed that due to the location of the proposed activity, there will be no cultural impacts to the Tiwi Islands. Given the multi-well location encompasses the Beehive-1 location, this comment referring to cultural heritage impacts at the Tiwi Islands remains applicable.

EOG has sent project information to all other relevant persons and invited comments, including Native Title determination group representatives, Aboriginal land councils and other Aboriginal relevant persons intersected by the spill EMBA. To date, no information from these groups regarding their cultural values and sensitivities have been obtained.

11.5.3 Healthy Country Plans

The spill EMBA has the potential to encounter areas containing important cultural features to First Nations people. The information presented here is based on information obtained during the consultation process undertaken for the Beehive-1 EP, and desktop research only, primarily Healthy Country Plans (HCPs). Where HCPs are unavailable, other online sources and publications have been

interrogated to gain an understanding of applicable marine values. Note that some areas lack publicly available and documented localised knowledge of the areas, and therefore, data was not able to be obtained via desktop research. Table 11.18 details the marine values for each of the relevant groups (based on Native Title determination areas) within the spill EMBA moving from east to west. Given the spill EMBA is exactly the same as the one in the Beehive-1 EP, this section remains applicable.

Table 11.18 Marine values of coastal First Nation groups within the spill EMBA

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
NT			
1. Croker Island (see Figure 11.64)	Yuwurruma members of the Mandilarri-Ildugij, Mangalara, Murran, Gadura-Minaga, and Ngaynjaharr clans	Native Title Report 2000: Chapter 3: Native title and sea rights. Cobourg Marine Park Plan of Management (2011)	Due to the absence of a HCP for Croker Island, information from the Native Title Report 2000 (Chapter 3) has been used to describe the marine values applicable to the determination area. The report quotes Mary Yamirr, one of the main Indigenous witnesses in the hearing of the Croker Island case 'As far as my eyes can carry me' was her answer under cross-examination to the question of the extent of her traditional Sea Country. The quote holds significant influence as it exemplifies the gap between Indigenous and non-Indigenous understandings of the coastal seas. However, the report does not detail specific marine values relating to Croker Island. The Cobourg Marine Park Plan of Management (2011), which is adjacent to Croker Island, provides the following information regarding marine values within the region that are important to the traditional owners of Cobourg Peninsula. Managing for Aboriginal values: • Cobourg Aboriginal people have responsibility and obligation to care for sea country. • Managing and maintaining sacred sites and sites of cultural significance through ceremony and ritual. • Passing on indigenous knowledge of the marine environment, rehouses and traditional management. • Desire to develop a secure economic base from the sustainable use of the Marine Park. • Hunt, use marine resources and conduct customary management practices in the park. • Concerns: marine debris, by-catch.

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
			Traditional resource use and cultural significance: • Section 122 of the *Territory Parks and Wildlife Conservation Act* provides for traditional use of land and water by Aboriginal people that have traditional rights. • Section 53 of the *NT Fisheries Act* reaffirms the rights of Aboriginal people to continue to use the resources of an area of land or water in the traditional manner in which they have done so historically. • Traditional owners live on Croker Island • Dugongs, turtle, crabs, fish and shellfish are important part of Cobourg Aboriginal people's diets. • Dugongs and turtles have spiritual, ritual and mythological significance. • Sacred sites and sites of significance – dreaming tracks and sacred sites in and under the sea. • Concerns: much traditional management knowledge in not written and may be lost with the passing of Elders.
2. Larrakia (see Figure 11.65	Larrakia people	Larrika nation annual report (2022-2023)	Due to the absence of a HCP for the Larrakia region, the Larrika nation annual report (2022-2023) has been used to describe applicable marine values. The Larrakia people are the traditional owners of the Darwin region. Despite Larrakia's native title rights being rejected in 2006, they have a dedicated land and sea ranger program. According to the Larrika nation annual report (2022-2023), the Larrika rangers were involved in monthly shorebird counts, daily turtle nesting surveys during peak nesting season, the annual dolphin survey of Shoal Bay and Darwin Harbour and the annual helicopter survey of Darwin Harbour for shore birds, marine megafauna, and crocodiles. A total of 67 days were spent undertaking marine based activities and 1,287 kg of marine debris was cleaned up (Larrakia Nation Aboriginal Corporation, 2023).
3. Legune (see Figure 11.66)	Gajerrong-Wadanybang, Gajerrong-Gurrbjim	N/A	No information is publicly available.

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
	and Gajerrong-Djarrajarrany groups		
4. Spirit Hills (see Figure 11.67)	Miriuwung-Nyawam Nyawam, Miriuwung-Bindjen, Gajerrong-Gurrbijim, Gajerrong-Djarradjarrany , Gajerrong-Djandumi and the Gajerrong-Wadanybang groups	N/A	No information is publicly available.
WA			
5. Miriuwung-Gajerrong (see Figure 11.68 & Figure 11.69)	Miriuwung, Gajerrong, Doolboong, Wardenybeng and Gija groups	Miriuwung-Gajerrong Cultural Planning Framework (Hill *et al*., 2008) Ecological Character Description of the Ord River Floodplain Ramsar Site (Hale, 2008) Allocating for the Future of the Lower Ord River: Balancing Ecological, Social, Cultural, and Consumptive Water Requirement (Storey and Trayler 2006)	There is no HCP plan specific to the Miriuwung-Gajerrong region. However, the publications outlined in the previous column have provided some detail regarding marine values within the region. The planning framework (Hill *et al*., 2008) mentions fish, turtle, crab, crocodile and barramundi being of importance as well as dreaming stories surrounding saltwater. The Ord River is a major feature within the determination area that connects to the sea. Hale et al (2008) lists the Aboriginal sites that hold great cultural significance to local indigenous people within the site, including: • Burial sites. • Artefact scatters. • Mythological sites. • Quarries. • Paintings. • Ceremonial sites. Storey and Trayler (2006) discuss the past sociocultural values of the Ord River including: • Provided food, particularly waterbirds, such as jabiru, pelican, flying fox, white crane, 'black divers', magpie goose, burdekin duck, black swan, and 'black and yellow ducks' (presumed to be whistling duck).

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
			• Freshwater turtles and freshwater crocodiles were collected from waterholes. • Fishing. • House Roof Hill, Bolgumirri and Adolphus Island, and Burrunungun are dreaming locations. • Wetland-dependent animals that appeared in stories; for example, brolgas (Gurrandalang), jabiru (Dariimbagang), and white crane (Djalarrang); and • The Kununurra diversion dam was built on an important cultural site known as Darram (Bandicoot Bar). In Aboriginal mythology, the rocky pool was formed by women, who, in the Dreamtime, attempted to trap barramundi with rolls of spinifex. Storey and Trayler (2006) also discuss the present socio-cultural values of the Ord River including: • Gather vegetable foods and hunt animals. • Use the riverbanks for hunting goannas, turtles, and wallabies, and fish the spillway of the Kununurra diversion dam and other parts of the river. • Cultural activities occur in close association with the river, which remains central to their society and worldview, in much the same way as the adjacent Fitzroy River does to the people associated with it.
6. Balanggarra (see Figure 11.70, Figure 11.71 & Figure 11.72)	Balanggarra	Balanggarra HCP 2012-2022 (BAC/KLC, 2011)	The Balanggarra HCP (BAC/KLC, 2011) provides the following information, relating to marine values. The nine most important things to the Balanggarra community are: 1. Balanggarra law and culture. 2. Our Gra (Country). 3. Cultural sites (rock art sites, burial sites, heritage places). 4. Right way fire. 5. Native animals. 6. Bush tucker and medicine plants. 7. Freshwater (places and freshwater fish) 8. Saltwater fish. 9. Migratory saltwater animals (turtle, dugong, whales, dolphins).

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
			Marine species mentioned in the HCP (target 8: saltwater fish & seafood and target 9: migratory saltwater animals): • Green turtle (most popular turtle species hunted for flesh). • Hawksbill turtle (poisonous to consume). • Flatback turtle (eggs are harvested). • Dugong. • Saltwater crocodiles. • Whale. • Snubfin dolphin. • Mullet. • Silver bream. • Coral trout. • Stingrays. • Oysters. • Cockle shells. • Baler shells. • Turtle eggs. Other species listed in the HCP (Matters of National Significance): • Common noddy. • Fork-tailed swift. • Great egret. • Cattle egret. • Streaked shearwater. • Little tern. • Brown booby. • White-bellied sea-eagle. • Blue whale. • Humpback whale. • Killer whale. • Bryde's whale. • Irriwaddy dolphin. • Indo-pacific humpback dolphin. • Spotted bottlenose dolphin. • Whale shark.

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
			• Loggerhead turtle. • Olive Ridley turtle. • Leatherback turtle. Geomorphic habitats mapped in the HCP: • Channel. • Flood-and ebb-tide delta. • Intertidal flats. • Mangrove. • Rocky reef. • Saltmarsh/sandflat. • Tidal sand banks. Main threats: • Lack of traditional owner consultation. • Lack of infrastructure to access country. • Climate change. • Weeds. • Cane toads. • Lack of land and sea management capacity. • Unmanaged wildfires. • Large, introduced animals. • Uncontrolled visitor access.
7. Uunguu (see Figure 11.73 & Figure 11.74)	Wanjina Wunggurr Community	Wunambal Gaambera HCP (Wunambal Gaambera Aboriginal Corporation, 2010)	The Wunambal Gaambera HCP (Wunambal Gaambera Aboriginal Corporation, 2010) provides the following information, relating to marine values. The ten most important things for looking after Uunguu are: 1. Wanjina Wunggurr Law – our culture. 2. Right way fire. 3. Aamba (kangaroos and wallabies) and other meat foods. 4. Wulo (rainforest). 5. Yawal (waterholes). 6. Bush plants. 7. Rock art. 8. Cultural places on islands. 9. Fish and other seafoods.

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
			10. Mangguru (marine turtles) and balguja (dugong). Saltwater resources of Wunambal Gaambera Country: • Mangrove snapper. • Barramundi. • Bream. • Mud-crab. • Mangrove worms. • Oysters. • Periwinkles. • Saltwater crocodile. • Stingrays. • Blue-bone groper. • Saddletail snapper. • Queenfish. • Potato cod. • Reefs. • Seagrass. Target 10: Mangguru (marine turtles) and balguja (dugong): • Dugong. • Green turtle (hunted the most for food). • Hawksbill turtle (poisonous). • Turtle eggs (consumption). • Sand goanna. • Whale. • Dolphin. • Snub-fin dolphin. • Birds. Appendix 3: Nested targets – cultural significance or cultural resource: • North-western Western Australia coral beds. • Northern river shark. • Speartooth shark.

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
			• Sandy beaches. • Reefs. • Mangrove species and communities. • Sharks. • Stingrays. • Blue-spotted stingray. • Mud-crab. • Clams. • White lips (*Plectorphynchus sp*). • Mangrove worms. • Oyster. • Barramundi. • Mangrove snapper. • Periwinkles. • White-bellied sea-eagle. • Blue-bone groper. • Rock cod. • Queenfish. • Trepang. • Green turtle. • Hawksbill turtle. • Flatback turtle. • Loggerhead turtle. • Leatherback turtle. • Olive Ridley turtle. • Dugong. • Seagrass. • Reefs. • Common dolphin. • Indo-pacific humpback dolphin. • Striped dolphin. • Spinner dolphin. • Snub-fin dolphin.

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
			The main threats: • Loss of traditional knowledge. • Not being secure on country. • Bauxite mining. • Climate change. • Wrong way fire. • Visitors not being respectful. • Lack of land and sea management capacity. • Weeds. • Feral animals. • Commercial fishing.
8. Dambimangari (see Figure 11.75)	Wanjina Wunggurr Community	Dambimangari Healthy Country Plan 2012-2022 (Dambimangari Aboriginal Corporation, 2012)	The Dambimangari HCP (Dambimangari Aboriginal Corporation, 2012) provides the following information, relating to marine values. Nine most important things to focus on: 1. Cultural sites ○ Rock art sites. ○ Stone arrangements. ○ Burial sites. ○ Important camping sites where old people rested while travelling through saltwater country. 2. Reefs, beaches & islands 3. Saltwater fish ○ Rock-cod. ○ Baler shell. ○ Mangrove Jack. ○ Mullet. ○ Barramundi. ○ Bluebone. ○ Spanish flag. ○ Oysters. 4. Turtle & dugong ○ Green turtle (meat). ○ Hawksbill turtle (mainly shell for ornaments/artefacts).

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
			○ Loggerhead turtle. ○ Flatback turtle (meat but mainly eggs). 5. Whales & dolphins ○ Humpback whales (stories of creation). ○ Common dolphin. ○ Humpback dolphin. ○ Snubnose dolphin. 6. Rivers, waterholes, waterfalls & wetlands (freshwater systems). 7. Culturally important native animals. 8. Bush fruits & medicine plants. 9. Right-way fire. Main threats: • Lack of culturally appropriate consultation with Traditional Owners. • Climate change. • Lack of Land and Sea Management capacity. • Visitors not being respectful. • Wrong-way fire (unmanaged). • Landowners prohibiting Traditional Owner access. • Lack of infrastructure to access country. • Mining/Industrial development. • Cane toads. • Weeds. • Gas/oil drilling. • Feral animals (cattle/pigs).
9. Mayala (see Figure 11.76 & Figure 11.77)	Kudumili, Galawa, Ngalgarrgard, Jabadayim, and Ulgirr/Oolgir	Mayala Country Plan 2019-2029 (Mayala Inninalang Aboriginal Corporation, 2019)	Cultural land and seascapes include: ○ Islands • Long yam. ○ Reefs. ○ Saltwater. • Food ▪ Saltwater fish. ▪ Mangrove jack. ▪ Golden lined spinefoot.

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
			▪ Spinefoot. ▪ Surgeonfish. ▪ Spanish Flag. ▪ Cod. ▪ Turtles – green turtles. ▪ Turtle eggs – green turtles and flatback turtles. ▪ Dugong. ▪ Crabs. ▪ Oysters. ▪ Trumpet shell. ▪ Baler shell. • Cultural. ▪ Humpback whales. ▪ Whale sharks. ○ Loo (tidal streams or currents). ○ Wetlands & Springs. ○ Cultural & historical sites. • Graveyard within Strickland Bay. ○ Seasonal camping areas. • Brue Reef. • Irvine/Bathurst Island. • Mermaid Island . • Herbert Islands Group. • Silica Beach. ○ Language. ○ Medicine. • Glycine spp. • Buchanania obovate. • Mimosops elengi. • Ficus virens. • Cyperus bulbosus. • Mangrove tree. • Paperbark. • Pandanus.

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
			• Big yam. ○ Food. • Figs • Oysters. • Trochus. • Clam shell. • Pearl shell – significant cultural species. • Fishes. • Turtle. • Octopus. • Blue crab. • Monsoonal vine thicket. • Acacia spp. Main threats: ○ Loss of connection to country. ○ Unmanaged tourism. ○ Illegal fishing. ○ Overfishing. ○ Introduced species. ○ Climate change. ○ Wrong-way fire. ○ Pollution. ○ Safety. ○ No-go zones.
10. Bardi and Jawi (see Figure 11.78)	Bardi and Jawi People	Bardi Jawi indigenous protected area management plan 2013-2023 (KLC/Bardi Jawi Niimidiman Aboriginal Corporation, 2013)	The seven identified targets are: 1. Marnany (Fringing Reefs). 2. Aarli (Fish). 3. Odorr (Dugong) and Goorlil (Turtle). 4. Significant sites. 5. Language, law and culture. 6. Traditional Oola (Water) places. 7. Indigenous plant resources.

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
			1. Target: marnany (fringing reefs): • Aarli (fish) species. • Abalone. • Banyjarr (clam shell). • Alngir (trochus). • Goowarn (pearl shell). • Oysters. • Dugong. Target: aarli (fish): • Goolan (small bluebone). • Barrambarr (large bluebone). • Jirral and Yawilil (trevally, numerous species). • Joordoo (mullet). • Joorloo (spanish flag). • Barrbal (yellow-lined spinefoot). • Maarrarn (mangrove jack). • Biindarral (coral trout). • Biidib (rock cod). • Birrinyan (queenfish). • Gambarl (surgeon fish). • Gooloorrganjoon (mackerel). • Barnamb (stingray). • Ngarrangg (mud crab). Target: goorlil (turtle) & odorr (dugong): • Green turtle (hunted for food). • Odorr (dugong). Target: significant sites: • Many significant sites associated with law are interconnected through songlines and stories that refer to mythological beings and places far afield. • Some sites are only for men while others belong to women who, traditionally, would meet to pass on knowledge and gather food.

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
			Target: Language, law and culture: • Law ceremonies are held and run by the Majamajin (law bosses). • Ceremonies take place in some significant sites, respected by Bardi Jawi people for that purpose. • In Bardi Jawi law, Balil (young boys) are initiated according to the ceremony Arnkooy. • Some parts of Bardi Jawi Law are kept secret but others are public ceremonies, in which women and families play a major part. • Bardi and Jawi language reflects a deep understanding of the land and sea, the plants and animals. • Bardi Jawi people have an obligation to respect Jawal (law teacher) and Alood (in-law) relationships, and other customs that are still largely followed. • Old people are much respected and many Traditional Owners try to make sure their old people receive fish, turtle, dugong or other favourite foods from country when they have been caught or collected. Habitat types: • Vine thicket. • Seagrass meadows. • Sandy flats. • Beaches. • Mangroves. • Fringing reefs. • Islands. Threats • Climate change. • Bushfire. • Mining. • Marine pests. • Visitors to country. • Weeds. • Lack of control over marine resource. • People not living on country.

Determination name	Affiliated language groups	Relevant HCP/publication	Marine values
			• Lack of transmission of knowledge. • People not looking after country. • Pearling leases and land-based infrastructure.
11. Warrwa Mawadjala Gadjidgar (see Figure 11.79)	Warrwa Mawadjala Gadjidgar people	N/A	No information is publicly available.
12. Bindunbur (see Figure 11.80)	Jabirr Jabirr/Ngumbarl, Nyul Nyul and Nimanburr people	N/A	No information is publicly available.

Marine Species

Table 11.19 summarises the marine species that hold significance to the coastal First Nation groups within the spill EMBA based on the information presented in Table 11.18. This shows that the marine species identified as being important across the majority of groups (according to publicly available data) include dugong, dolphins, whales, turtles, assorted fish species and molluscs. All of these provide sustenance and are embedded in their lifestyle and culture. Section 11.3.5 discusses the presence of the dugong within the spill EMBA as well as the cultural significance. Section 11.3.6 discusses the presence of marine turtles within the spill EMBA as well as the cultural significance. Threatened fish species within the spill EMBA are listed and described in Section 11.3.4 and molluscs are described in Section 11.3.1. Traditional fishing is also described in Section 11.5.6.

Table 11.19 Marine species that hold significance to the coastal First Nation groups within the spill EMBA

	Marine species														
	Dugong	Dolphins	Whales	Saltwater crocodile	Turtles	Turtle eggs	Fish (assorted species)	Sharks	Octopus	Stingrays	Crab	Molluscs	Mangrove worms	Seabirds	Waterbirds
1															
2															
3	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd
4	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd
5															
6															
7															
8															
9															
10															
11	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd
12	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd

Key:

1	Croker Island, NT	5	Miriuwung-Gajerrong, WA	9	Mayala, WA
2	Larrakia, NT	6	Balanggarra, WA	10	Bardi and Jawi, WA
3	Legune, NT	7	Uunguu, WA	11	Warrwa Mawadjala Gadjidgar, WA
4	Spirit Hills, NT	8	Dambimangari, WA	12	Bindunbur, WA
dd	Data deficient				
	Green shading denotes the presence of the value				

Intangible Values

Table 11.20 summarises the intangible values that hold significance to the coastal First Nation groups within the spill EMBA based on the information presented in Table 11.18. Intangible cultural heritage is defined in Section 11.5. Sea Country (described in Section 11.5.5) is a value uniformly recognised across all First Nation groups that exist within the coastal region of the spill EMBA.

Table 11.20 Intangible values that hold significance to the coastal First Nation groups within the spill EMBA

	Intangible values					
	Sea Country	Law and culture	Dreaming	Sacred sites	Mythological sites	Ceremonial sites
1						
2						
3	dd	dd	dd	dd	dd	dd
4	dd	dd	dd	dd	dd	dd
5						
6						
7						
8						
9						
10						
11	dd	dd	dd	dd	dd	dd
12	dd	dd	dd	dd	dd	dd

Same key as Table 11.19.

Tangible Values

Table 11.21 summarises the tangible values that hold significance to the coastal First Nation groups within the spill EMBA based on the information presented in Table 11.18. Tangible cultural heritage is defined in Section 11.5. Paintings/rock art is the most commonly listed tangible value across the First Nation groups within the spill EMBA (according to publicly available data). Section 11.5.7 also discusses Aboriginal rock art within the spill EMBA.

Table 11.21 Tangible values that hold significance to the coastal First Nation groups within the spill EMBA

	Tangible values				
	Burial sites	Important camping sites	Artefact scatters	Stone arrangements	Paintings/ rock art
1					
2					
3	dd	dd	dd	dd	dd
4	dd	dd	dd	dd	dd
5					
6					
7					
8					
9					
10					
11	dd	dd	dd	dd	dd
12	dd	dd	dd	dd	dd

Same key as Table 11.19.

Geomorphic Features/Habitat

Table 11.22 summarises the geomorphic features/habitat that hold significance to the coastal First Nation groups within the spill EMBA based on the information presented in Table 11.18.

Geomorphic features and habitat hold intrinsic value to the coastal First Nation groups within the spill EMBA. Habitats signify the health of Country, provide food and resources and represent changes in landscape in dreaming and creation stories. Geomorphology of the spill EMBA is described in Section 11.1.7 and mapped in Figure 11.8. Coastal environments of the spill EMBA are described in section 11.2 and Table 11.1 and mapped in Figure 11.9 - Figure 11.23. Reef/rocky reef/fringing reef are the most commonly listed feature (according to publicly available data). Reefs within the spill EMBA are described in Section 11.3.1.

Table 11.22 Geomorphic features/habitat that hold significance to the coastal First Nation groups within the spill EMBA

	Geomorphic features/habitat												
	Channel/ rivers	Flood-and ebb-tide delta	Intertidal flats	Mangrove	Coral	Reef/rocky reef/fringing reef	Saltmarsh /sandflat	Tidal sand banks	Islands	Beaches	Seagrass	Vine thicket	Tidal streams or currents
1													
2													
3	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd
4	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd
5													
6													
7													
8													
9													
10													
11	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd
12	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd

Same key as Table 11.19.

Threats

Table 11.23 summarises the major threats that are marine in nature that hold significance to the coastal First Nation groups within the spill EMBA based on the information presented in Table 11.18. An extensive list of threats is listed in Table 11.18. The following threats in relation to the activity have been addressed in the impact and risk assessment in Sections 7 and 8 of the EP.

- Climate change: Section 7.4 of the EP discusses the routine atmospheric emissions that will occur during the activity and evaluates the impacts.
- Pollution: Sections 7.6 – 7.11 of the EP discuss the discharges of drill cuttings and muds, discharges of cement and routine vessel discharges associated with the activity, and evaluates the impacts. Section 8.1 of the EP discusses the risks associated with accidental release of waste overboard and evaluates the potential impacts. Section 8.6 of the EP discusses the risks associated with MDO release and evaluates the potential impacts. Section 8.7 of the EP discusses the risks associated with a LoWC and major oil spill and evaluates the potential impacts. Chapter 9 of the EP evaluates the potential impacts associated with hydrocarbon spill response activities.
- Marine Pests: Section 8.3 discusses the risk of introducing and establishing invasive marine species and evaluates the potential impacts.
- Oil drilling: The entire impact assessment chapter (Chapter 7) and risk assessment chapters (Chapter 8 & 9) evaluate all the impacts (planned activities) and risks (unplanned events) associated with exploration drilling for the proposed multi-well. The EIA & ERA conclude that all residual impacts are negligible, and all residual risks range from negligible to medium (once all controls have been adopted).

Table 11.23 Threats that hold significance to the coastal First Nation groups within the spill EMBA.

	Threats												
	Lack of Traditional Owners consultation	Lack of infrastructure to access country	Climate change	Lack of land and sea management capacity/ Lack of control over marine resource	Uncontrolled visitor access/ visitors not being respectful	Loss of traditional knowledge/ Loss of connection to country/ People not living on country	Gas/oil drilling	Pearling leases	Commercial fishing/ illegal fishing/ overfishing	Pollution	Safety	No-go zones	Marine pests
1													
2	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd
3	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd
4	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd
5	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd
6													
7													
8													
9													
10													
11	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd
12	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd	dd

Same key as Table 11.19.

11.5.4 Native Title

Native Title is the recognition that Aboriginal and Torres Strait Islander people have rights and interests to land and waters, according to their traditional law and customs as set out in the Australian Law (KLC, 2022).

A determination of Native Title is a decision on whether Native Title exists in relation to a particular area of land, or waters and a Native Title claim is an area that is undergoing assessment for determination. Table 11.24 describes the Native Title determination areas within the spill EMBA (moving from east to west) using search records from the National Native Title Tribunal (NNTT) Register. There are currently no Native Title claims present within the spill EMBA.

Table 11.24 Native Title Determination areas within the spill EMBA (east to west)

Native Title Determination area	Distance from multi-well location	Description	Type of exposure to spill EMBA	Earliest time to contact and/or probability of exposure (reported by WAMOPRA DoT cells and RPS OSTM)
Croker Island (Figure 11.64)	523 km northeast	Represented by the Top End (Default prescribed bodies corporate (PBC/CLA) Aboriginal Corporation registered Native Title body corporate (RNTBC). The determination area includes the sea and seabed surrounding Croker Island, Templer Island, Valencia Island, Darch Island, Grant Island, Lawson Island, Oxley Island and Mc Cluer Island. Native Title was determined in 1998 and is held by the Yuwurruma members of the Mandilarri-Ildugij, Mangalara, Murran, Gadura-Minaga, and Ngaynjaharr clans.	Entrained oil	*Minjilang* Entrained: Summer – 8% (low) Winter – N/A Transitional – N/A *Oxley Island* Entrained: Summer – 8% (low) Winter – N/A Transitional – N/A *Lawson Island* Entrained: Summer – 6% (low) Winter -N/A Transitional – N/A *Grant Island* Entrained: Summer – 4% (low) Winter – N/A Transitional – N/A *McCluer Island*

Native Title Determination area	Distance from multi-well location	Description	Type of exposure to spill EMBA	Earliest time to contact and/or probability of exposure (reported by WAMOPRA DoT cells and RPS OSTM)
				Entrained: Summer – 7% (low) Winter – N/A Transitional – N/A
Larrakia (Part A - consolidated proceeding) (Figure 11.65)	296 km southwest	Represented by the Northern Territory Aboriginal/ Torres Strait Islander (A/TSI) body area. The determination area includes waters near and surrounding Darwin Port including the Darwin waterfront and Darwin municipality. In 2006 the court made the decision that Native Title does not exist within this area on the basis that the current laws and customs were not 'traditional' as required under the Native Title Act. This is the second claim within the Darwin region to be denied a Native Title determination. This hearing was consolidated with other claims within the area seeking Native Title determinations.	Primarily dissolved oil, with small levels of entrained, surface oil and shoreline oil.	*Darwin* Dissolved: Summer – 12% (low), 5% (moderate), 1% (high) Winter – N/A Transitional – 1% (low) Entrained: Summer – 28% (low), 22% (high) Winter –1% (low), 1% (high) Transitional – N/A Surface: Summer – 78 days Winter – N/A Transitional – N/A Shoreline: Summer – 48 days (low) 51 days (moderate) Winter – N/A Transitional – N/A
Legune Pastoral Lease	114 km southeast	Represented by the Top End (Default PBC/CLA) Aboriginal Corporation RNTBC. The determination area is in the NT near	Surface oil and shoreline oil.	*Turtle Point* Surface:

Native Title Determination area	Distance from multi-well location	Description	Type of exposure to spill EMBA	Earliest time to contact and/or probability of exposure (reported by WAMOPRA DoT cells and RPS OSTM)
(Figure 11.66)		the Keep River National Park Extension. Native Title was determined in 2011 and is held by the Gajerrong-Wadanybang, Gajerrong-Gurrbjim and Gajerrong-Djarrajarrany groups.		Summer -23 days (low) Winter – 14 days (low) Transitional – 29 days (low) <u>Shoreline:</u> Summer – 18 days (low), 24 days (moderate) Winter – 13 days (low), 14 days (moderate) Transitional – 22 days (low), 24 days (moderate)
Spirit Hills Pastoral Lease No.2 (Figure 11.67)	99 km southeast	Represented by Top End (Default PBC/CLA) Aboriginal Corporation RNTBC. The western boundary of the determination area is on the WA/NT border and includes the land and waters associated with six estates or pastoral leases on the NT mainland. Native Title was determined in 2011 and is held by the Miriuwung-Nyawam Nyawam, Miriuwung-Bindjen, Gajerrong-Gurrbijim, Gajerrong-Djarradjarrany , Gajerrong-Djandumi and the Gajerrong-Wadanybang groups.	Primarily shoreline and surface oil and small amounts of dissolved oil.	*Turtle Point* <u>Surface:</u> Summer -23 days (low) Winter – 14 days (low) Transitional – 29 days (low) <u>Shoreline:</u> Summer – 18 days (low), 24 days (moderate) Winter – 13 days (low), 14 days (moderate) Transitional – 22 days (low), 24 days (moderate)
Miriuwung Gajerrong (WA and #4) (Figure 11.68 and Figure 11.69)	WA - 77 km south #4 - 84 km south	Both areas are represented by the Miriuwung and Gajerrong Aboriginal Corporation (MG Corporation). The determination areas extend to intertidal areas and sea country intersected by the spill EMBA in the Cambridge Gulf and eastern Kimberley region. Native Title was determined in 2003 for the WA section as is and is held by the members of the Miriuwung (including Yirralalem, Ngamoowalem, Wiram, Yardanggarlm, Nganalam and Mandangala), Gajerrong, Doolboong, Wardenybeng and	The intertidal areas of both determination areas are exposed primarily to dissolved oil, shoreline and surface oil, with	*East Cape Domett – WA- NT Border (C)* <u>Shoreline:</u> Summer – 16 days (low), 17 days (moderate), 42 days (high) Winter – 15 days (low), 26 days (moderate), 90 days (high) Transitional – 11 days (low), 12 days (moderate), 51 days (high)

Native Title Determination area	Distance from multi-well location	Description	Type of exposure to spill EMBA	Earliest time to contact and/or probability of exposure (reported by WAMOPRA DoT cells and RPS OSTM)
		Gija and, in respect to Boorroongoong (Lacrosse Island), also Balangarra. Native Title for section #4 was determined in 2006 and is held by members of the Miriuwung, Gajerrong, Doolboong, Wardenybeng and Gija groups and other Aboriginal people who are acknowledged by these groups as having rights in the determination area.	small amounts of entrained oil.	
Balanggarra (#4) (Figure 11.70)	118 km southwest	Represented by the Balanggarra Aboriginal Corporation RNTBC. The Native Title determination covers all land comprising Adolphus Island, above the high-water mark. Native Title was determined in 2015 and is held by the members of the Balanggarra community.	Shoreline and surface oil.	*Bare Hill - East Cape Domett (B)* <u>Shoreline:</u> Summer – 33 days (low), 45 days (moderate) Winter – 34 days (low), 39 days (moderate) Transitional – 23 days (low), 35 days (moderate)
Balanggarra (#3) (Figure 11.71)	130 km southwest	Represented by the Balanggarra Aboriginal Corporation RNTBC. The northern boundary of the area is situated south of Adolphus Island and continues south along the Ord River. Native Title was determined in 2013 and is held by the Balanggarra community.	Primarily dissolved and entrained oil with a small amount of surface and shoreline oil.	*Bare Hill - East Cape Domett (A)* <u>Shoreline:</u> Summer – 36 days (low), 64 days (moderate) Winter - 44 days (low), 74 days (moderate) Transitional – 36 days (low, 83 days (moderate) *Ord river floodplain* <u>Surface oil:</u> Summer- 28 days (low) Winter – 47 days (low) Transitional – 46 days (low) <u>Dissolved:</u> Summer – 33% (low), 18% (moderate), 1% (high)

Native Title Determination area	Distance from multi-well location	Description	Type of exposure to spill EMBA	Earliest time to contact and/or probability of exposure (reported by WAMOPRA DoT cells and RPS OSTM)
				Winter – 50% (low), 27% (moderate), 2% (high) Transitional -36% (low), 25% (moderate), 5% (high) <u>Entrained:</u> Summer – 67% (low), 37% (high) Winter – 68% (low), 64% (high) Transitional - 45% (low), 39% (high)
Balanggarra (Combined) (Figure 11.72)	69 km southwest	Represented by the Balanggarra Aboriginal Corporation RNTBC. The determination area includes waters at the 3 nautical mile coastal water limit including Lacrosse Island (above the low water mark) and Adolphus Island (above the high-water mark). Native Title was determined in 2013 and is held by members of the Balanggarra community.	Primarily shoreline and surface oil with small areas of dissolved oil.	*Wyndham – East Kimberley* <u>Dissolved:</u> Summer – 61% (low), 49% (moderate), 27% (high) Winter –97% (low) 95% (moderate), 82% (high) Transitional – 79% (low), 68% (moderate), 40% (high) <u>Surface:</u> Summer – 21 days (low) Winter – 54 days (low) Transitional – 29 days (low) <u>Shoreline:</u> Summer - 11 days (low), 12 days (moderate), 27 days (high) Winter – 16 days (low), 17 days (moderate), 28 days (high) Transitional – 11 days (low), 12 days (moderate), 25 days (high) <u>Entrained:</u>

Native Title Determination area	Distance from multi-well location	Description	Type of exposure to spill EMBA	Earliest time to contact and/or probability of exposure (reported by WAMOPRA DoT cells and RPS OSTM)
				Summer – 82% (low), 62% (high) Winter – 97% (low), 97% (high) Transitional – 86% (low), 72% (high)
Uunguu Part A (Figure 11.73) Uunguu Area B (Figure 11.74)	Uunguu Part A - 212 km west Uunguu Area B – 285 km southwest	The Uunguu Part A is represented by Wanjina-Wunggurr (Native Title) Aboriginal Corporation RNTBC. The determination area includes the offshore islands and waters of York Sound, Montague Sound, and Admiralty Gulf. Native Title was determined in 2011 and is held by the members of the Wanjina Wunggurr Community. The Uunguu Area B is represented by Wanjina-Wunggurr (Native Title) Aboriginal Corporation RNTBC. The determination area includes the nearshore waters of Port Warrendah and the adjacent Kimberley mainland. Native Title was determined in 2012 and is held by the members of the Wanjina Wunggurr Community.	Surface, dissolved and entrained.	*Tait Bank* <u>Surface oil:</u> Summer – 37 days (low) Winter – 19 days (low) Transitional – 29 days (low) <u>Dissolved:</u> Summer – 42% (low), 36% (moderate), 14% (high) Winter – 83% (low), 62% (moderate), 8% (high) Transitional – 58% (low), 47% (moderate), 12% (high) <u>Entrained:</u> Summer – 50% (low), 43% (high)_ Winter – 93% (low), 88% (high) Transitional - 68% (low), 88% (high) *Long Reef* <u>Surface oil:</u> Summer – 40 days (low) Winter – 23 days (low) Transitional – 29 days (low) <u>Dissolved:</u>

Native Title Determination area	Distance from multi-well location	Description	Type of exposure to spill EMBA	Earliest time to contact and/or probability of exposure (reported by WAMOPRA DoT cells and RPS OSTM)
				Summer – 42% (low), 33% (moderate), 19% (high) Winter – 72% (low), 50% (moderate), 5% (high) Transitional – 59% (low), 54% (moderate), 16% (high) <u>Entrained:</u> Summer – 43% (low), 43% (high) Winter – 87% (low), 78% (high) Transitional – 60% (low), 60% (high) *Jamieson Reef* <u>Surface oil:</u> Summer – 59 days (low) Winter – 31 days (low) Transitional – 34 days (low) <u>Dissolved:</u> Summer – 31% (low), 25% (moderate), 5% (high) Winter – 56% (low), 30% (moderate), 3% (high) Transitional – 57% (low), 51% (moderate), 7% (high) <u>Entrained:</u> Summer – 38 % (low), 35% (high) Winter – 74% (low), 67% (high) Transitional -60% (low), 59% (high)

Native Title Determination area	Distance from multi-well location	Description	Type of exposure to spill EMBA	Earliest time to contact and/or probability of exposure (reported by WAMOPRA DoT cells and RPS OSTM)
Dambimangari (Figure 11.75)	372 km southwest	Represented by Wanjina-Wunggurr (Native Title) Aboriginal Corporation RNTBC. The determination area covers the Shire of Derby, West Kimberley and Shire of Wyndham-East Kimberley. Native Title was determined in 2011 and is held by the Wanjina Wunggurr Community.	Primarily dissolved and entrained oil.	*Derby – West Kimberley* Entrained: Summer – 8% (low) Winter – 5% (low) Transitional – 13% (low), 1% (high) *Cockell reefs* Entrained: Summer – 9% (low) Winter – 4% low, 1% (high) Transitional – 11% (low) *Wildcat Reefs* Dissolved: Summer – 5% (low) Winter – 3% (low) Transitional – 4% low Entrained: Summer – 5% (low), 8% (high) Winter – 12% (low), 5% (low) Transitional – 35% (low), 15% (high)
Mayala People (Figure 11.76)	571 km southwest	Represented by the Mayala Inninalang Aboriginal Corporation. The determination includes parts of King Sound, Cone Bay, Strickland Bay, Yampi Sound and numerous offshore islands off the Derby-West Kimberley sector including Bathurst Island and	Primarily entrained oil, small amount of dissolved oil.	*Brue Reef* Entrained: Summer – 9% (low), 9% (high)

Native Title Determination area	Distance from multi-well location	Description	Type of exposure to spill EMBA	Earliest time to contact and/or probability of exposure (reported by WAMOPRA DoT cells and RPS OSTM)
		Sir Frederick Island. Native Title was determined in 2018 and is held by descendants (including such people descended by adoption and are accepted in accordance with traditional law and custom) of the following persons Kudumili, Galawa, Ngalgarrgard, Jabadayim, and Ulgirr/Oolgir.		Winter – 10% (low), 2% (high) Transitional – 18% (low), 9% (high)_ Dissolved: Summer – 3% (low) Winter – 2% (low), 1% (moderate) Transitional – 4% (low), 1% (moderate)
Mayala #2 (Figure 11.77)	587 km southwest	Represented by the Mayala Inninalang Aboriginal Corporation. The native title exists in parts of the determination area on two islands (Area 1 and Area 2) east of Arbidej Island and one island (Area 3) northeast of Umida island. Native Title was determined in 2019, The Mayala Inninalang Aboriginal Corporation ICN 9067 hold the determined native title in trust for the native title holders pursuant to section 56(2)(b) of the Native Title Act 1993 (Cth).	Entrained oil.	*Brue Reef* Entrained: Summer – 9% (low), 9% (high) Winter – 10% (low), 2% (high) Transitional – 18% (low), 9% (high)_
Bardi and Jawi (Figure 11.78)	626 km southwest	Represented by the Bardi and Jawi Niimidiman Aboriginal Corporation RNTBC. The determination area includes the waters from Pender Bay, Thomas Bay, Curlew Bay, Cygnet Bay and Goodenough Bay. Native Title was determined in 2019 and is held by the Bardi and Jawi People.	Entrained oil	*Broome* Entrained oil: Summer – 2% (low) Winter –1% (low) Transitional – 7% (low)
Warrwa Mawadjala Gadjidgar (Figure 11.79)	609 km southwest	Represented by the Kimberley A/TSI. The determination area includes the land and sea surrounding the Port of Derby and encompasses both branches of Doctors Creek. Native Title was determined in 2020 and is held by the Warrwa Mawadjala Gadjidgar people.	Entrained oil	*Derby – West Kimberley* Entrained: Summer – 8% (low) Winter – 5% (low) Transitional – 13% (low), 1% (high)

Native Title Determination area	Distance from multi-well location	Description	Type of exposure to spill EMBA	Earliest time to contact and/or probability of exposure (reported by WAMOPRA DoT cells and RPS OSTM)
Bindunbur (Figure 11.80)	622 km southwest	Represented by the Gogolanyngor Aboriginal Corporation, Nimanburr Aboriginal Corporation and Nyul Nyul PBC Aboriginal Corporation. Coastal parts of determination area within the spill EMBA include Lacepede Islands and its surrounding waters offshore and Goodenough Bay on the Dampier Peninsula. Native Title was determined in 2018 and is held by the Jabirr Jabirr/Ngumbarl, Nyul Nyul and Nimanburr people.	Primarily entrained oil. Small amount of shoreline oil on Lacepede Islands	*Broome* Entrained oil: Summer – 2% (low) Winter –1% (low) Transitional – 7% (low) *Lacepede Islands* Shoreline: Summer – 17 days (low), 19 days (moderate), 50 days (high) Winter – N/A Transitional – 73 days (low) Entrained: Summer – 1% (low) Winter –N/A Transitional – 2% (low)

Note: Native Title determination areas that are situated in coastal regions will be primarily exposed to shoreline levels of exposure.

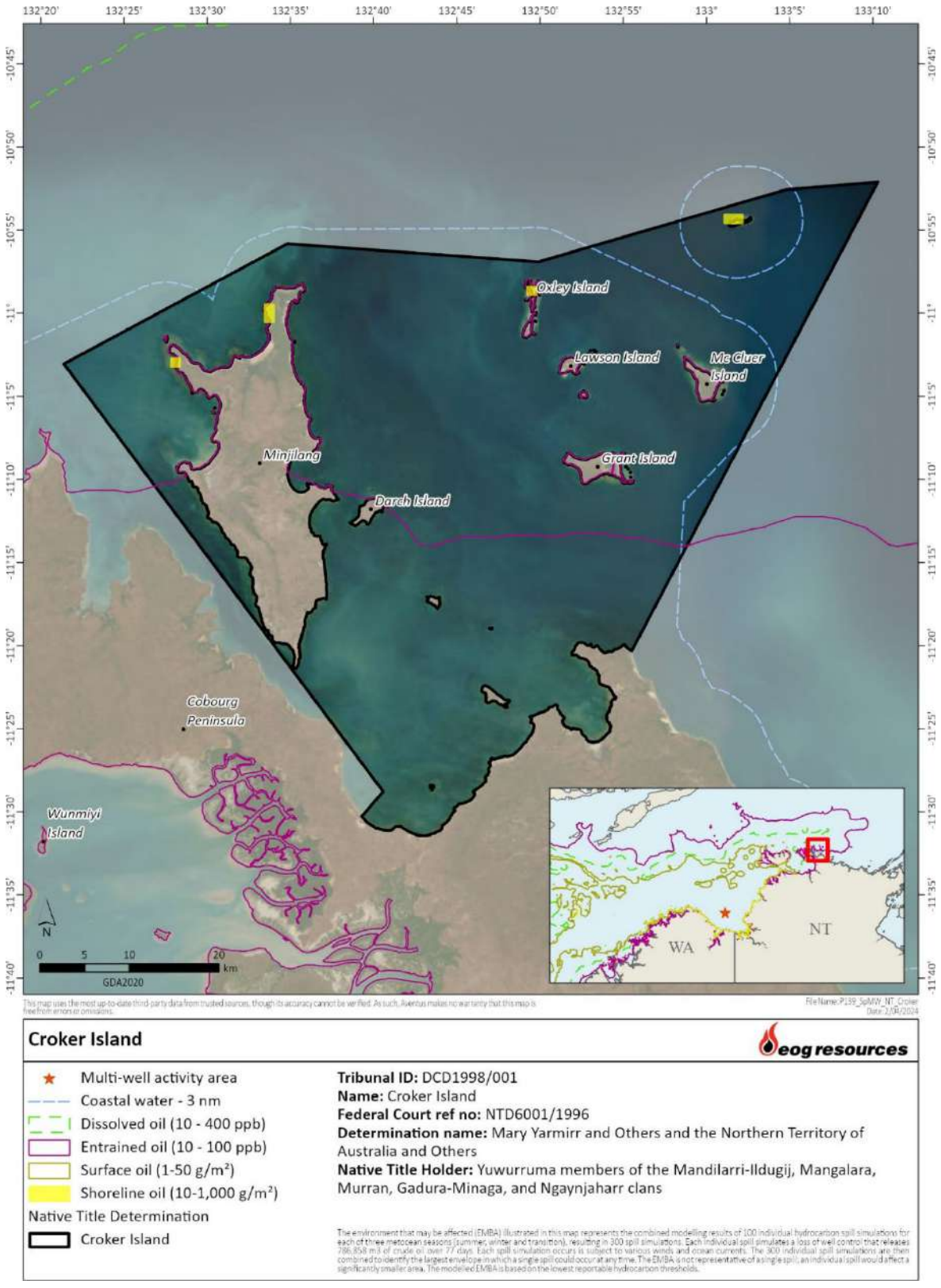


Figure 11.64 Croker Island Native Title determination exposure to the spill EMBA

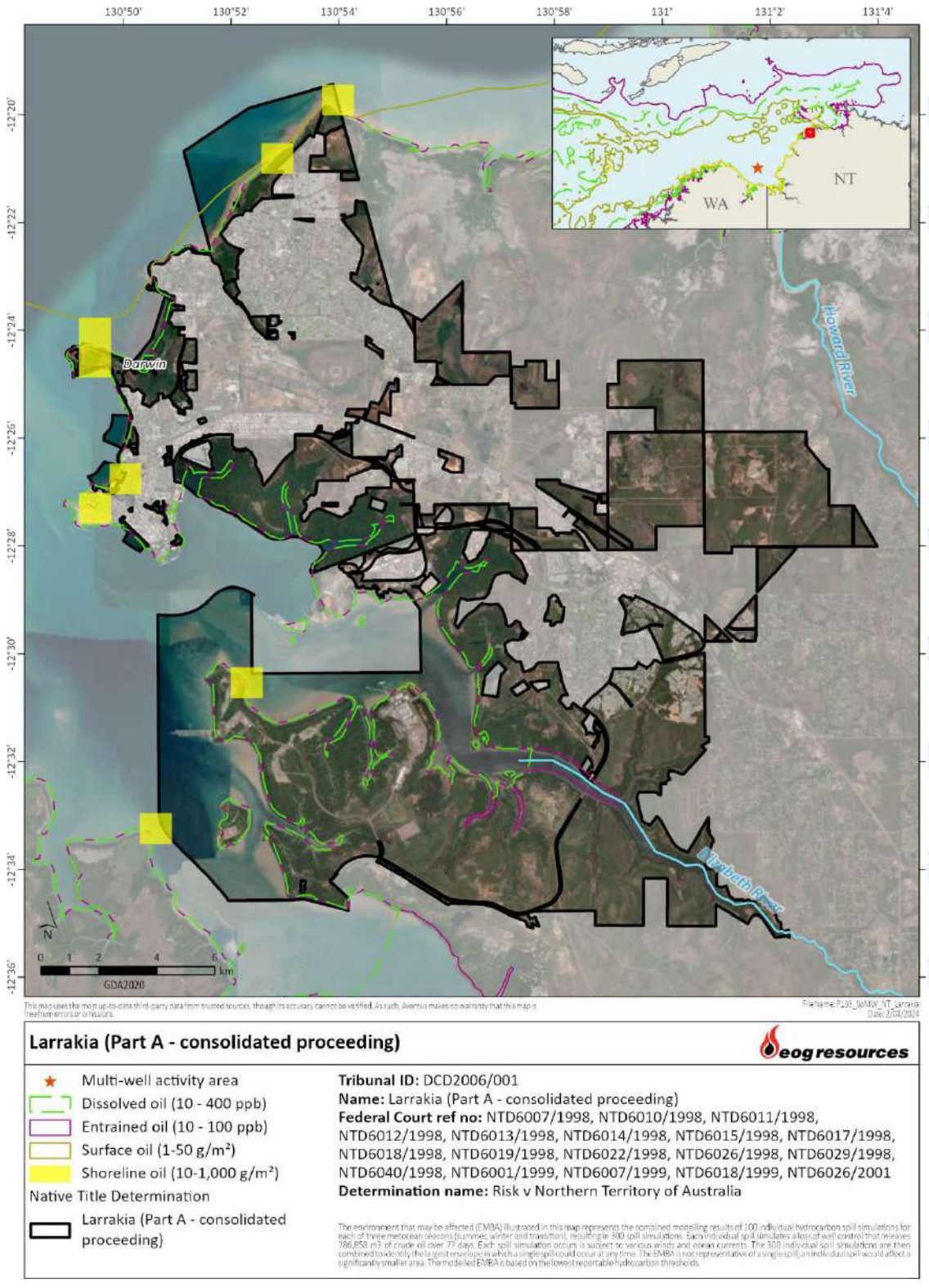


Figure 11.65 Larrakia (Part A - consolidated proceeding) Native Title determination exposure to the spill EMBA

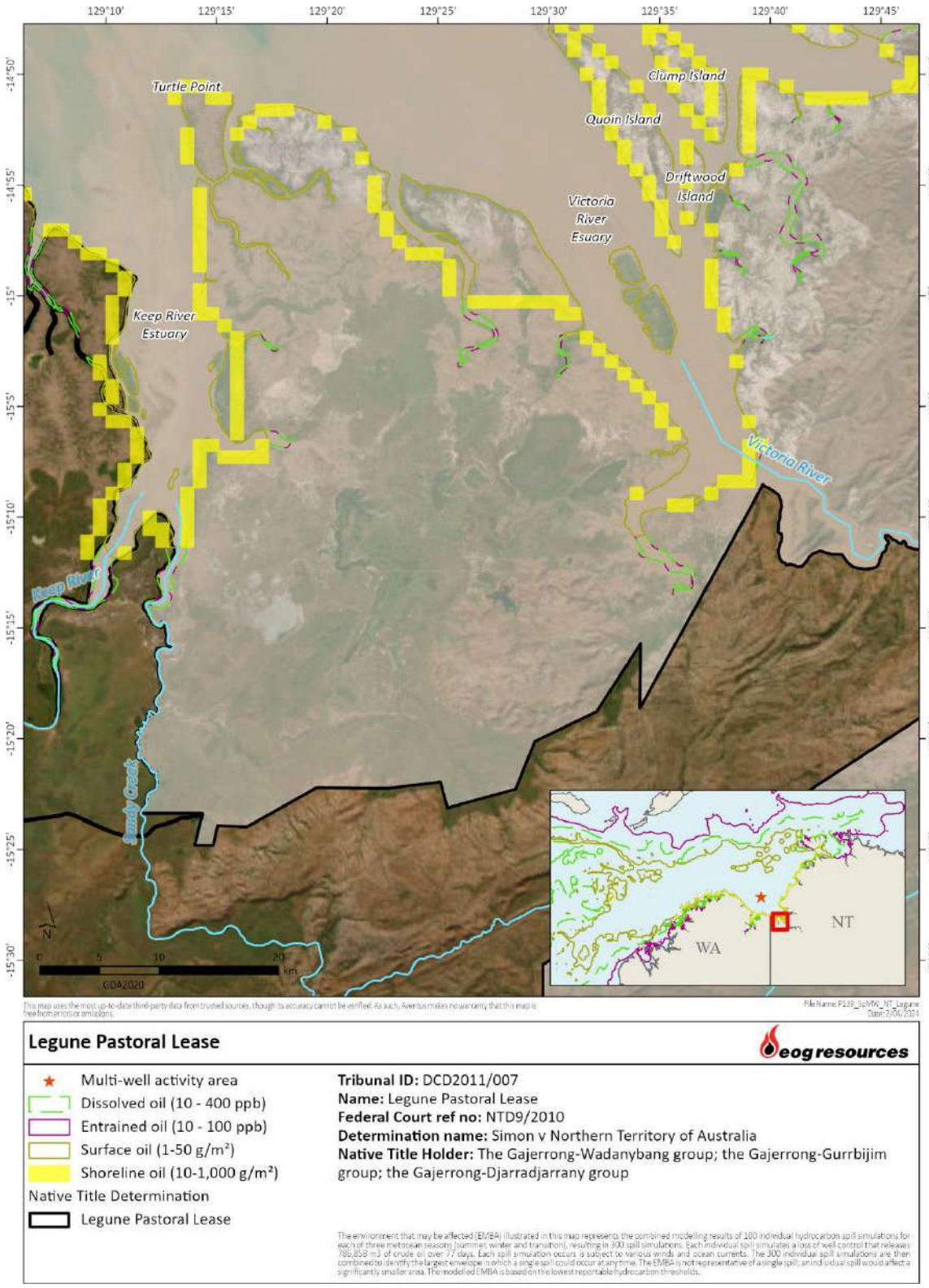


Figure 11.66 Legune Pastoral Lease Native Title determination exposure to the spill EMBA

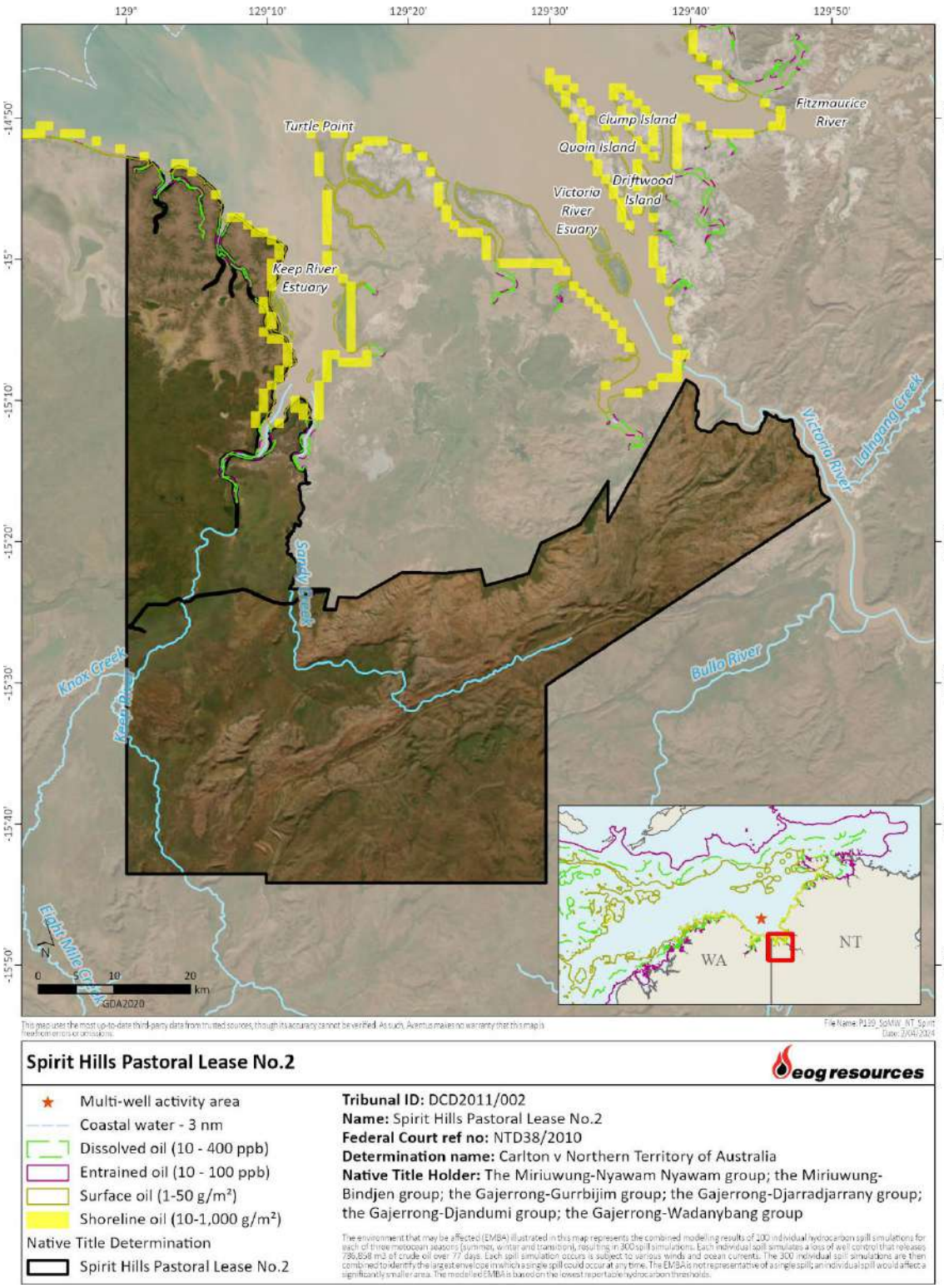


Figure 11.67 Spirit Hills Native Title determination exposure to the spill EMBA

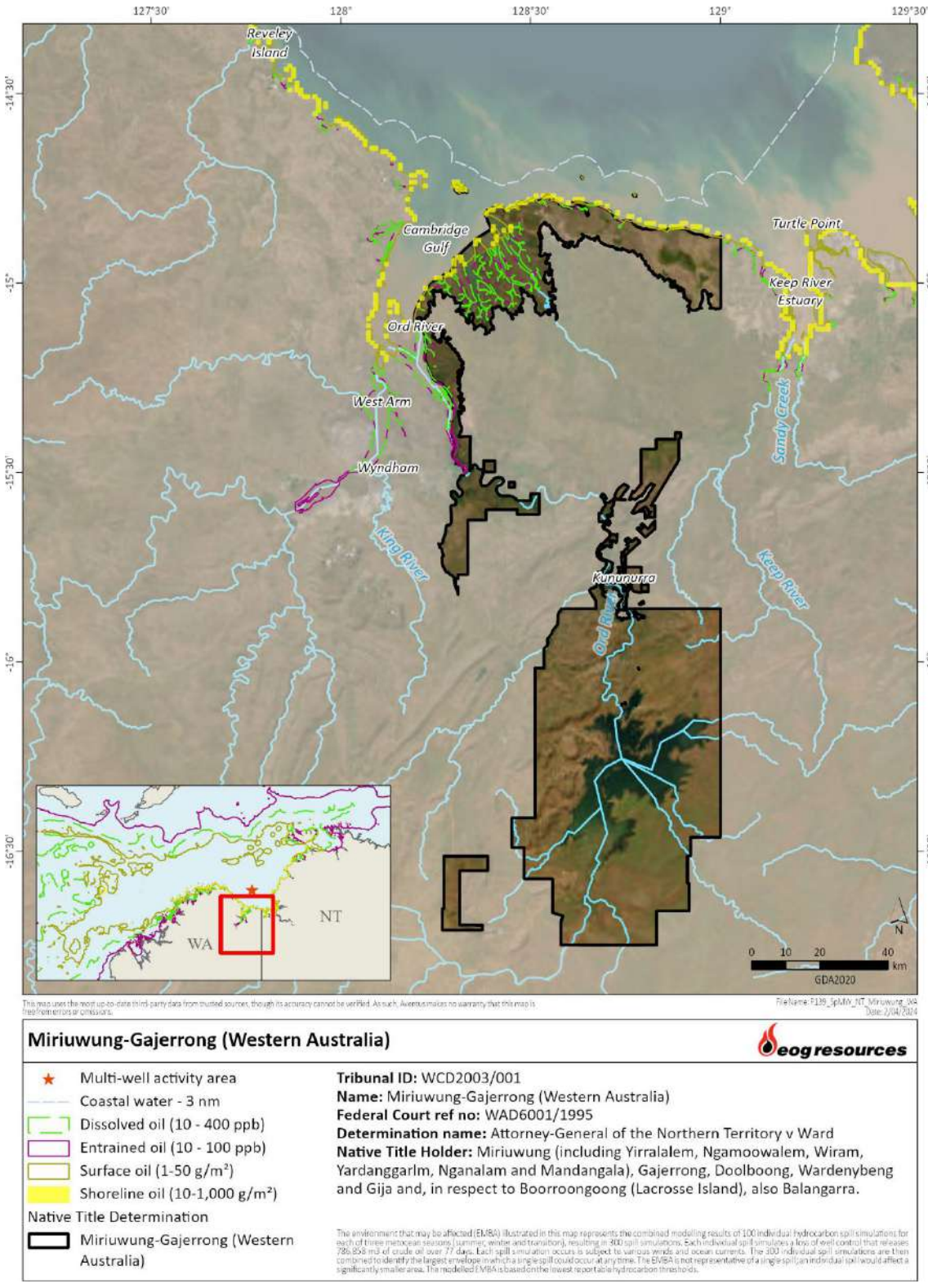


Figure 11.68 Miriuwung Gajerrong (Western Australia) Native Title determination exposure to the spill EMBA

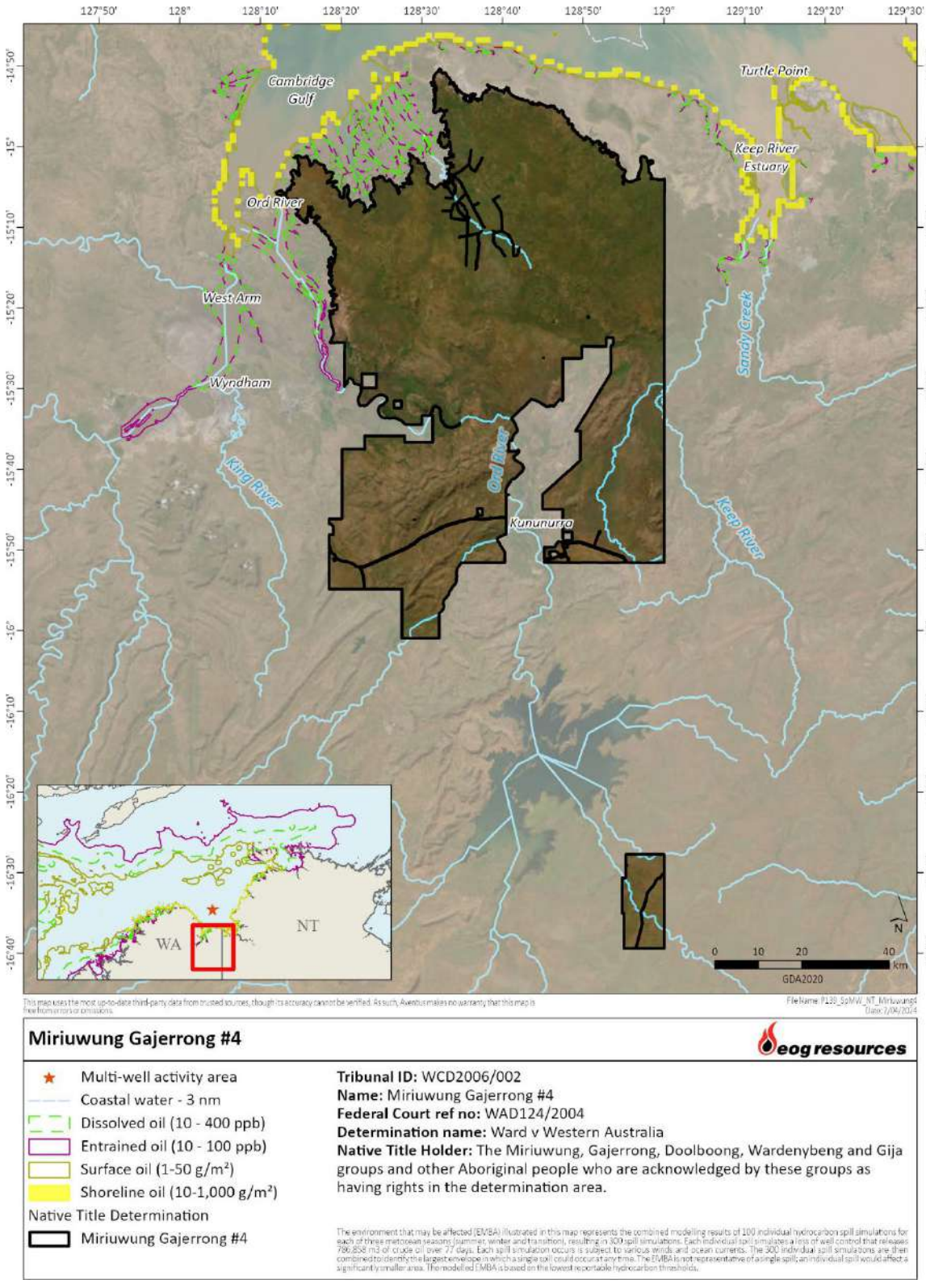


Figure 11.69 Miriuwung Gajerrong (#4) Native Title determination exposure to the spill EMBA

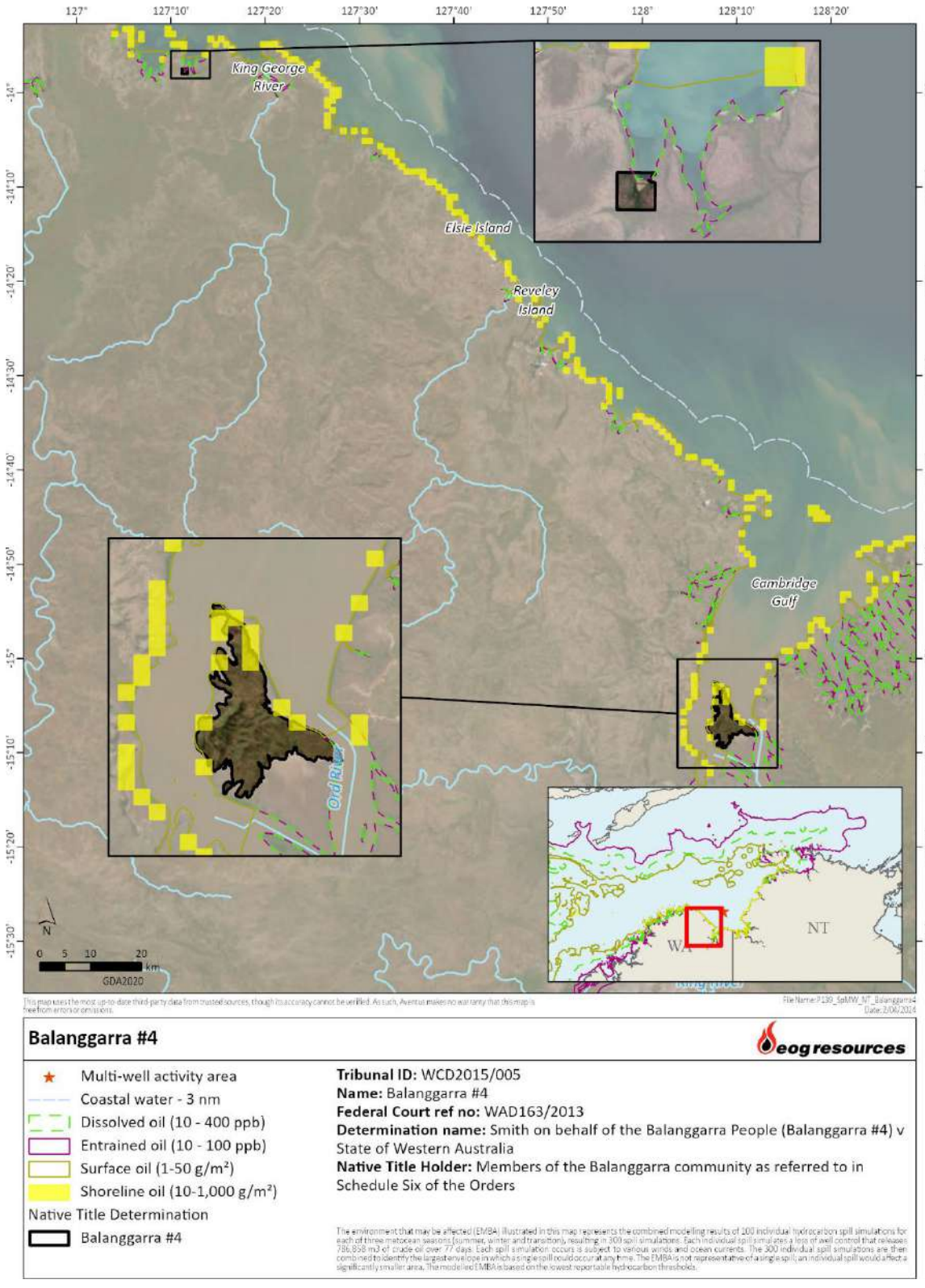


Figure 11.70 Balanggarra (#4) Native Title determination exposure to the spill EMBA

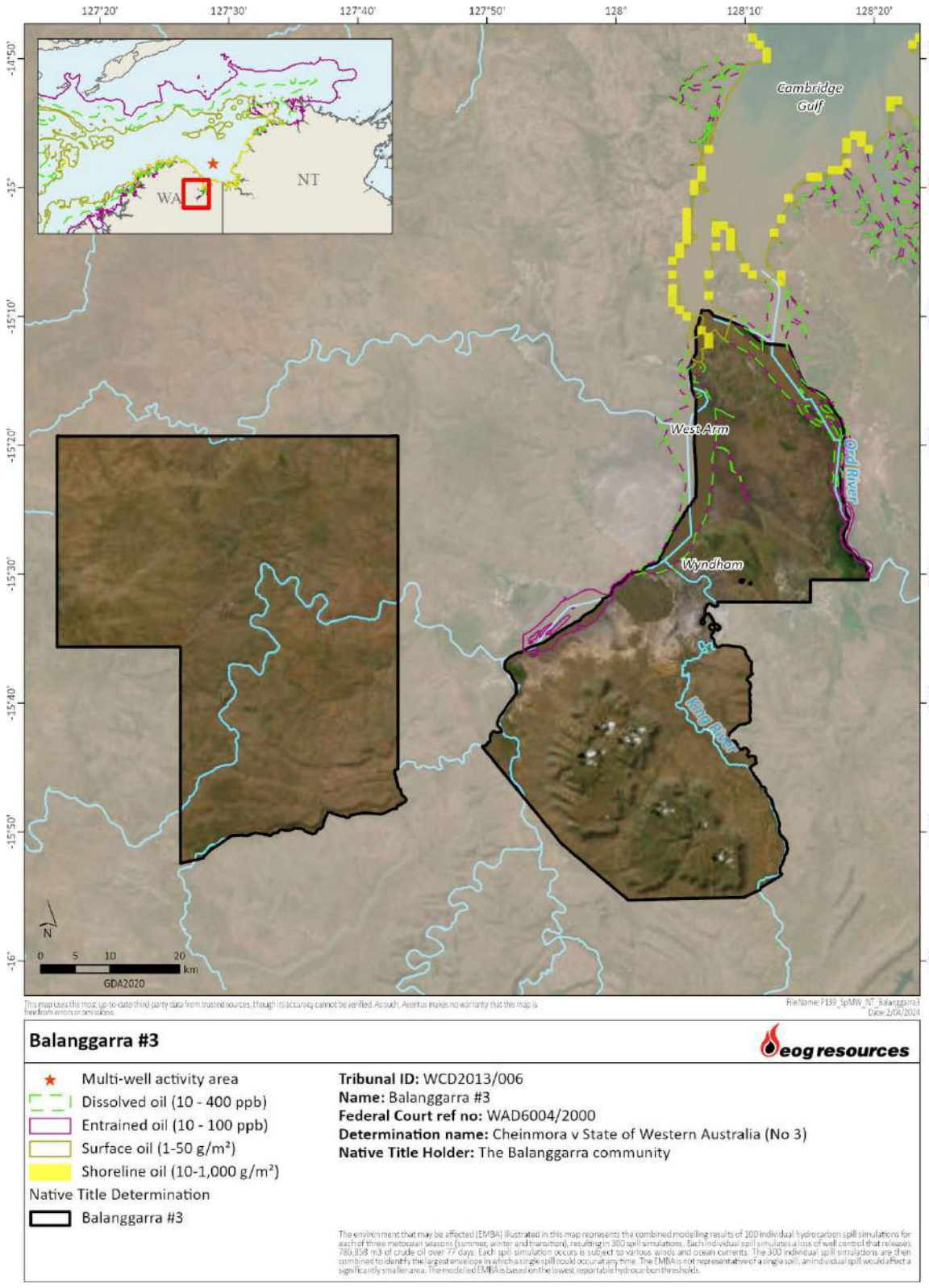


Figure 11.71 Balanggarra (#3) Native Title determination exposure to the spill EMBA

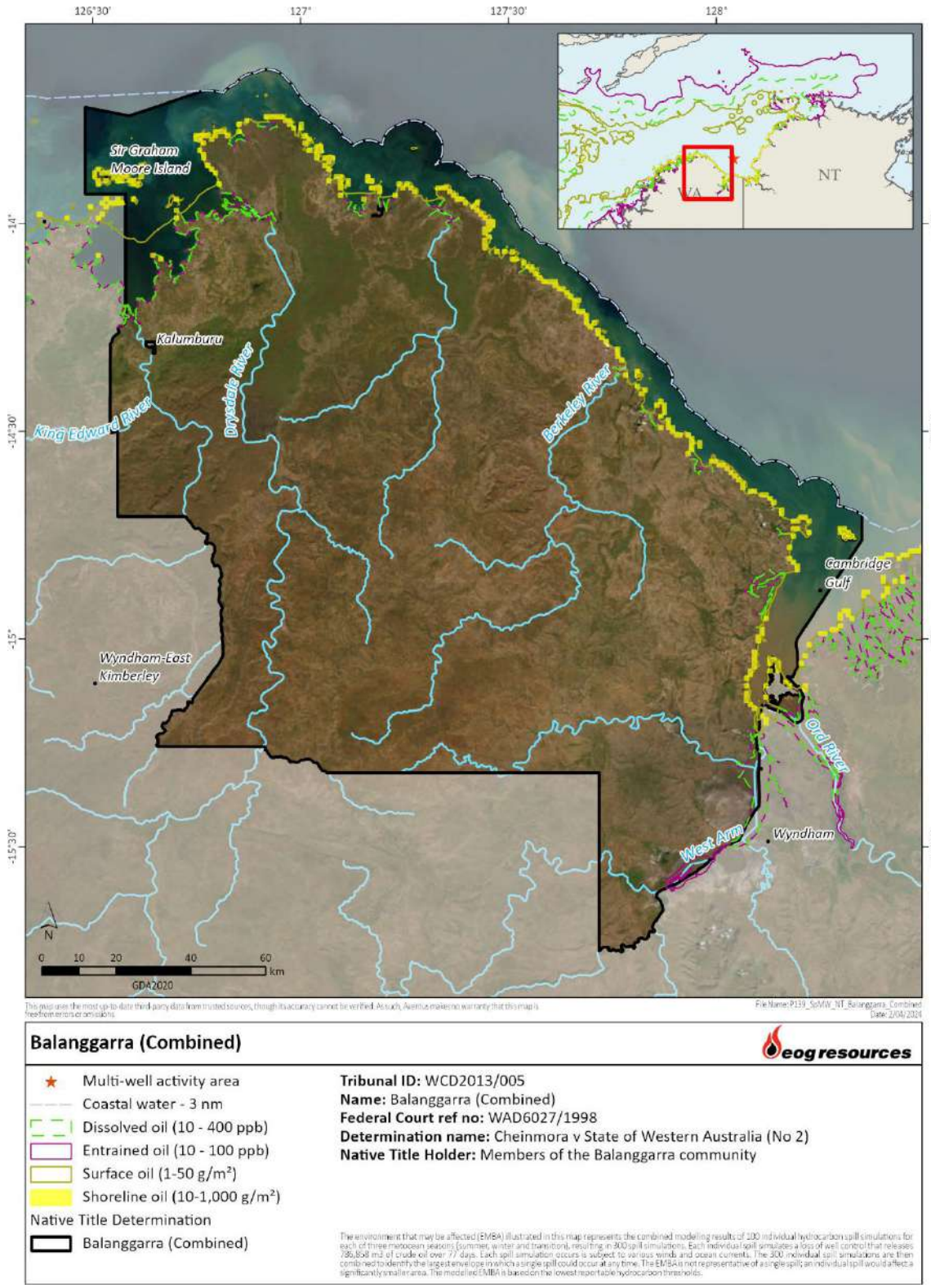


Figure 11.72 Balanggarra (combined) Native Title determination exposure to the spill EMBA

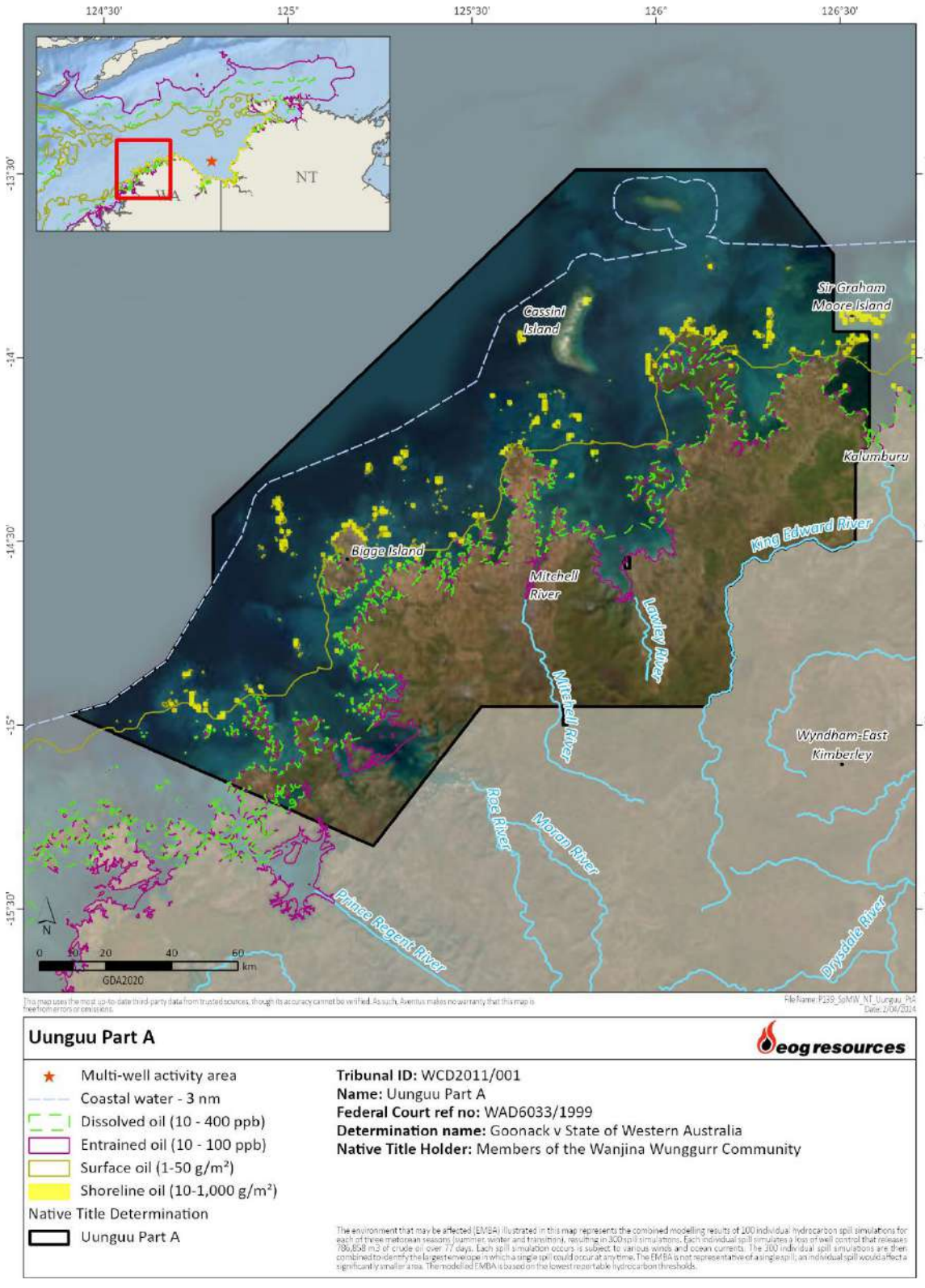


Figure 11.73 Uunguu Part A Native Title determination exposure to the spill EMBA

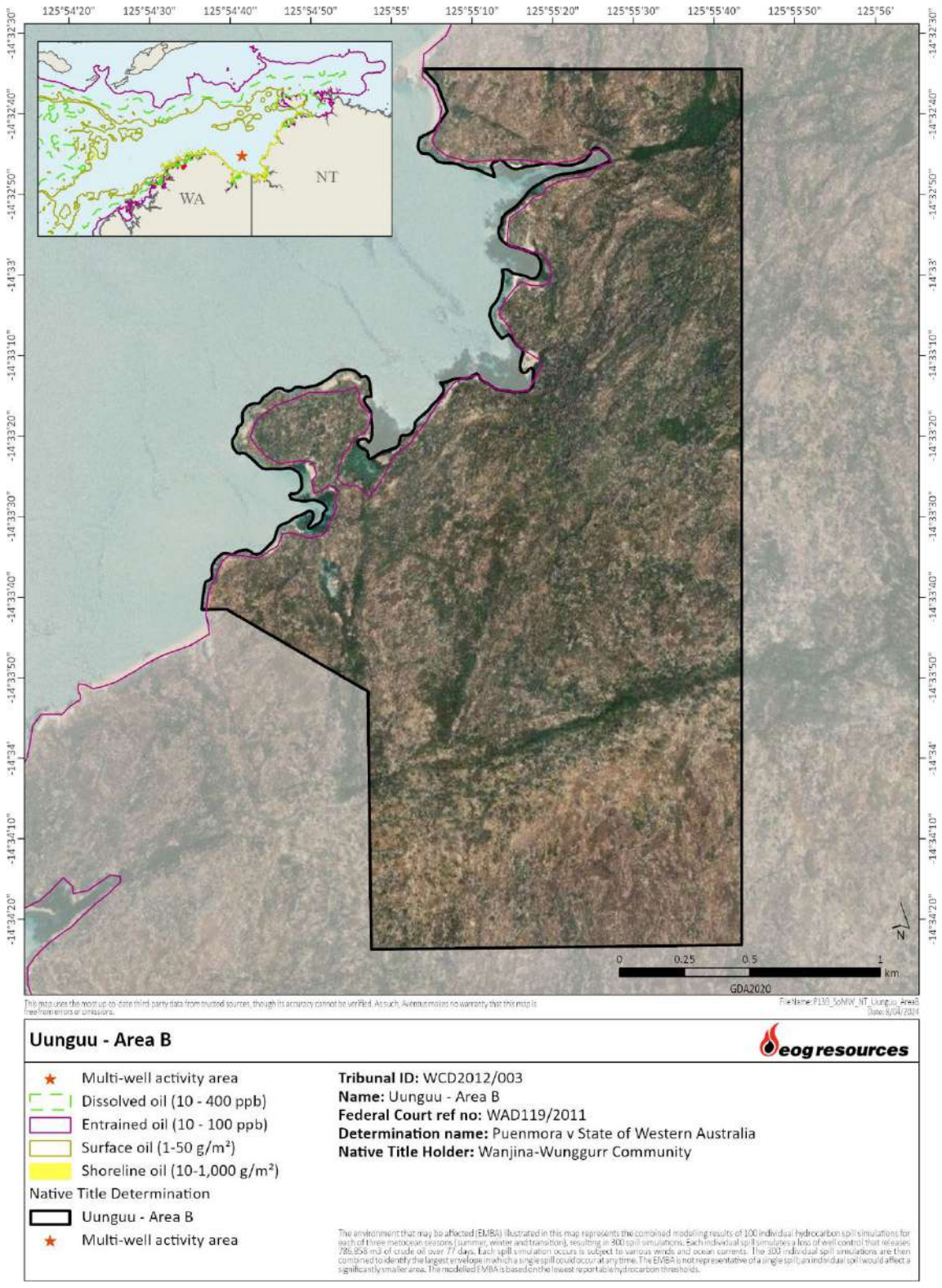


Figure 11.74 Uunguu Part B Native Title determination exposure to the spill EMBA

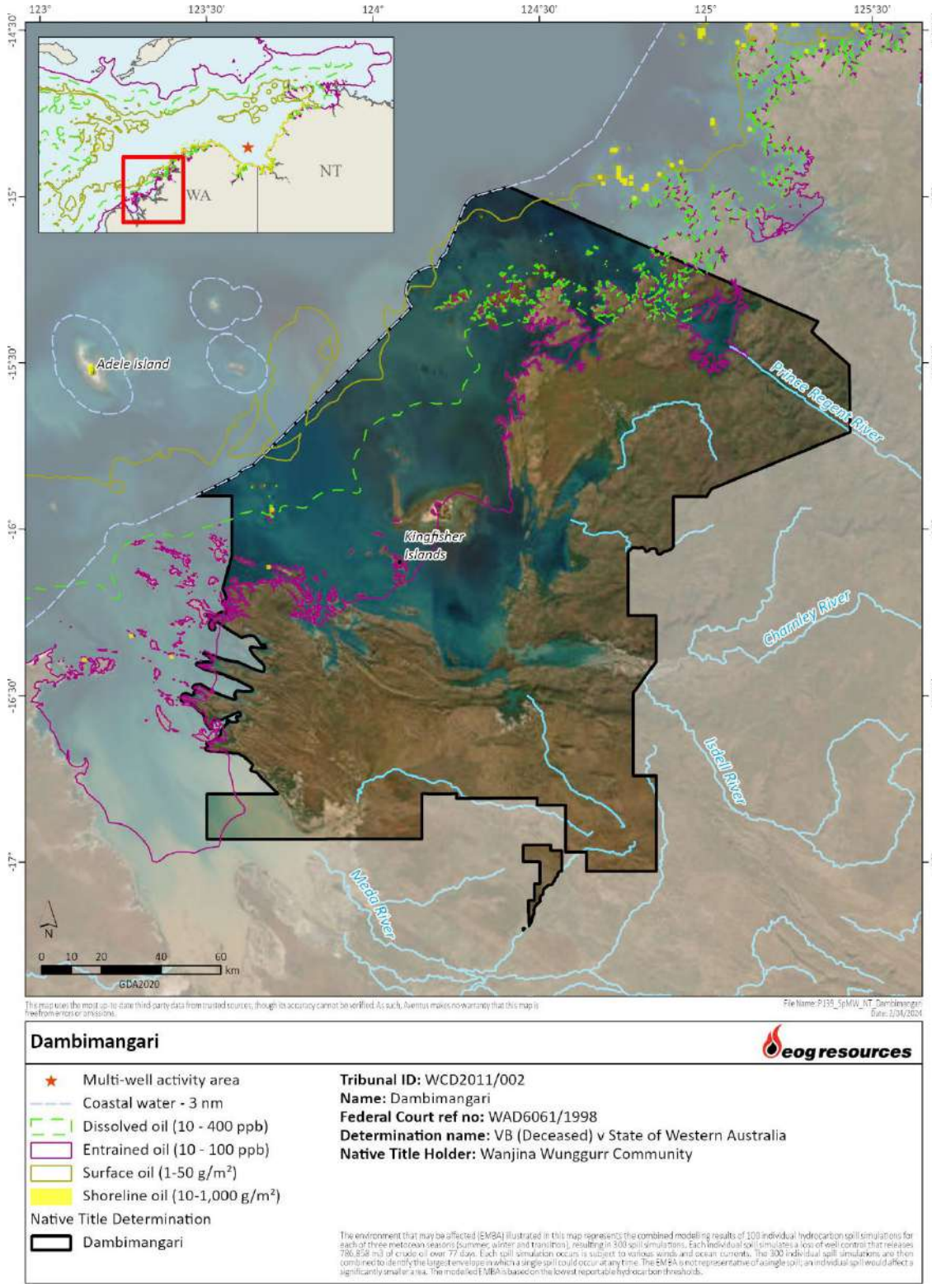


Figure 11.75 Dambimangari Native Title determination exposure to the spill EMBA

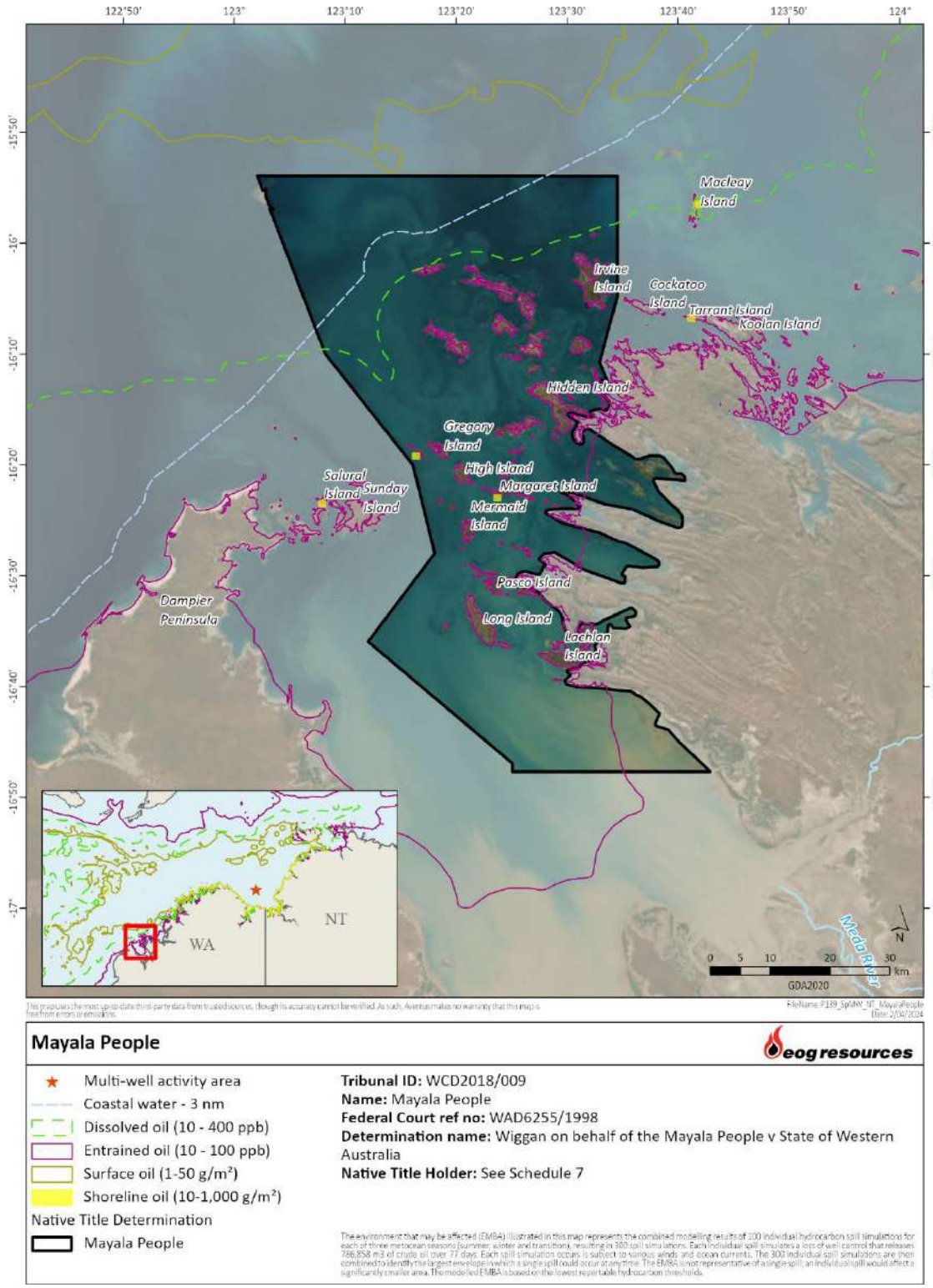


Figure 11.76 Mayala People Native Title determination exposure to the spill EMBA

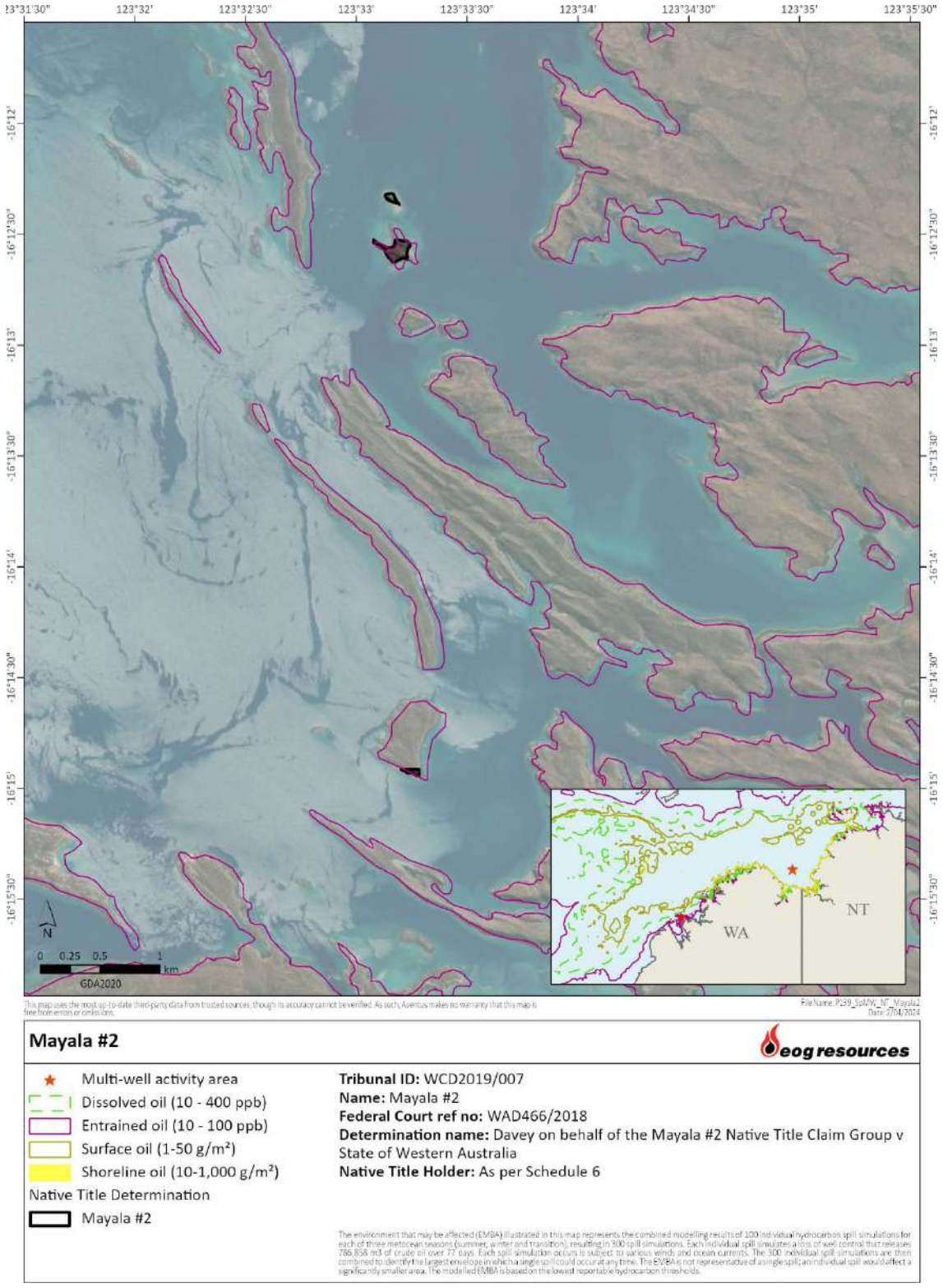


Figure 11.77 Mayala #2 Native Title determination exposure to the spill EMBA

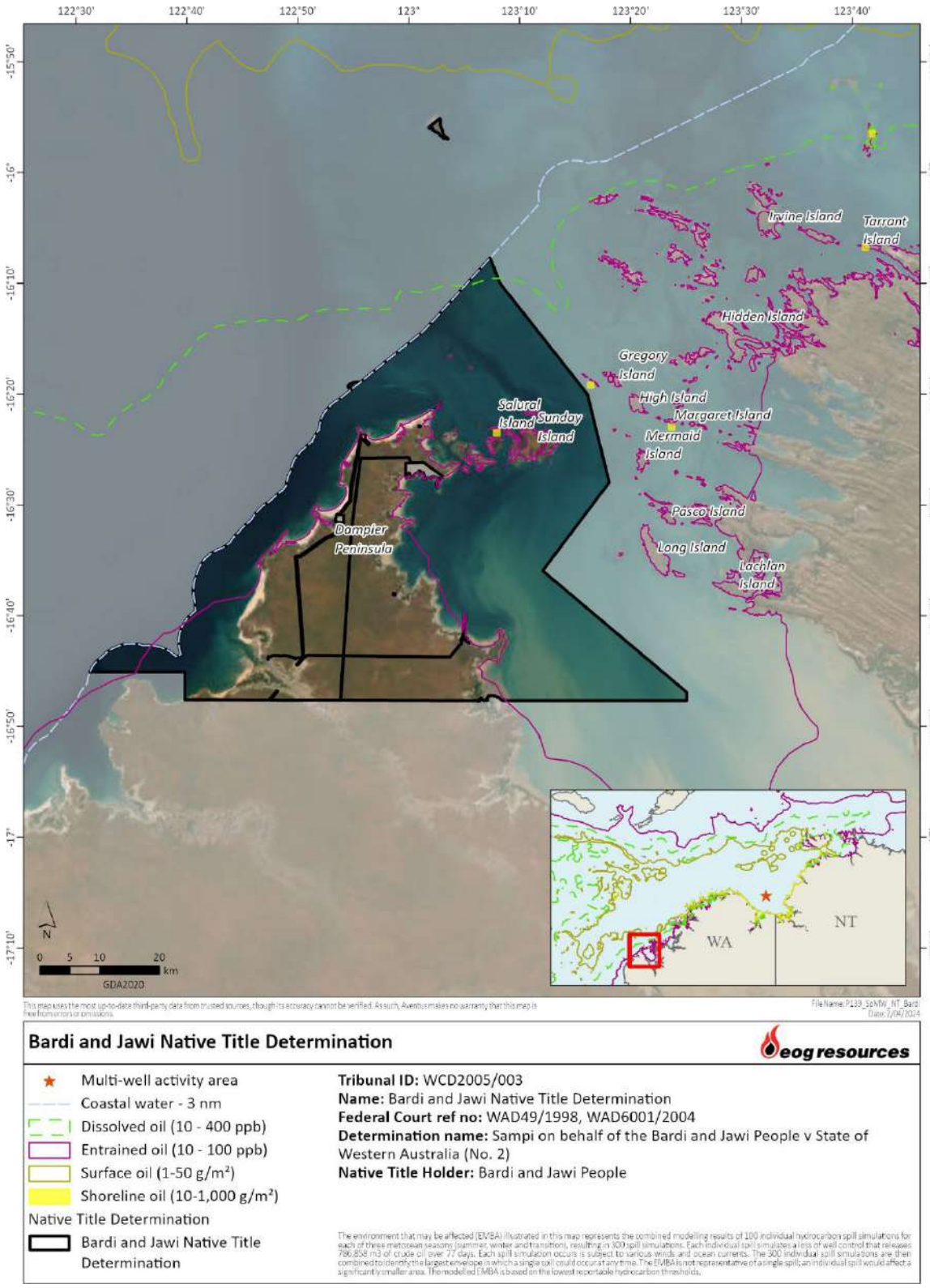


Figure 11.78 Bardi and Jawi Native Title determination exposure to the spill EMBA

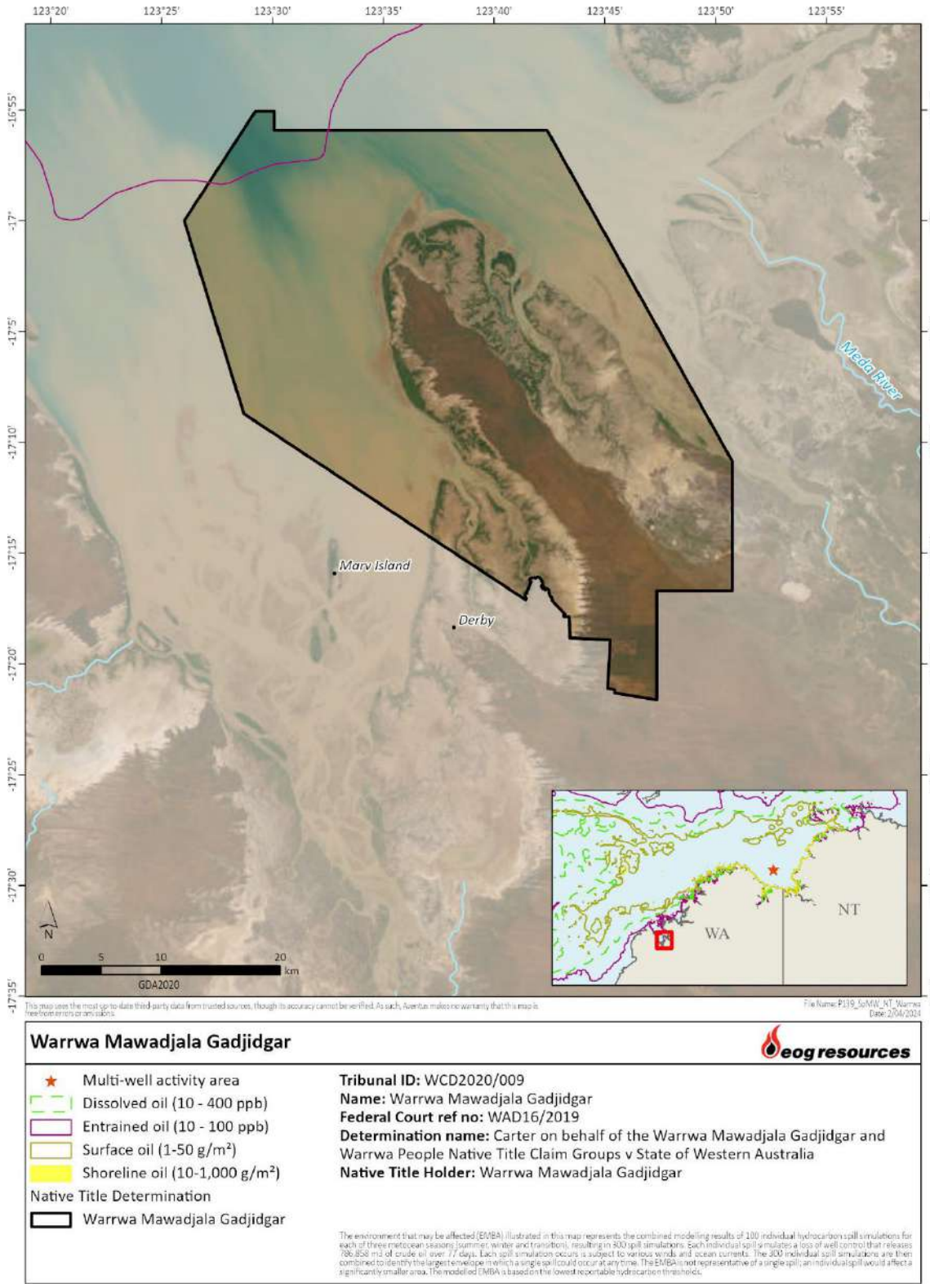


Figure 11.79 Warrwa Mawadjala Gadjidgar Native Title determination exposure to the spill EMBA

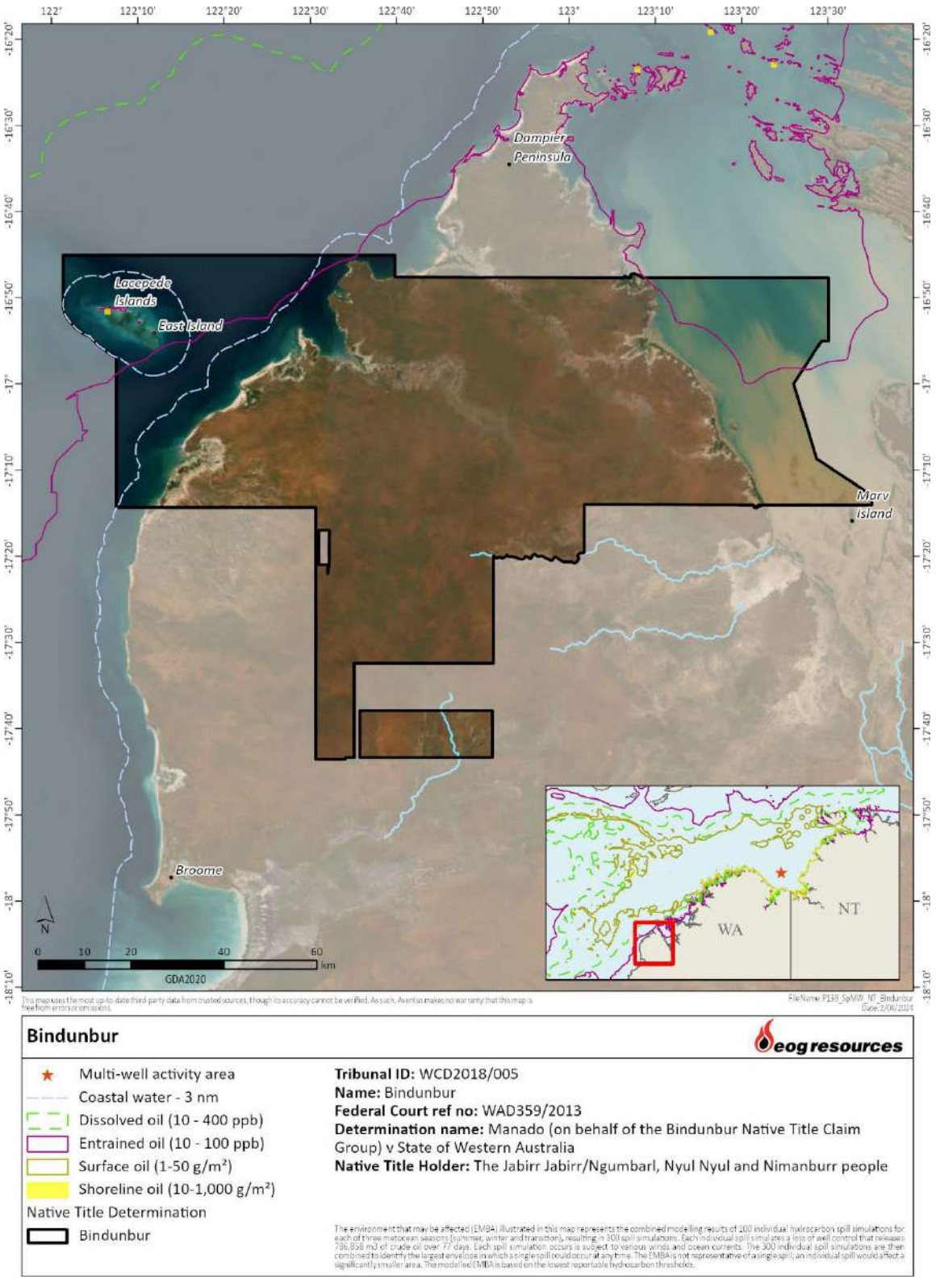


Figure 11.80 Bindunbur Native Title determination exposure to the spill EMBA

11.5.5 Sea Country

Sea Country refers to the areas of the sea that First Nations groups are particularly affiliated with through their traditional lore and customs (DNP, 2018a). Traditional owners have managed and used sea country within the region for tens of thousands of years, in some cases since before rising sea levels created these marine environments. They use and actively manage the coastal and marine environments of the region as a resource and to maintain cultural identity, health, and wellbeing. Fishing, hunting and the maintenance of culture and heritage through ritual, stories and traditional knowledge continue as important uses of nearshore and adjacent areas. Smyth and Isherwood (2016) describe Sea Country as all estuaries, beaches, bays, and marine areas collectively, within a traditional estate. Sea country contains evidence of the ancient mystical events by which all geographic features, animals, plants, and people were created. Sea Country contains sacred sites and contains tracks (or song lines) along which mythological beings travelled during the creation period (Smyth and Isherwood, 2016).

The sea, like the land, is integral to the identity of First Nation groups. Connection to sea country is accompanied by a complexity of cultural rights and responsibilities. Formal recognition of Sea Country rights lags considerably compared to land rights; this could be for a range of reasons including conflicting perspectives and opinions on traditional custodianship of land and how far it extends (Smyth and Isherwood, 2016). First Nations people continue to assert inherited rights and responsibilities over sea country within the region. It is recognised that spiritual corridors extend from terrestrial areas into nearshore and offshore waters, a number of marine animals are totems for Indigenous people, and that song lines pass through marine parks (DNP, 2018b).

The spill EMBA has the potential to encounter areas of Sea Country. EOG has sent project information to relevant persons and invited comments, including Native Title determination group representatives, Aboriginal land councils and other Aboriginal relevant persons intersected by the spill EMBA. The BAC expressed concerns to EOG regarding their Sea Country being within the spill EMBA, noting that important cultural sites exist within the spill EMBA (although did not specify where) and a number of tourism activities are present. The BAC also expressed interest in co-managing risks to the Kimberley coast.

11.5.6 Traditional Aboriginal Fishing

Traditional Aboriginal fishing in NT waters predominately occurs within inshore tidal waters. Approximately 85% of the NT's intertidal zone is recognised as Aboriginal land under the *Aboriginal Land Rights (Northern Territory) Act 1976*.

From a cultural perspective, fishing for food and traditional purpose is central to the health and wellbeing of Aboriginal communities across the NT (NT Government, 2019).

Nearly all of the effort of Indigenous sectors is concentrated in coastal waters (DPIR, 2019). Hand lines are the most common traditional fishing method used by Indigenous fishers, with most of this effort (93%) concentrated onshore (i.e., from beaches rivers, or lakes) (NT Government, 2019). Less than 2% of the fish caught by Indigenous fishers are released, as fishing is undertaken as a subsistence activity (DPIR, 2019).

Around 10% of all fishing by Indigenous fishers in the NT involve the use of some form of net (DPIR, 2019). Sharks are taken in significant quantities by Indigenous fishers, with the vast majority from shore (DPIR, 2019). Most (85%) of the mud crabs harvested by Indigenous fishers are taken by hand or with spears. These two collection methods account for around 50% of all fishing events by Indigenous fishers in the NT (DPIR, 2019).

Hunting, subsistence fishing and shell collecting are recognised as occurring in the Kimberley region (DNP 2018a; DPaW 2016b, Smyth 2007). The land and sea country of the Balanggarra people extends from Napier-Broome Bay to Cambridge Gulf and Wyndham in the JBG, inshore from where the multi-well activity is proposed. In the past, the Balanggarra people speared fish along the rocky shoreline and in shallow waters. Saltwater fish, turtles, dugong, mud crabs and cockles continue to be important food sources for the Balanggarra people today (DPaW, 2016b). The Miriuwung Gajerrong land and sea country extends from the Cambridge Gulf to the NT. In the past, the Miriuwung Gajerrong people would hunt, fish and gather bush tucker in tidal areas such as mangroves, with fishing and hunting still practiced today (DPaW, 2016b).

11.5.7 Aboriginal Rock Art

The National Museum of Australia (2022) defines Aboriginal rock art as the oldest surviving human art form and is an integral part of First Nations life and customs, dating back to the earliest times of human settlement on the continent. Research indicates that there are more than 100,000 significant rock sites within Australia, over 5,000 of which are found in Kakadu National Park (The National Museum of Australia, 2022). The coastline of this park is located in the western portion of the spill EMBA.

EOG's consultation with the BAC for the Beehive-1 EP, indicates that rock art may be present within coastal areas of the spill EMBA within the Balangarra Native Title determination area(s). Rock art was also mentioned during the relevant persons consultation process at a community meeting in June 2023 in Kalumburu (for the Beehive-1 EP). The exact locations of the rock art have not been made available to EOG, however, Figure 11.63 does contain spatially defined areas labelled 'painting' that intersect with the spill EMBA. Given the multi-well location encompasses the Beehive-1 location and the spill EMBA is exactly the same, this comment remains applicable.

11.5.8 Maritime Archaeological Heritage

Historic shipwrecks are recognised and protected under the *Underwater Cultural Heritage Act* 2018, which aims to protect historic wrecks and associated relics. Under the Act, all wrecks more than 75 years old are protected, together with their associated relics regardless of whether their actual locations are known.

There are 178 shipwrecks identified within the spill EMBA; 106 located off the WA coast and 72 located off the NT coast. The locations of these shipwrecks are illustrated in Figure 11.81.

The spill EMBA intersects with the following shipwreck protection zones:

- *SS Florence D* (1942) located Northwest of Bathurst Island; and
- *I-124* (Japanese Submarine) (1942) located south of Yinanapi Point, Bathurst Island.

Shipwreck protection zones can be in place for conservation, management, or public safety reasons.

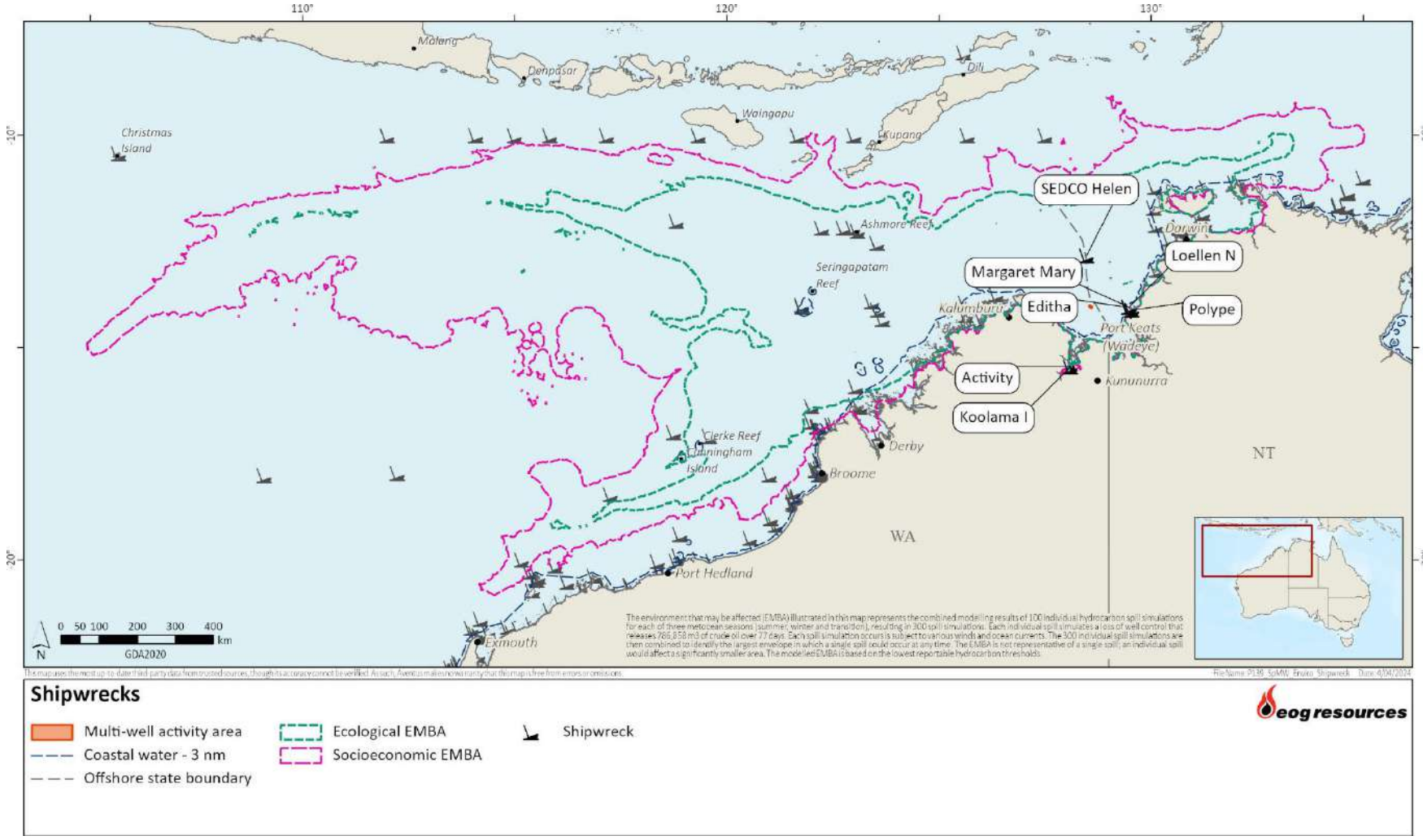


Figure 11.81 Shipwrecks in the spill EMBA

11.6 Socio-economic environment

This section describes the social and economic environment of the spill EMBA.

11.6.1 Commercial Fishing

Several Commonwealth, WA and NT commercial fisheries are licensed to operate in the spill EMBA. These are described in the following sections.

Commonwealth-managed Fisheries

Commonwealth fisheries are managed by AFMA under the *Fisheries Management Act 1991* (Cth). Their jurisdiction covers the area of ocean from 3 nm from the coast out to the 200 nm limit (the extent of the Australian Fishing Zone [AFZ]). Commonwealth commercial fisheries with jurisdictions to fish the spill EMBA are the:

- Northern Prawn Fishery (NPF).
- North West Slope Trawl Fishery;
- Southern Bluefin Tuna (SBT) Fishery;
- Western Tuna and Billfish Fishery;
- Western Deepwater Trawl Fishery; and
- Western Skipjack Fishery.

Of these fisheries, only the NPF and the North West Slope Trawl Fishery have evidence of recent (within the last three years) fishing activity in the spill EMBA. The NPF is discussed in detail in Section 5.71 of Chapter 5 of the EP.

Although there is no current fishing effort nor previous active fishing for the Southern Bluefin Tuna Fishery off WA, the spill EMBA does overlap a known spawning ground for this species (see Figure 11.84). Table 11.25 summarises the key facts and figures of the relevant fisheries.

Table 11.25 Commonwealth-managed commercial fisheries with jurisdictions to fish in the spill EMBA

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
NPF (Figure 11.82)	Redleg banana prawn (*Fenneropenaeus indicus),* white banana prawn (*F. merguiensis*), brown tiger prawn (*Penaeus esculentus*), grooved tiger prawn (*P. semisulcatus*), blue endeavour prawn (*Metapenaeus endeavouri*) and red endeavour prawn (*M. ensis*)	Yes – Areas include JBG (low-medium fishing intensity), south-west of Darwin (low to medium intensity), north of Melville Island (low to high intensity) extending to Cobourg Peninsula (low to medium intensity). The spill EMBA overlaps 17.53% of the total fishery.	The NPF operates in two seasons; • First – beginning in April for a duration of 6-12 weeks during which time banana prawns are mainly caught. • Second (August – November), when tiger prawns are predominately caught.	Otter trawl is the primary fishing method. In 2021, there were 52 fishing permits and 54 active vessels.	Catch data and economic value available for the last five years: • 2022 – 5,325 tonnes valued at $91.7 million. • 2021 – 5,390 tonnes valued at $76.6 million. • 2020 – 4,767 tonnes valued at 84.9 million. • 2019 – 8,581 tonnes valued at $117.1 million. • 2018 – 6,778 tonnes valued at $98.2 million.
North West Slope Trawl Fishery (Figure 11.83)	Australian scampi (*Metanephrops australiensis*) smaller quantities of velvet scampi (*M. velutinus*) and Boschma's scampi (*M. boschmai*) are also harvested. Mixed deep-water snappers are also a component of the catch.	Yes - Low to high intensity fishing area northeast of Clerke Reef; including a small area southwest of Cunningham Island. The spill EMBA overlaps 18.02% of the total fishery.	All year round.	Deepwater demersal trawling. Fishing occurs on the continental slope in water depths greater than 200 m. There were six fishing permits and four active vessels in the 2020-21 fishing season, a drop from seven permits and six vessels in the 2019-2020 fishing season.	Catch data available for the following years (economic value confidential): • 2021-22 – 85.8 tonnes. • 2020-21 – 86.9 tonnes. • 2019-20 – 111.5 tonnes. • 2018-19 – 67.4 tonnes. • 2017-18 – 79.8 tonnes.

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Southern Bluefin Tuna Fishery (Figure 11.84)	Southern bluefin tuna (*Thunnus maccoyii*).	No - There has been no active fishing in WA in recent years as fishing efforts are concentrated off the south eastern coast of New South Wales, eastern Victoria, Tasmania and SA (Butler *et al.,* 2023). However, the spill EMBA extends to the potential spawning grounds of the target species in the northwest of WA between September and March, and larvae are seasonally abundant in surface waters during these months.	12-month season begins 1st December.	Purse seine catch in the GAB for transfer to aquaculture farms off Port Lincoln in South Australia (five to eight vessels consistently fish this area). Port Lincoln is the primary landing port. On the east coast, pelagic longline fishing is the key fishing method. 27 active vessels in the last fishing season (2020-2021).	There is no recent fishing effort in the spill EMBA. Catch data and economic value available for the following years: • 2022 – 5,972 tonnes worth 35.45 million. • 2021 – 5,646 tonnes worth $35.49 million. • 2019-20 – 5,429 tonnes worth $41.27 million. • 2018-19 – 6,074 tonnes worth $43.41 million. • 2017-18 – 6,159 tonnes worth $39.73 million.

Sources: Butler et al (2023) Patterson et al (2022, 2021; 2020; 2019; 2018).

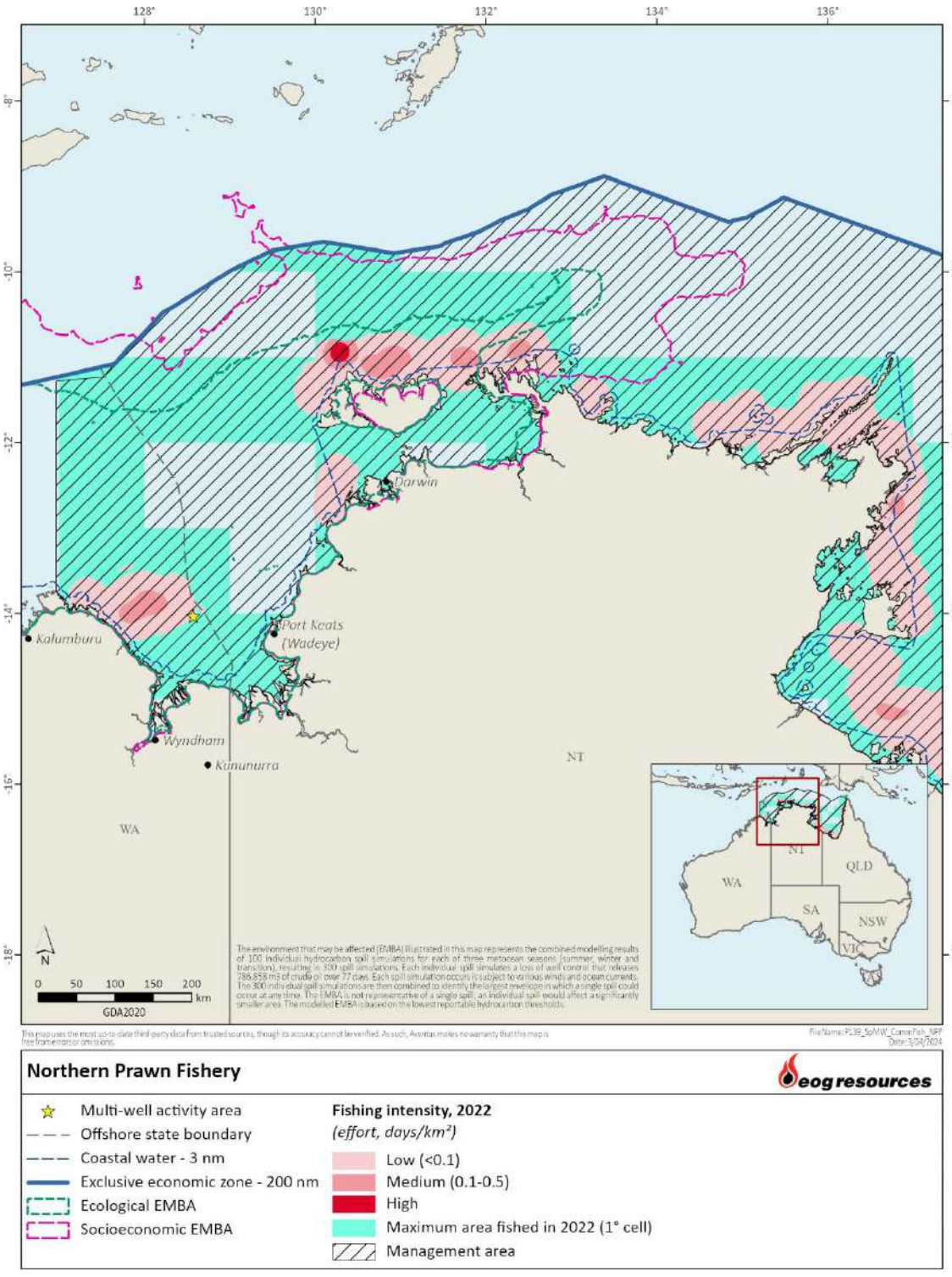


Figure 11.82 Northern Prawn Fishery overlapped by the spill EMBA (2022 intensity)

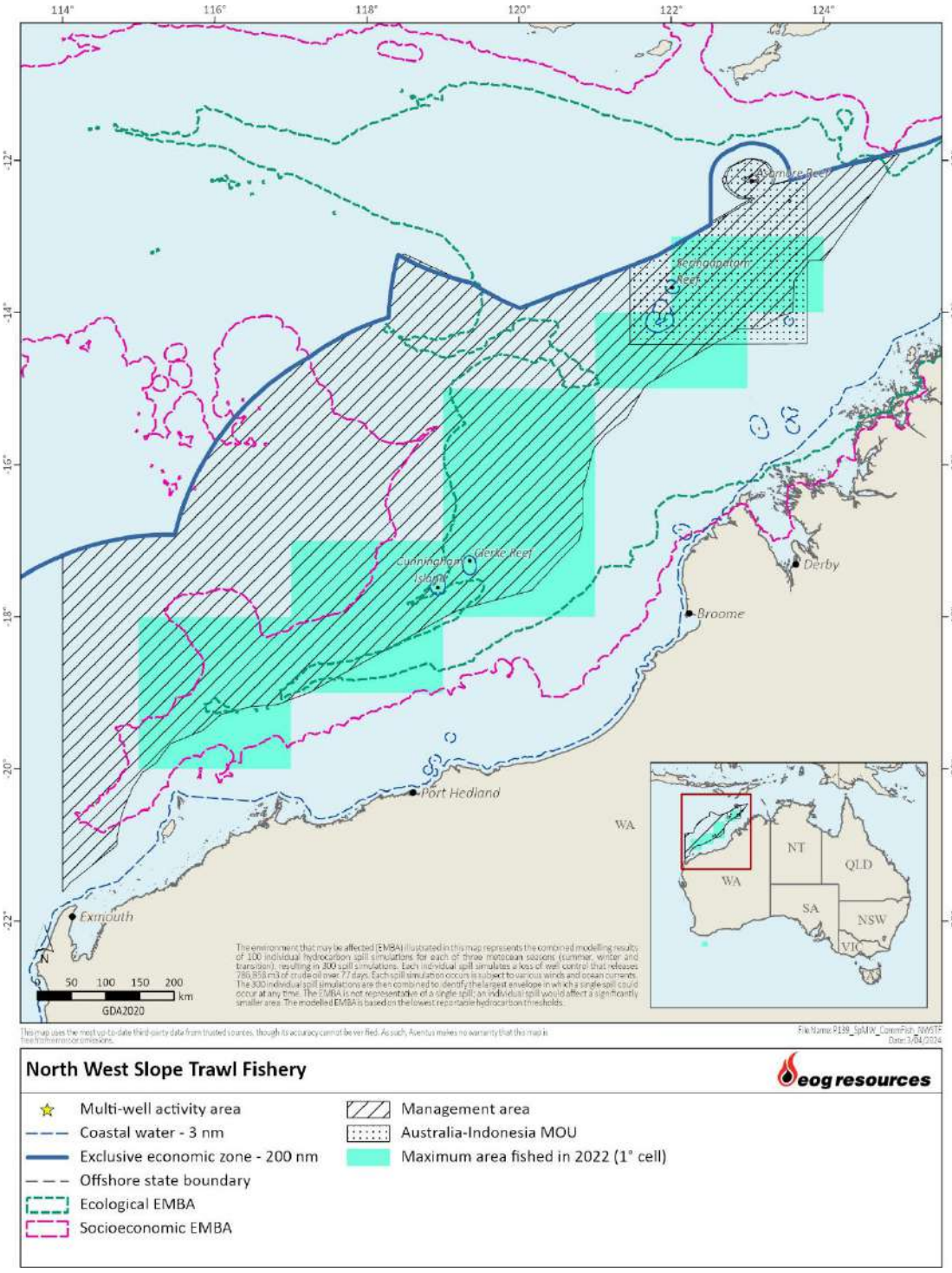


Figure 11.83 North West Slope Trawl Fishery overlapped by the spill EMBA (2022)

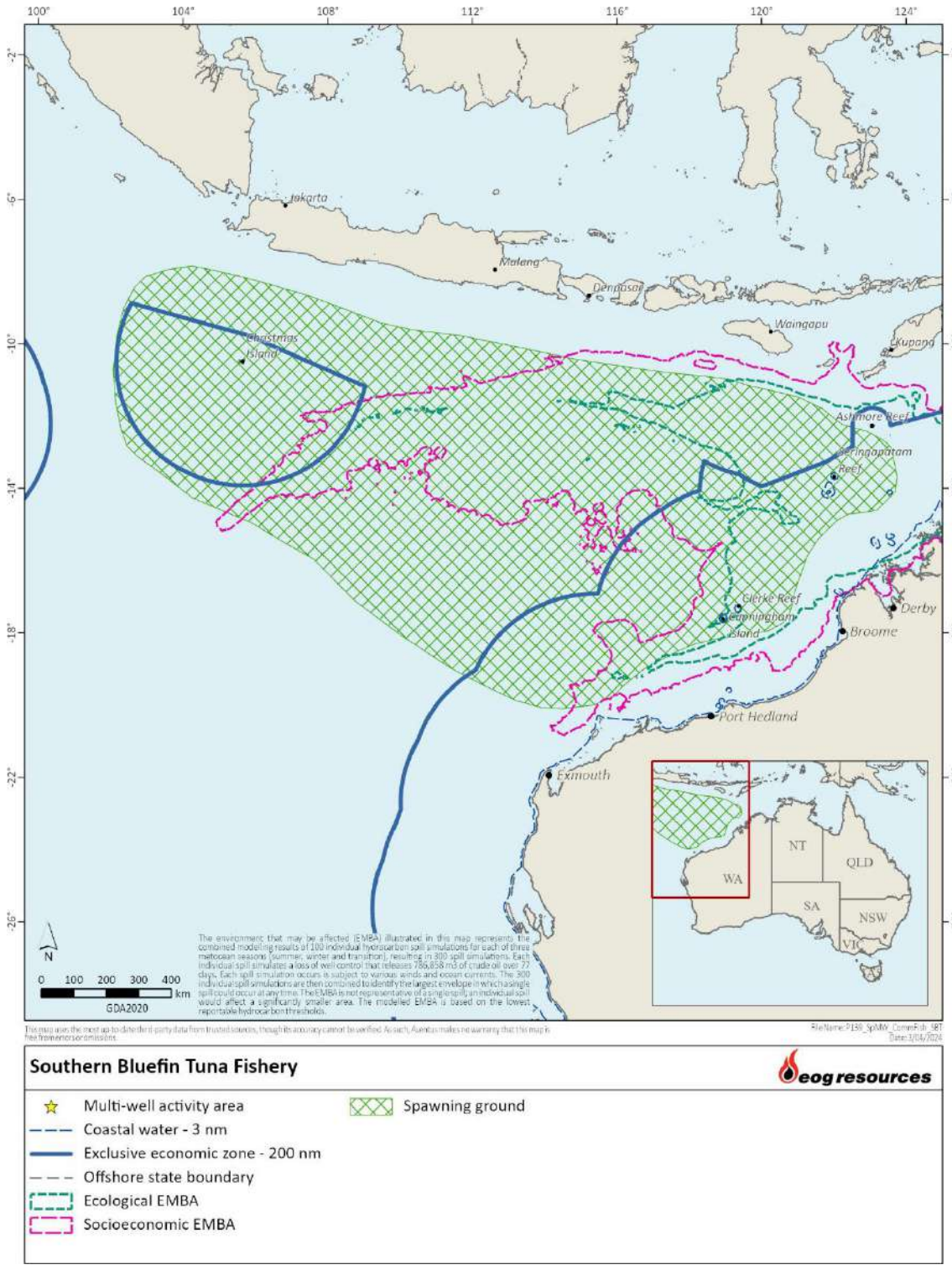


Figure 11.84 Southern Bluefin Tuna spawning grounds overlapped by the spill EMBA

Western Australian-managed Fisheries

Western Australian-managed commercial fisheries that are authorised to harvest in the waters of the spill EMBA include the following (noting that not all actively fish):

- Mackerel Managed Fisheries (MMF);
- Northern Demersal Scalefish Managed Fishery;
- Pearl Oyster Managed Fishery;
- Abalone Managed Fishery;
- Kimberley Crab Managed Fishery (North Coast Crab Fishery);
- Kimberly Prawn Managed Fishery;
- Kimberley Gillnet and Barramundi Managed Fishery;
- Broome Prawn Managed Fishery;
- Nickol Bay Prawn Managed Fishery;
- Onslow Prawn Managed Fishery;
- Specimen Shell Fishery;
- Marine Aquarium Fish Managed Fishery (MAFMF);
- Pilbara Demersal Scalefish Fishery;
- Pilbara Crab Managed Fishery (PCMF); and
- West Coast Deep Sea Crustacean Managed Fishery.

Through the consultation process for the Beehive-1 EP with the WA DPIRD, EOG identified the MMF, the Northern Demersal Scalefish Managed Fishery, Kimberley Crab Managed Fishery, Kimberley Prawn Managed Fishery and the Kimberley Gillnet and Barramundi Fishery as the key fisheries that actively fish in the spill EMBA. Given the spill EMBA is exactly the same for this EP, the comments relating to active fisheries within the spill EMBA remains applicable.

Table 11.26 presents information for these fisheries (noting that catch data for 2023 is not yet publicly available).

Table 11.26 WA-managed commercial fisheries with jurisdictions to fish within the spill EMBA

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Northern Demersal Scalefish Managed Fishery (Figure 11.85)	Targets predominately goldband snapper (*Pristipomoides multidens*), crimson snapper, red emperor (*Lutjanus sebae*) bluespotted emperor (*Lethrinus punctulatus*), saddletail snapper (*L. malabaricus*), rankin cod (*Epinephelus multinotatus*), brownstripe snapper (*L. vitta*), rosy threadfin bream (*Nemipterus furcosus*) and spangled emperor (*Lethrinus nebulosus*).	The spill EMBA intersects both the Pilbara zone (30.50% overlap, Figure 11.97) and Kimberely zone (2.72% overlap, Figure 11.85) of this fishery.	Assumed to be year-round.	Although permitted to use handlines, droplines and traplines, since 2002 the fishery has been essentially trap based. Eight vessels actively fished in 2022, employing at least 27 people.	Catch data available for the last five years: • 2022 – 1,458 t. • 2021 – 1,544 t. • 2020 – 1,419 t. • 2019 – 1,507 t. • 2018 – 1,297 t. Majority of catch (1,235 t) was landed in Zone B in the 2022 season.
Mackerel Managed Fishery (Area 1 and 2) (Figure 11.86)	Spanish mackerel (*Scomberomorus commerson*) and grey mackerel (*Scomberomorus semifasciatus*).	The spill EMBA intersects 44.48% of this fishery, particularly, fishing Area 1 (Kimberley) and Area 2 (Pilbara) (Figure 11.86)	Fishing is primarily from May – November in 2019. In the Pilbara sector, approximately 65% of effort has historically occurred from July to August.	A total of 13 vessels operated during 2022 across the fishery, employing 30-40 people. In 2014, only three vessels operated in the Kimberley region. Trolling and handline are the only allowable fishing methods.	Catch data available for the last five years: • 2022 – 212 t. • 2021 – 248 t. • 2020 – 299 t. • 2019 – 291 t. • 2018 – 213 t.
Kimberley Crab Managed Fishery (KCMF) (Figure 11.87)	Green mud crabs (*Scylla serrata*) and brown mud crabs (*Scylla olivacea*).	The spill EMBA intersects 2.17% of this fishery, particularly, fishing Area 1 (permitted areas of fishing) (Figure 11.87)	Generally, March to November with June to September being the most productive months.	Crab traps are the primary fishing method. In 2022, two people were employed as skippers and crew on vessels fishing for mud crab in the KCMF.	Catch data available for the last five years: • 2022 – 2.4 t. • 2021 – 0.8 t. • 2020 – 1.5 t. • 2019 – 7.4 t. • 2018 – 3.2 t.

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Kimberley Prawn Managed Fishery (Figure 11.88)	Banana prawns (*Fenneropenaeus indicus* and *F. merguiensis*) are the primary target species though brown tiger prawns (*Penaeus esculentus*) and blue endeavour prawns (*Metapenaeus endeavouri*) are taken as bycatch.	The spill EMBA intersects the trawled areas and trawl closure areas nearshore and inshore as shown in Figure 11.88. The spill EMBA intersects 8.82% of the fishery.	There are two fishing periods for the season (April to mid-June, then from August to the end of November) with around 81% of the total landings taken in the first fishing period.	Otter board trawl system is the primary fishing method.	Catch data available for the last five years: • 2022 – 238.5 t. • 2021 - 203.9 t. • 2020 – 253.4 t. • 2019 – 100 t. • 2018 – 333 t.
Kimberley Gillnet and Barramundi Fishery (Figure 11.89)	Barramundi (*Lates calcarifer*), king threadfin (*Polydactylus macrochir*) and blue threadfin (*Eleutheronema tetradactylum*) are the primary target species.	The spill EMBA primarily intersects the fishery in areas where the fishery is closed from 1st November to 31st January and 1st December to 31st January inclusive (Figure 11.89). The spill EMBA intersects 0.85% of the fishery.	Year round, though predominantly occurs from April to September.	Fishing is restricted to state waters. Three vessels were active during the 2022 season, employing approximately six people.	Catch data available for the last five years: • 2022 – 64.5 t. • 2021 – 100 t. • 2020 – 44.6 t. • 2019 – 73.4 t. • 2018 – 91.8 t.

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Pearl Oyster Managed Fishery (Figure 11.90)	Silver lipped pearl oyster (*Pinctada maxima*).	The spill EMBA intersects Zone 1, Zone 2 and Zone 3 including the Kimberley development zone of the fishery (Figure 11.90Figure 11.90).	Most vessels operate between March and June each year.	Quota-based diver fishery operating in shallow coastal waters. The number of active vessels in 2022 was six. Most vessels operate with 10 – 14 crew. Personnel employed in the pearling industry and current full-time is estimated to be around 300.	Catch data available for the last five years: • 2022 - 756,531 shells. • 2021 – 590,064 shells. • 2020 – 455,980 shells. • 2019 – 611,816 shells. • 2018 – 614,002 shells.

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Abalone Managed Fishery (Figure 11.91)	Roe's abalone (*Haliotis roei*).	Yes	Between 1 October to 15 May the following year.	Abalone diving generally occurs close to the shoreline (generally no greater than 30 m depth) using hookah gear (breathing air supplied via hose connected to an air compressor on the vessel). Commercial divers do not use SCUBA gear.	Catch data available for the last five years: • 2022 – 28.9 t. • 2021 – 39 t. • 2020 – 18.2 t. • 2019 – 47 t. • 2018 – 48 t. Area 8 of this fishery (where the spill EMBA intersects) has been closed since the 2011/12 season due to catastrophic mortality following the 2011 marine heatwave. With no evidence of natural recovery, a restocking project has been successful on a trial-scale, but it has yet to be implemented on a commercial scale.
Marine Aquarium Fish Managed Fishery (Figure 11.92)	Multispecies including Syngnathids, invertebrates, hard coral, soft coral, living rock and sand, sponges and seagrasses.	Likely	Assumed year-round.	13 licences were active during the 2021 season.	Catch data available for the last five years: • 2022 – 19,710 individuals • 2021 – 13,362 individuals • 2020 – 28,165 individuals • 2019 – 11,925 individuals • 2018 – 27,327 individuals

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Broome Prawn Managed Fishery (Figure 11.93)	Western king prawn (*Melicertus latisulcatus*)	The socio-economic EMBA intersects a known fishing area off Broome.	Assumed to follow that of the Kimberley Prawn Managed Fishery	Demersal trawl.	Between 2015-2021, there was trial fishing only with landings <1 tonne each year. No fishing effort occurred in 2022 as no boats undertook trial fishing activities.
Nickol Bay Managed Prawn Fishery (Figure 11.94)	Banana prawns (*Fenneropenaeus indicus* and *F. merguiensis*) are the primary target species though brown tiger prawns (*Penaeus esculentus*) and blue endeavour prawns (*Metapenaeus endeavouri*) are taken as bycatch.	Yes –within the fishery extent, however it does not intersect the fishery trawled area nor the size management fish ground (Figure 11.94).	Assumed to follow that of the Kimberley Prawn Managed Fishery.	Demersal trawl.	Catch data available for the last five years: • 2022 – 51 t • 2021 - 123.4 t • 2020 – 202.4 t • 2019 – 254 t. • 2018 – 81 t.
Onslow Managed Prawn Fishery (Figure 11.95)	Banana prawns (*Fenneropenaeus indicus* and *F. merguiensis*) are the primary target species though brown tiger prawns (*Penaeus esculentus*) and blue endeavour prawns (*Metapenaeus endeavouri*) are taken as bycatch.	Yes – within the fishery extent, however it does not intersect the fishery trawled area nor the size management fish ground (Figure 11.95Figure 11.95).	Assumed to follow that of the Kimberley Prawn Managed Fishery.	Demersal trawl. One boat fished during the 2022 season.	Catch data available for the last five years: • 2022 – confidential. • 2021 - Undisclosed (less than the target catch range) • 2020 – Undisclosed (less than the target catch range) • 2019 – 50 t. • 2018 – 60 t.

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Specimen Shell Fishery (Figure 11.96)	In the past 5 years, more than 438 separate species of molluscs have been collected, with an average of more than 200 species per year.	Low fishing intensity.	Year-round.	Hand collection.	Catch data available for the last five years: • 2022 - 5,074 shells. • 2021 – 5,443 shells. • 2020 – 6,152 shells. • 2019 – 7,232 shells. • 2018 – 7,628 shells.
Pilbara Demersal Scalefish Managed Fishery (Figure 11.97)	Goldband snapper (*Pristipomoides multidens*), blue spotted emperor (*Lethrinus punctulatus*), red emperor (*Lutjanus sebae*), saddletail snapper (*L. malabaricus*), crimson snapper (*L. erythropterus*) and rosy threadfin bream (*Nemipterus furcosus*).	Yes – the southwestern extent of the spill EMBA intersects the Pilbara offshore closed waters (trawl) (Zone 1 and Area 6) and Pilbara trawl (Zone 1 and Zone 2) and trap fishing (Figure 11.97).	Year-round.	Hand line, drop line and fish traps are permitted. At least 34 people (e.g., 2-4 crew per vessel) were directly employed in the PDSF in 2022.	Catch data available for the last five years: • 2022 – 2,485 t. • 2021 - 2,714 t. • 2020 – 2,854 t. • 2019 – 2,980 t. • 2018 – 2,651 t.
Pilbara Crab Managed Fishery (PCMF) (Figure 11.98)	Blue swimmer crabs (*Portunus pelagicus*)	Yes - the southwestern extent of the spill EMBA intersects the permitted area of the fishery (Figure 11.98).	Fishers generally operate from March to November with May to September being the most productive months.	Crab trap and drop nets are used to harvest crabs. During 2022, two people were employed as skippers and crew on vessels fishing for blue swimmer crabs along the Pilbara coast.	Catch data available for the last five years: • 2022 – 11.2 t. • 2021 – 8.9 t. • 2020 – 0.6 t. • 2019 – 19 t. • 2018 – 35 t.

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
West Coast Deep Sea Crustacean Managed Fishery (Figure 11.99)	Crystal crab (*Chaceon albus*), Snow crab (*Chaceon albus*), spiny crab (*Hypothalassia acerba*) and giant crab (*Pseudocarcinus gigas*).	Yes –within the fishery extent and closed waters of the fishery, however fishing effort is concentrated in areas south of Exmouth (outside of EMBA) (Figure 11.99).	Typically, from January to June with greater intensity in January/February.	Baited pots or traps in a long line formation in the shelf edge waters (>150 m).	Catch data available for the last five years: • 2022 – 123.2 t. • 2021 – 154.5 t. • 2020 – 153 t. • 2019 – 153 t. • 2018 – 154 t.

Newman et al. (2023a; 2023b, 2021); Gaughan and Santoro (2021; 2020; 2018); Gaughan et al (2019).

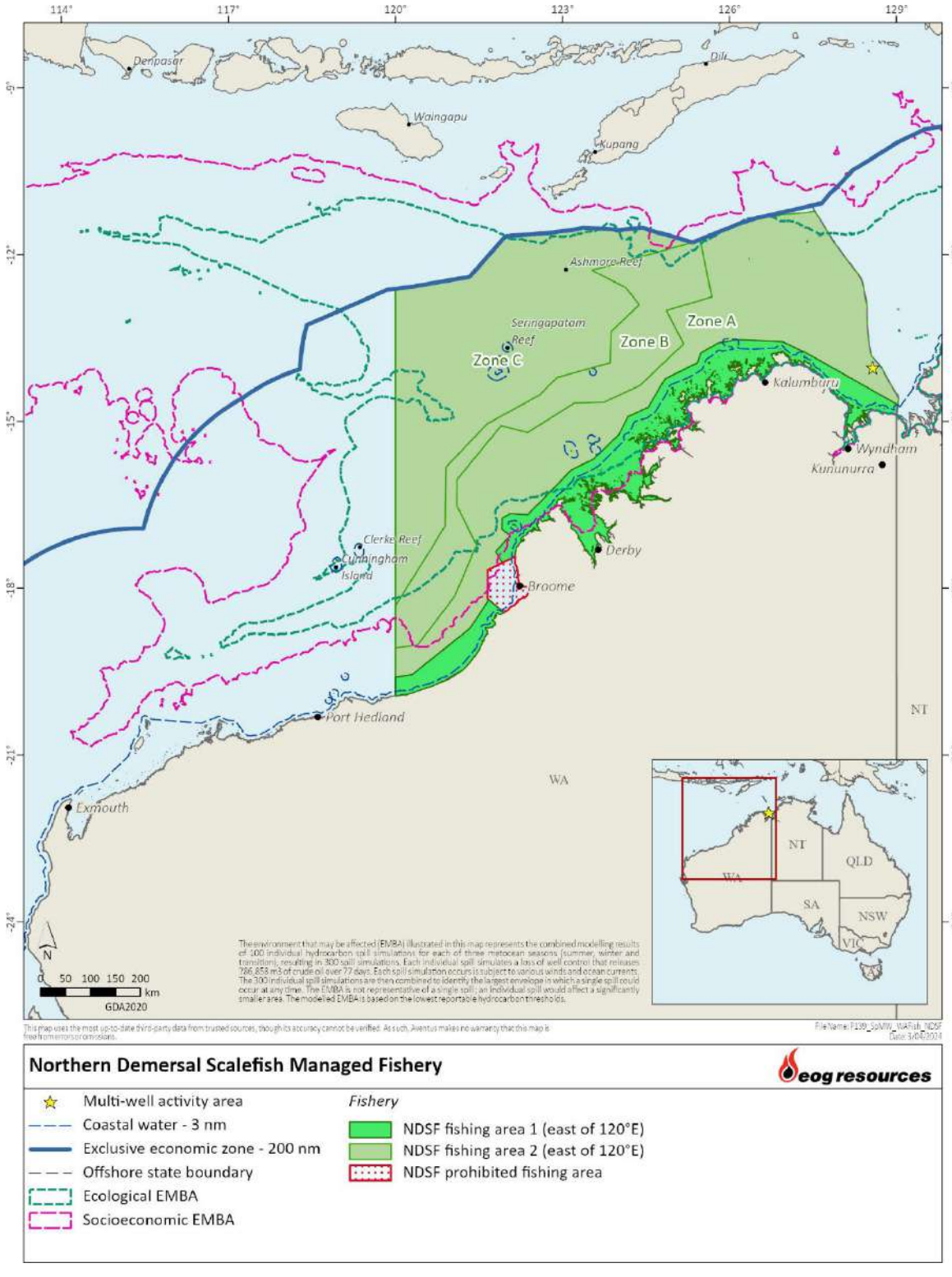


Figure 11.85 WA Northern Demersal Scalefish Fishery overlapped by the spill EMBA

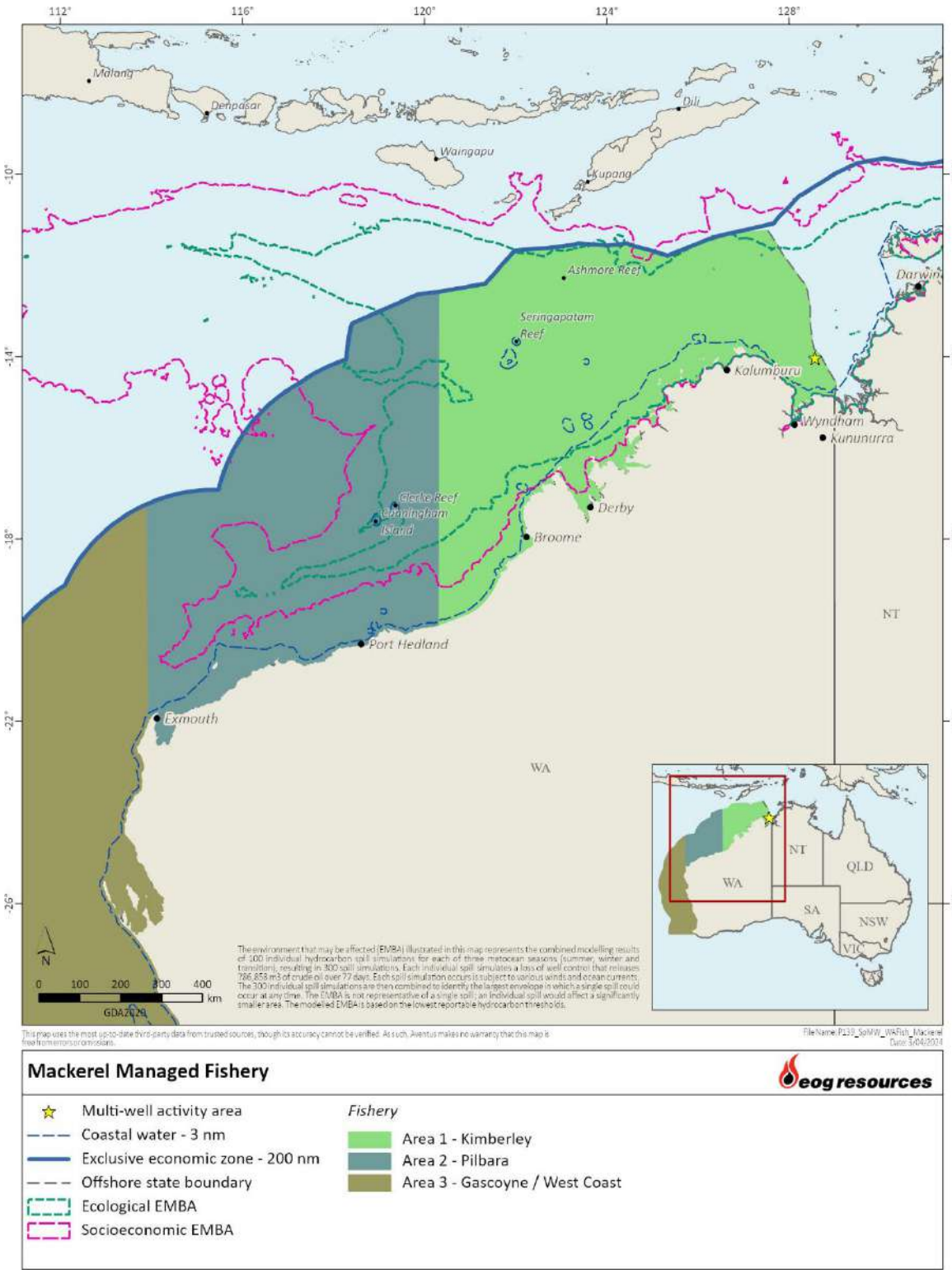


Figure 11.86 WA Mackerel Managed Fishery overlapped by the spill EMBA

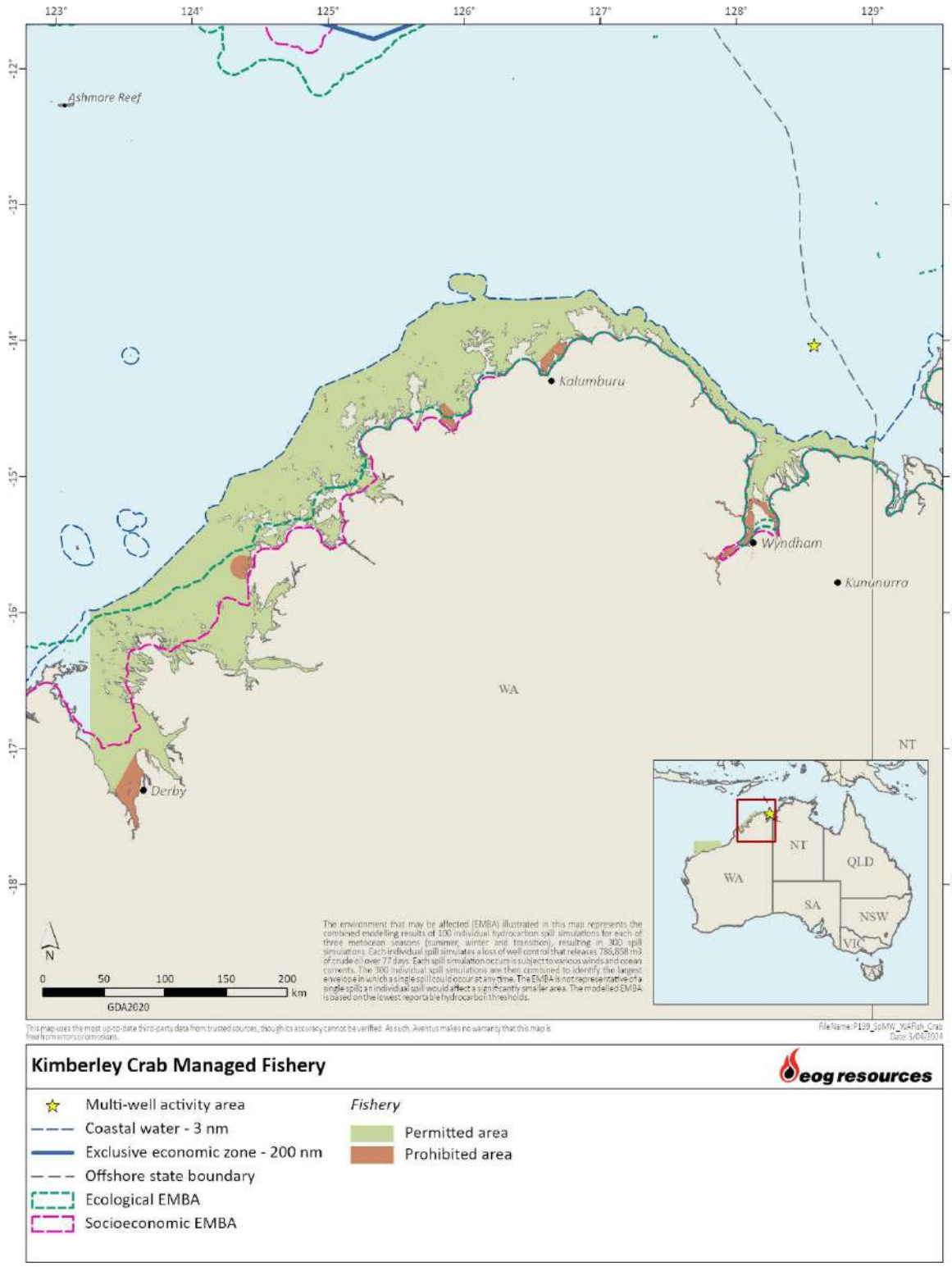


Figure 11.87 WA Kimberley Crab Managed Fishery (North Coast Crab Fishery) overlapped by the spill EMBA

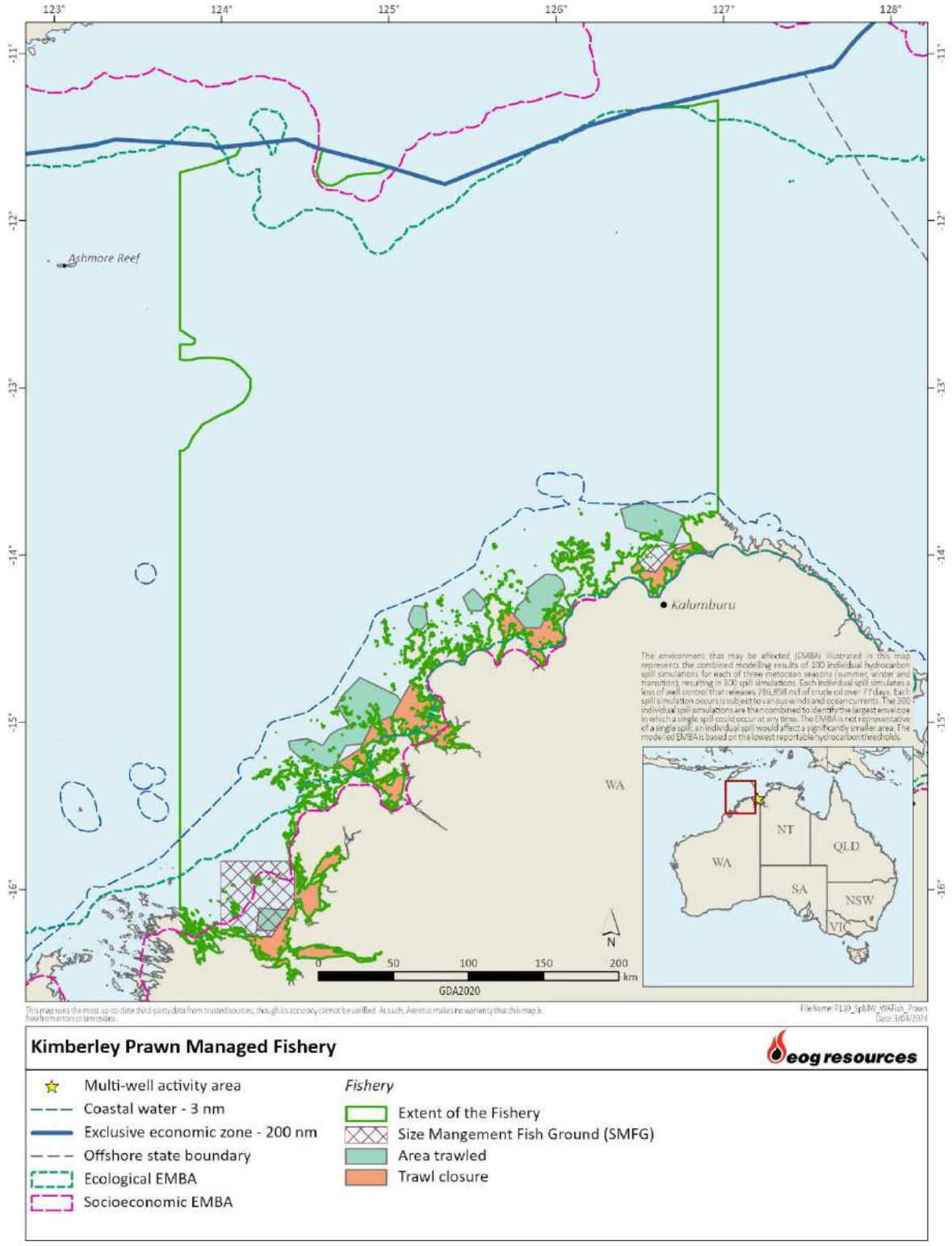


Figure 11.88 WA Kimberley Prawn Managed Fishery overlapped by the spill EMBA

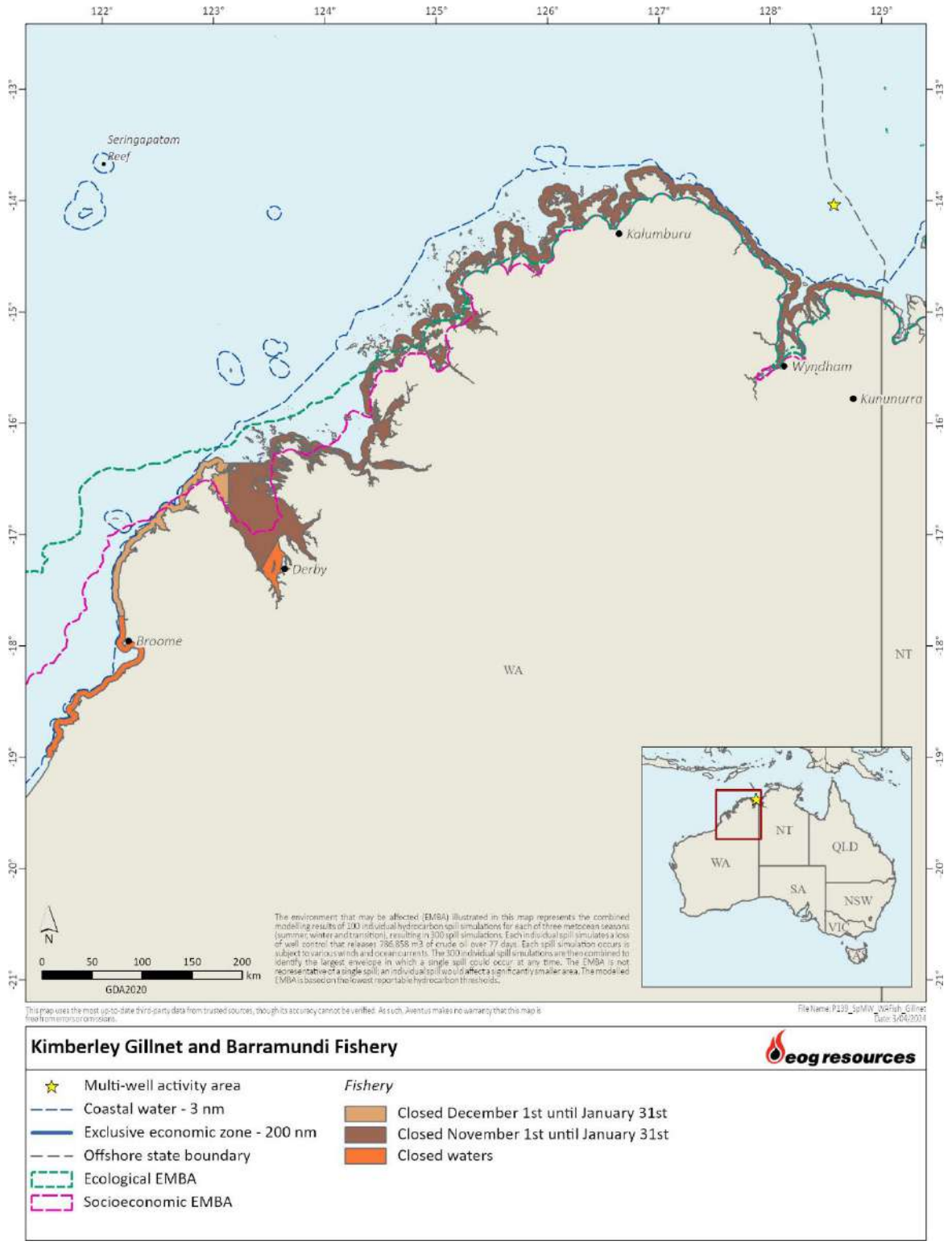


Figure 11.89 WA Kimberley Gillnet and Barramundi Fishery overlapped by the spill EMBA

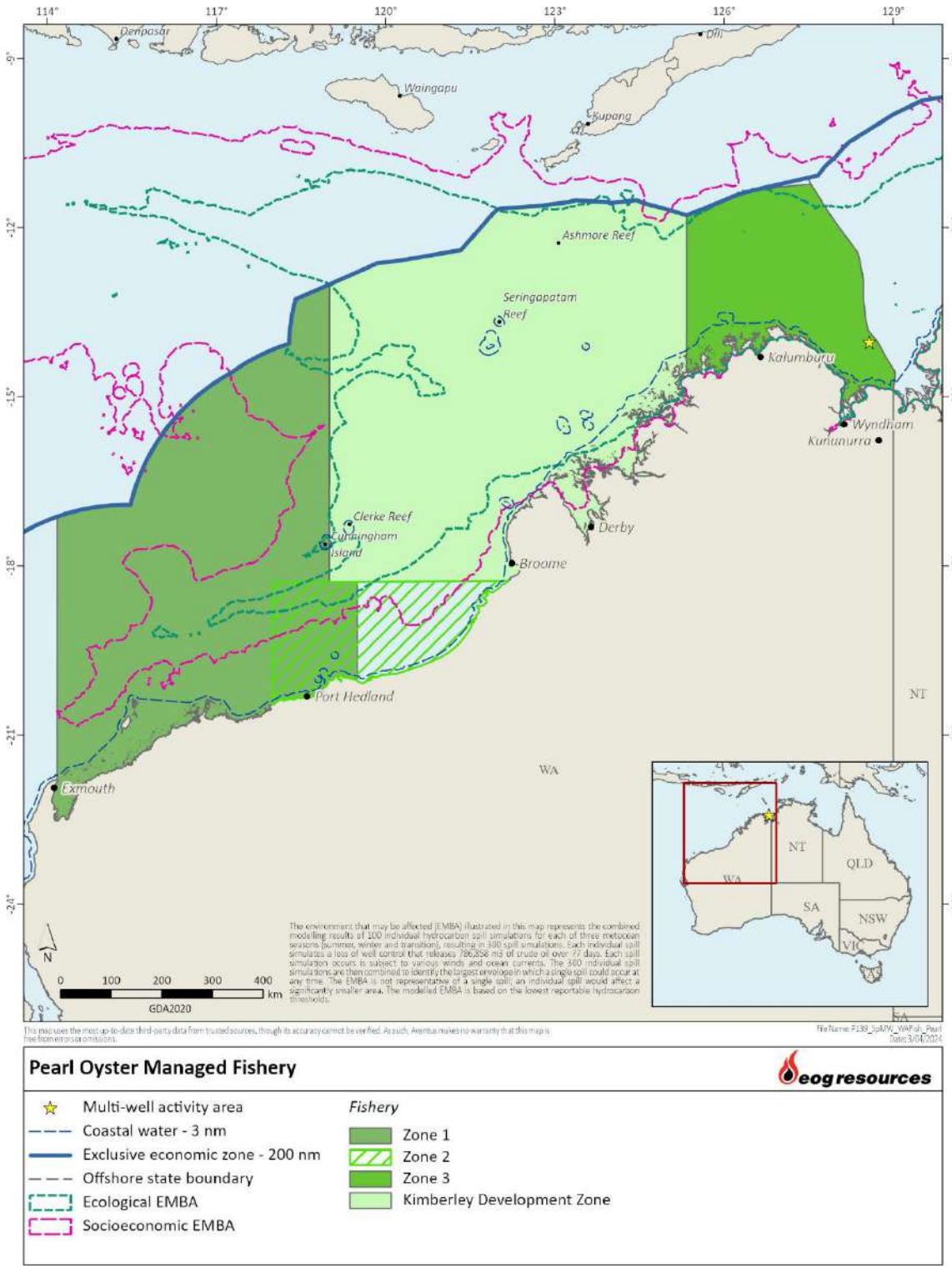


Figure 11.90 WA Pearl Oyster Managed Fishery overlapped by the spill EMBA

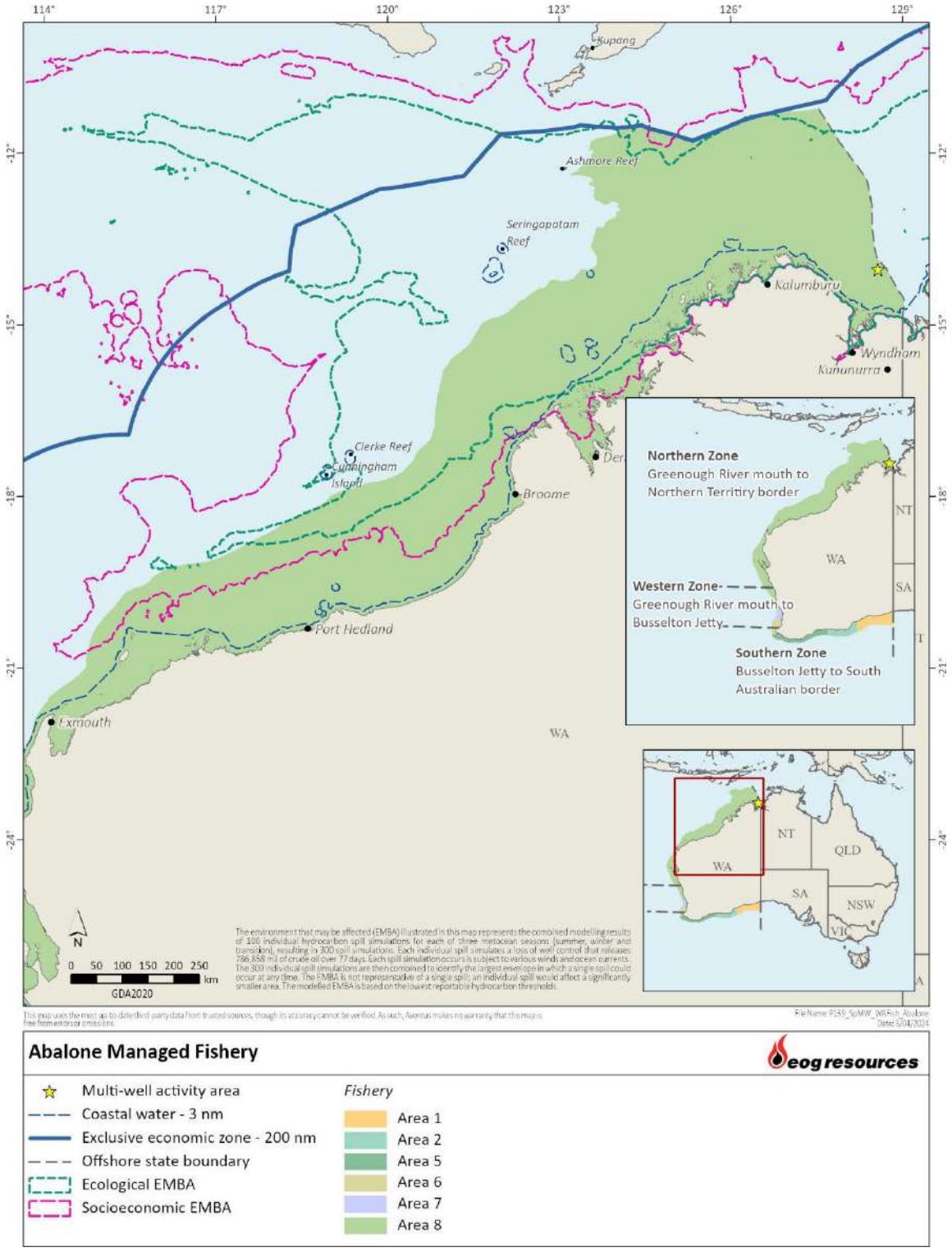


Figure 11.91 WA Abalone Managed Fishery overlapped by the spill EMBA

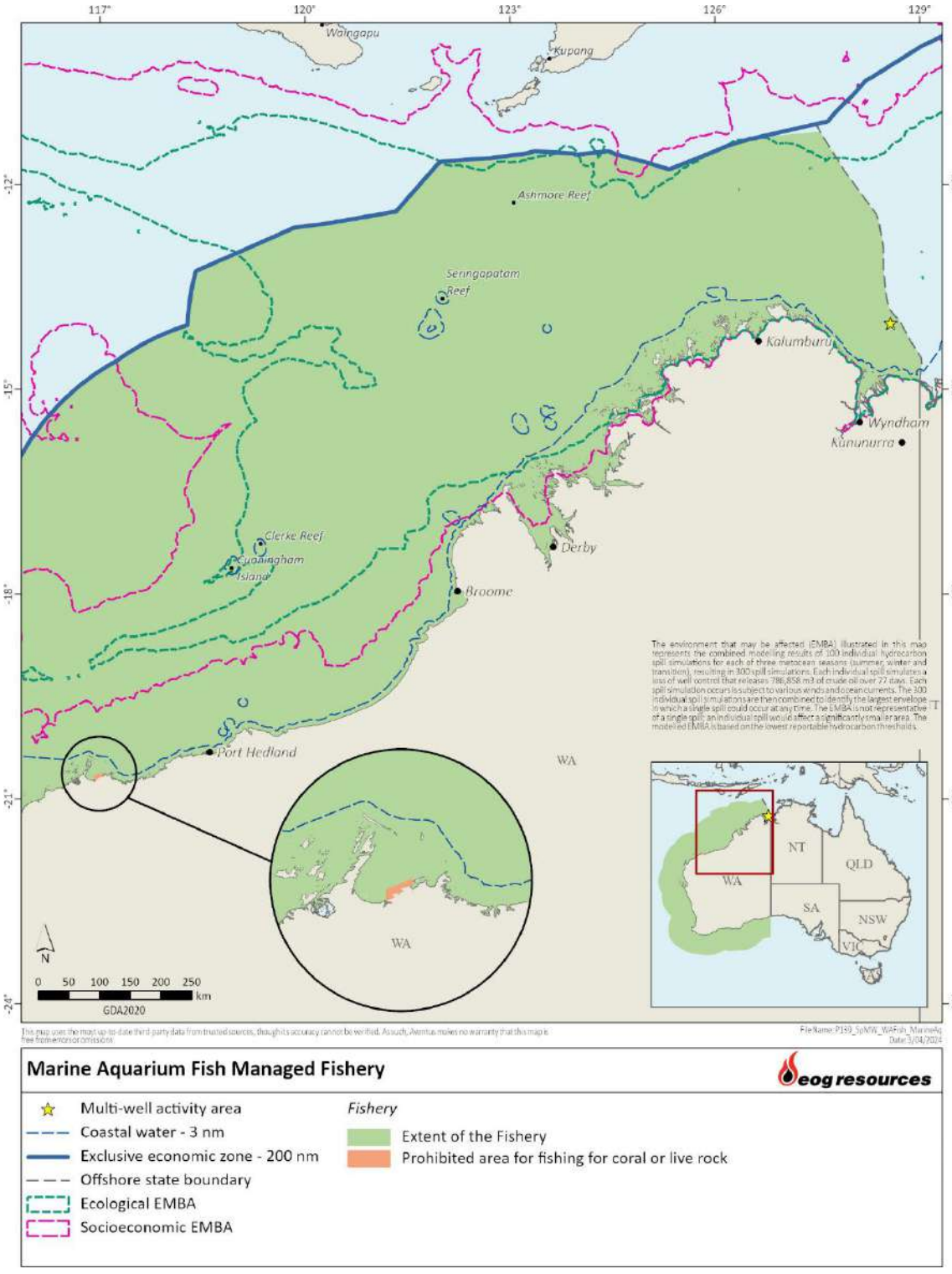


Figure 11.92 WA Marine Aquarium Managed Fishery overlapped by the spill EMBA

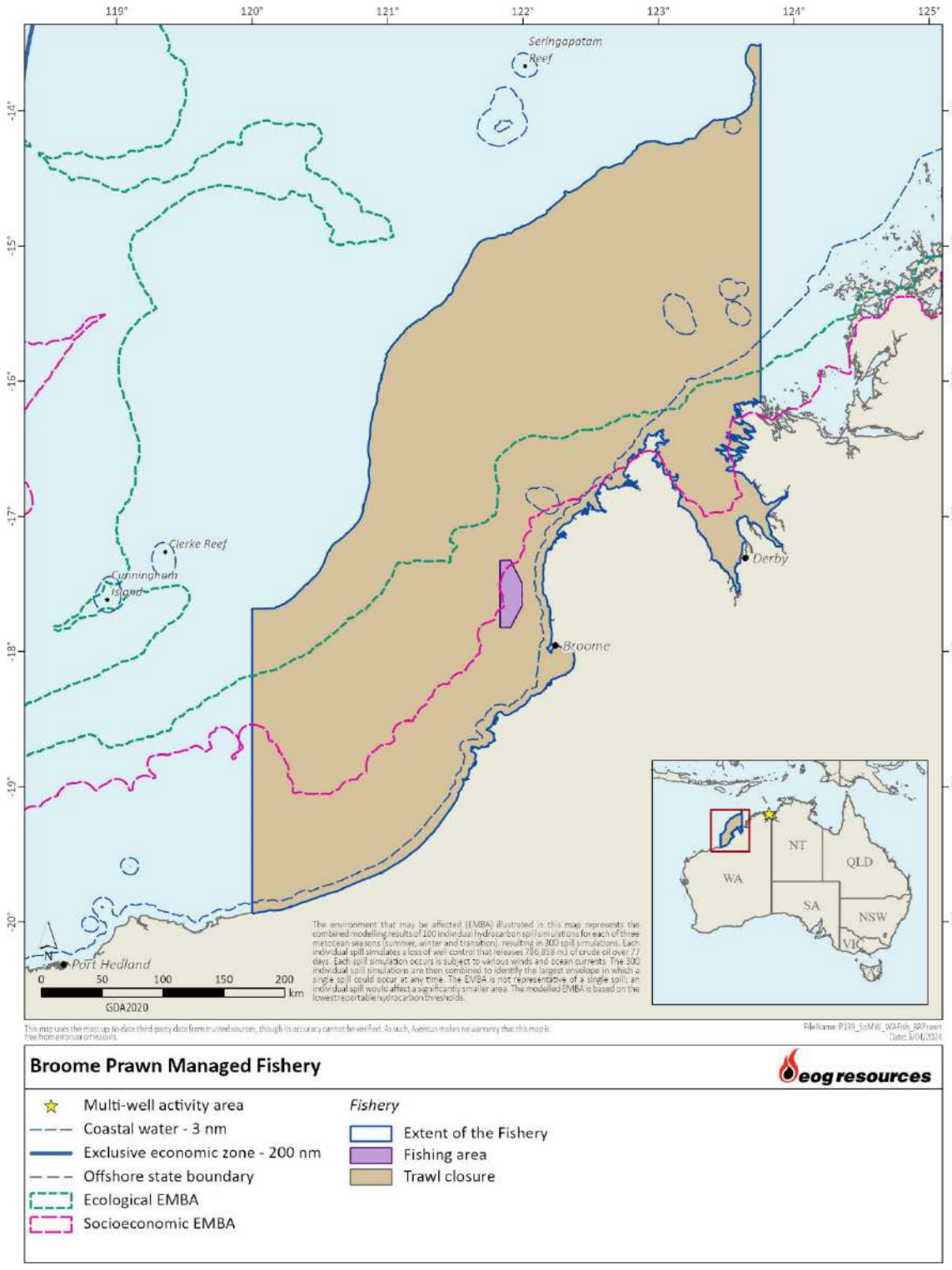


Figure 11.93 WA Broome Prawn Managed Fishery overlapped by the spill EMBA

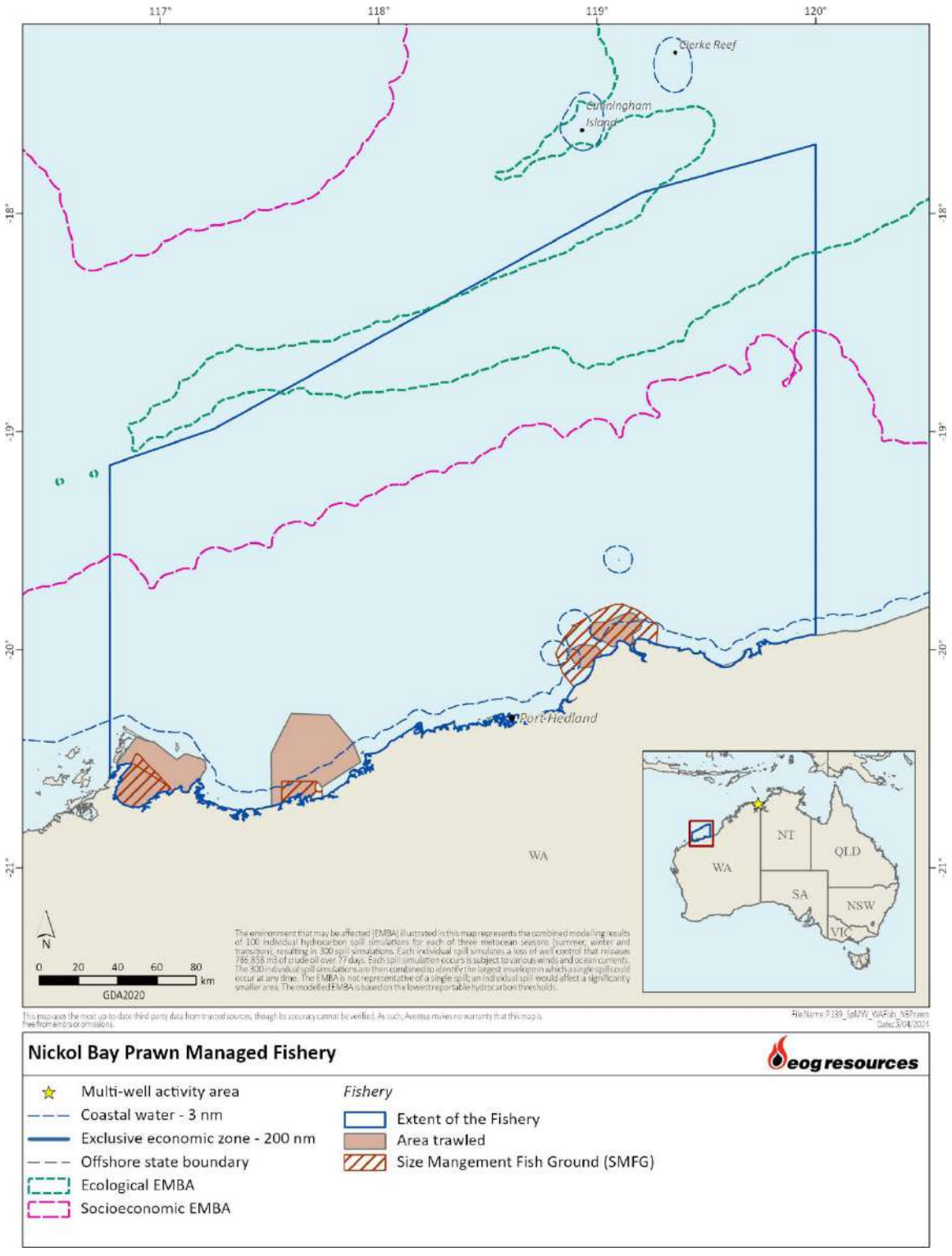


Figure 11.94 WA Nickol Bay Prawn Managed Fishery overlapped by the spill EMBA

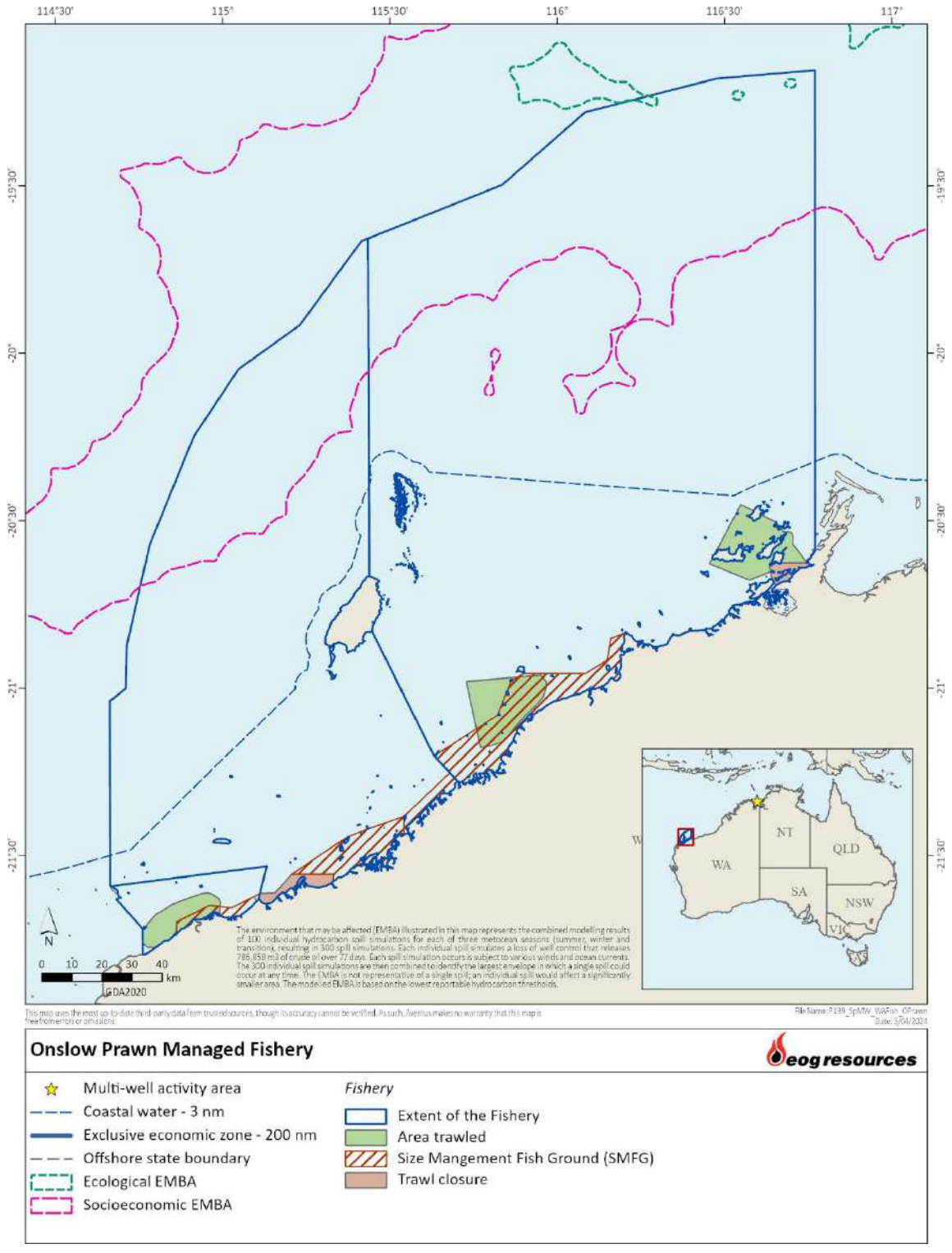


Figure 11.95 WA Onslow Prawn Managed Fishery overlapped by the spill EMBA

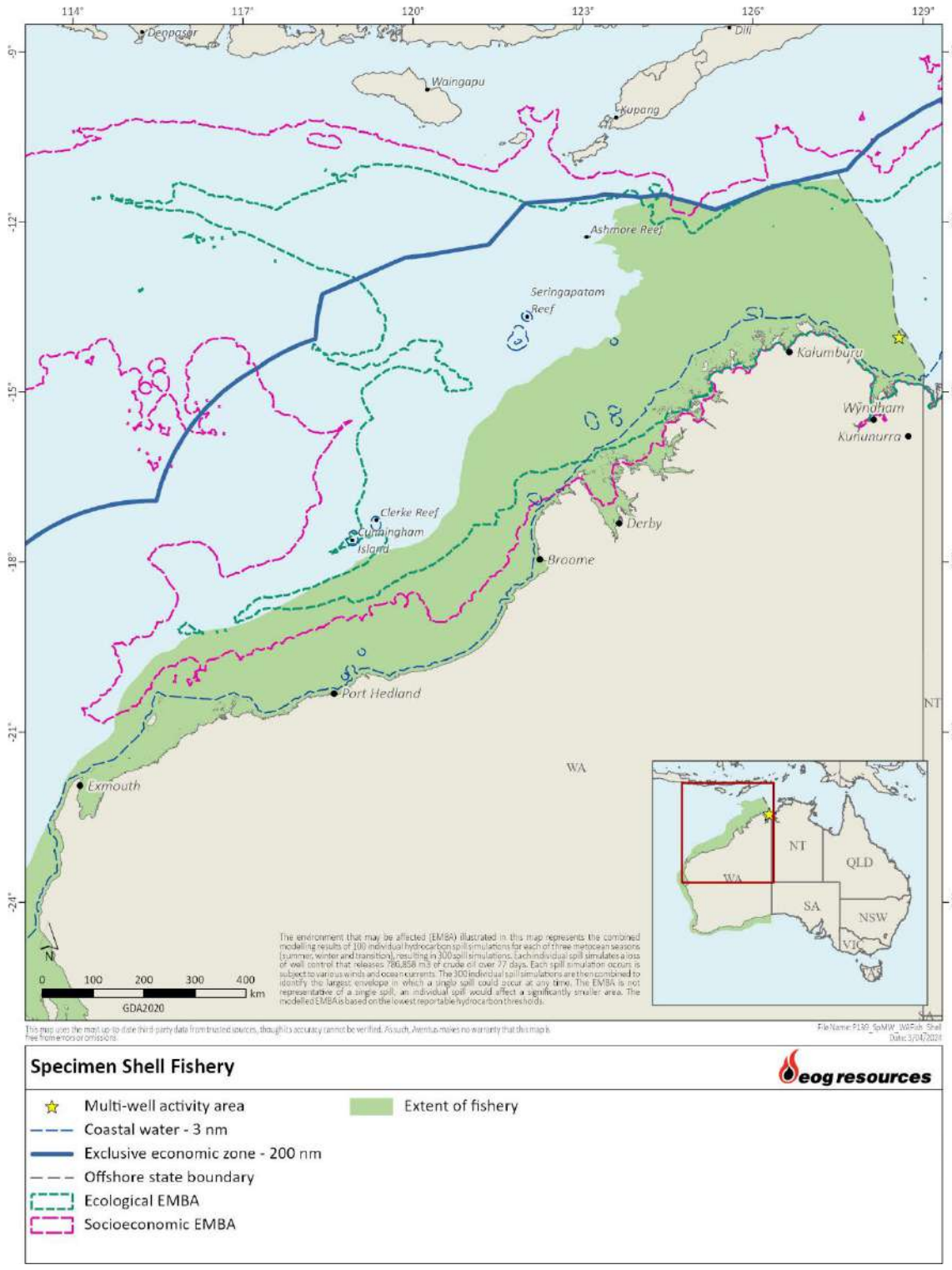


Figure 11.96 WA Specimen Shell Managed Fishery overlapped by the spill EMBA

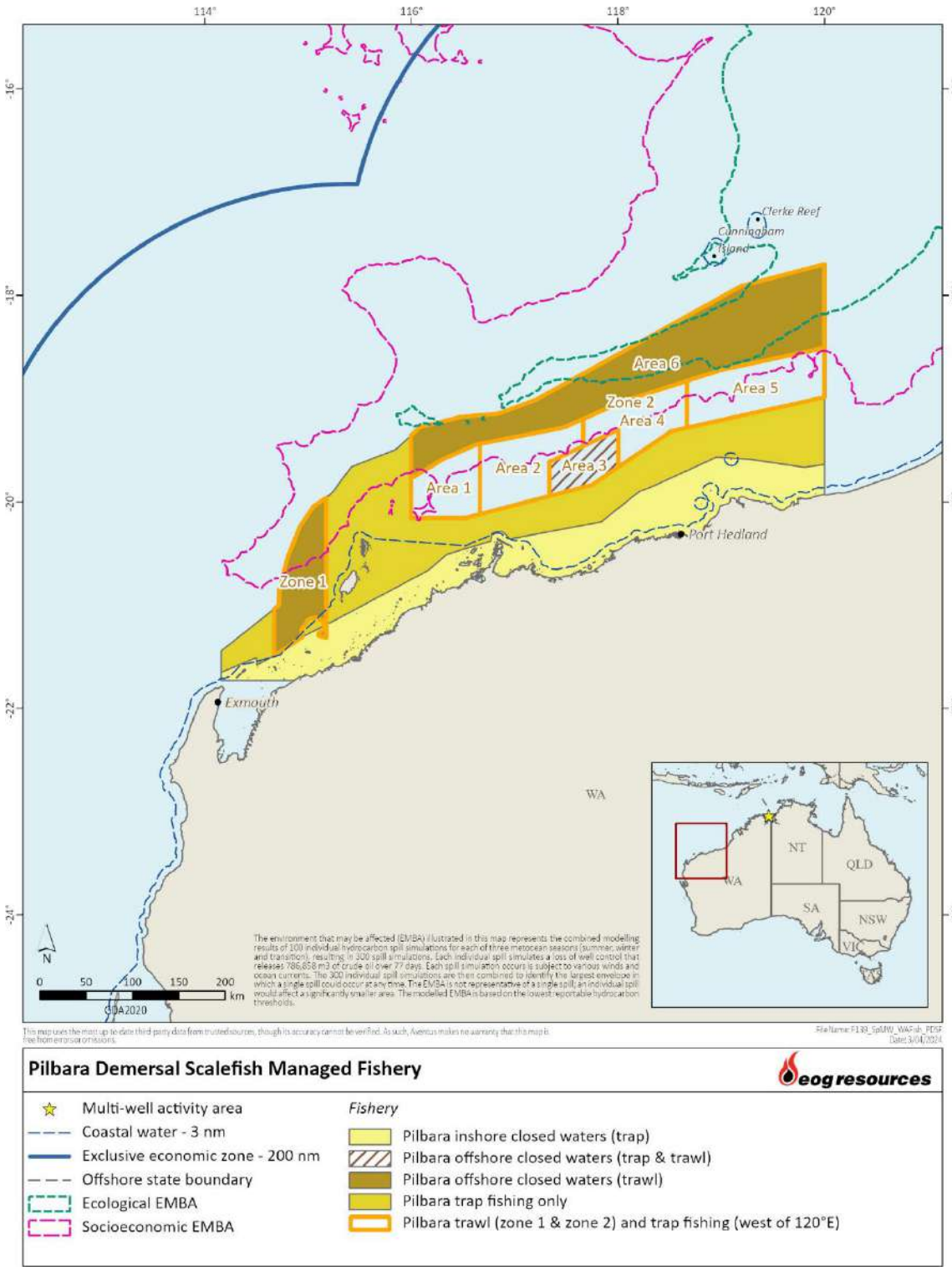


Figure 11.97 Pilbara Demersal Scalefish Fishery overlapped by the spill EMBA

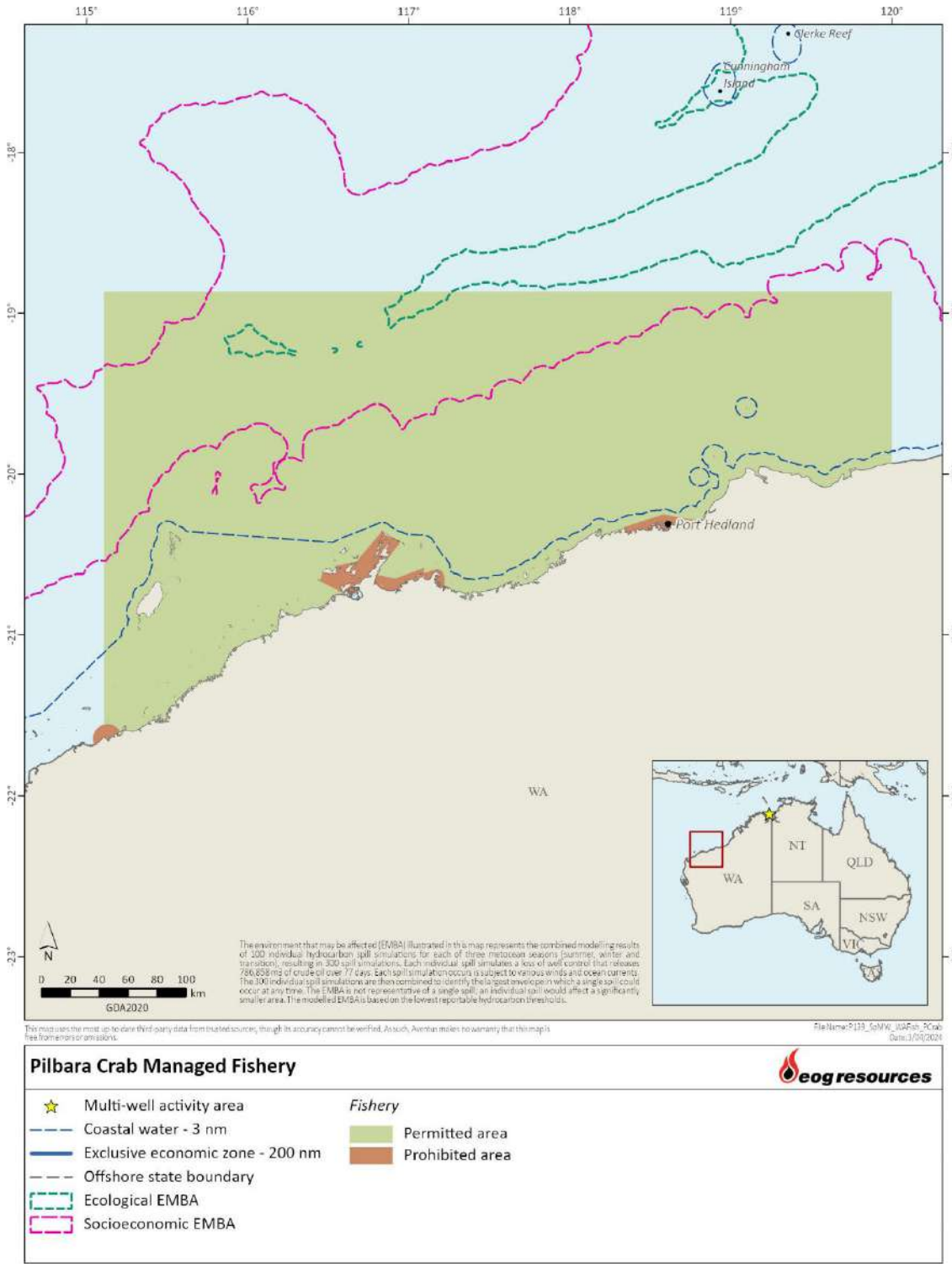


Figure 11.98 Pilbara Crab Managed Fishery overlapped by the spill EMBA

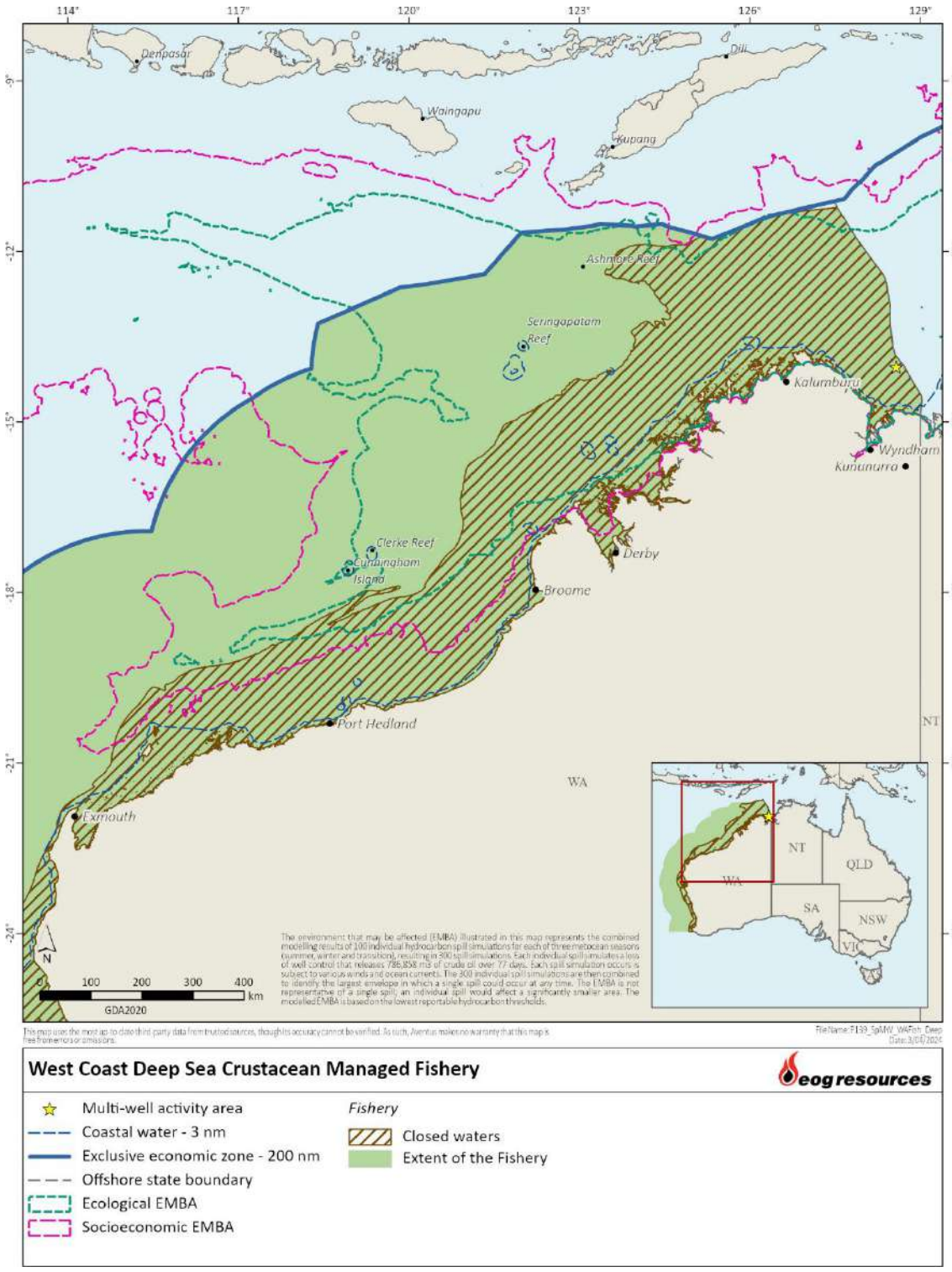


Figure 11.99 West Coast Deep Sea Crustacean Managed Fishery overlapped by the spill EMBA

Northern Territory-managed Fisheries

NT-managed commercial fisheries (under the jurisdiction of the NT DITT) that are authorised to fish the waters of the spill EMBA include the following (noting that not all actively fish in the spill EMBA):

- Spanish Mackerel Fishery;
- Barramundi Fishery;
- Bait Net Fishery;
- Coastal Net Fishery;
- Coastal Line fishery;
- Trepang Fishery;
- Aquaculture (pearl oyster and barramundi farming);
- Aquarium Fishery;
- Mollusc Fishery;
- Mud Crab Fishery;
- Pearl Oyster Fishery;
- Small Pelagic Developmental Fishery;
- Fishing Tour Operator Fishery;
- Timor Reef Fishery;
- Offshore Net and Line Fishery; and
- Demersal Fishery.

A review of data from the NT DITT website and consultation undertaken for the Beehive-1 EP with DITT, identified the Demersal Fishery, Timor Reef Fishery, Spanish Mackerel Fishery and Offshore Net and Line Fishery as have recently fished in the spill EMBA. Given the spill EMBA is exactly the same for this EP, the comments relating to active fisheries within the spill EMBA remains applicable.

Table 11.27 presents the available information for these fisheries.

Table 11.27 NT-managed commercial fisheries with jurisdictions to fish within the spill EMBA

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Demersal Fishery (Figure 11.100)	Primarily targets red snapper (*Lutjanus erythropterus*), goldband snapper (*Pristipomoides multidens*) and saddletail snapper (*L. malabaricus*).	Yes – the spill EMBA intersects the line and fish trap permitted areas and Zone A and Zone B (line and fish trap, finfish trawl gear permitted) (Figure 11.100). The spill EMBA overlaps with 10.09% of the fishery.	Assumed year-round.	Fishing method is through the use of vertical lines, drop lines, finfish long-lines, baited fish traps and semi-demersal trawl nets in two multi-gear areas. There are 16 licences currently issued in the Demersal Fishery and 7 boats nominated for fishing.	Catch data for the 2022 calendar year revealed a catch of 3,530 t valued at $19.7 million. In 2020, 3,492 t (including 2,522 t of red snapper and 218 t of goldband snapper) was caught. No data found for 2018 and 2019. In 2017, 3,387 t (including 505 t of red snapper and 341 t of goldband snapper) was caught, with an estimated value of $17.9 million. In 2016, 3,463 t (including 2,510 t of red snapper and 318 t of goldband snapper) was caught. In 2015, 3,107 t (including 2,299 t of red snapper and 279 t of goldband snapper) was caught.

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Spanish Mackerel Fishery (Figure 11.101)	Primarily targets Spanish mackerel (*Scomberomorus commerson*).	Yes – northeastern extent of EMBA intersects the fishery (Figure 11.101). The spill EMBA overlaps with 13.76% of the fishery.	Assumed year-round.	The primary fishing method used by all sectors is trolling, where baited hooks or lures are towed behind a boat moving at 3–6 knots near reefs, headlands and shoals. In 2021 there were 15 licences in the fishery, all of which were allocated.	Catch data available: • 2022 – 269.5 t valued at $5.5 million. • 2019/20 – 357 t. • 2018/19 – 408 t. • 2017/18 – 372 t. • 2016/17 – 411 t.
Offshore Net and Line Fishery (Figure 11.102)	Blacktip shark (*Carcharhinus limbatus*), spot tail shark (*Carcharhinus sorrah*) and grey mackerel (*Scomberomorus semifasciatus*).	Yes – northeastern extent of EMBA intersects the fishery (Figure 11.102). The spill EMBA overlaps with 13.76% of the fishery.	Assumed year-round.	Demersal or pelagic longlines or pelagic net gear is permitted.	Catch data available (for combination of grey mackerel, combined black tip shark, spot tail shark only): • 2022 – 455.1 t valued at $6.2 million • 2018/2019 – 553 t • 2017/2018 – 461 t • 2016/2017 – 486 t • 2015/2016 – 424 t
Timor Reef Fishery (see Figure 11.100 *(as per Demersal Fishery)*	Goldband snapper (*Pristipomoides multidens*).	Yes. The spill EMBA overlaps with 10.09% of the fishery.	There is no closed season for the Timor Reef Fishery, but normally, it is most productive between October and May.	Operates in remote offshore waters in the Timor Sea in a defined area approximately 370 km northwest of Darwin. Methods include vertical lines, drop line, long lines and fish baited traps	Catch data available: • 2022 – 585.6 t valued at $5.4 million • 2019 – 246 t • 2018 – 349 t • 2017 – 329 t • 2016 – 280 t

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Bait Net Fishery	Bait fish.	Possibly.	Assumed year-round	Fishing allowed from the high-water mark to the 3 nm seaward of the low-water mark, excluding Darwin Harbour and Shoal Bay. Methods include bait net, cast net or scoop net. In 2021, the fishery was restricted to two licences, both were allocated.	No data available.
Coastal Net Fishery (Figure 11.103)	Mullet (*Mugil* spp)	Yes – fishery operates inshore, extending from the high-water mark out to 3 nm.	Assumed year-round.	Fishery is divided into 3 regions: Darwin – from Cape Hotham to Native Point and Cape Ford to Cape Dooley, between Cape Arnhem and Cape Wilberforce; and from Bing Bong Creek and Pelican Spit. Only netting is permitted. In 2021, fishery was restricted to five licences, all of which were allocated.	Catch data for the 2022 calendar year revealed a catch of 2.65 t valued at $13,411.
Coastal Line Fishery	Black jewfish (*Protonibea diacanthus*).	Possibly.	Possibly all year-round.	Extends 15 nm from the low water mark and covers the entire NT coastline. The majority of fishing effort is focused around rocky reefs within 150 km of Darwin. Mainly hook and line gear is used.	Catch data available: • 2022 - 132.7 t valued at $2.3 million • 2019 – 141 t • 2018 – 120 t • 2017 – 173 t • 2016 – 155 t

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Barramundi Fishery	Primarily barramundi (*Lates calcarifer*) and king threadfin (*Polydactylus macrochir*).	Possibly.	Annual commercial fishing runs from 1st February to 30 September.	Operate in tidal mud flats and inside a restricted number of rivers using gillnets. As of 2016, there were 14 licences and approximately 10 boats.	Catch data available: • 2022 – 312.1 t valued at $5.7 million • 2019 – 276 t • 2018 – 277 t • 2017 – 392 t • 2016 – 305 t
Trepang Fishery (Figure 11.104)	Sandfish (*Holothuria scabra*)	Yes - fishery area extends from the NT high-water mark out to 3 nm (see Figure 11.104).	All year-round, though harvesting occurs on neap tides during the dry season (May to October).	Method is by hand either on foot or by diving, usually on neap tides during the dry season when the water is clearer. In 2021, there were 6 licences in the fishery, with only one or two boats active over the past few years.	Catch data available: • 2022 – 42.9 t valued at $708, 543 • 2019/2020 – 32 t • 2018/2019 – 48 t • 2017/2018 – 56 t • 2016/2017 – 94 t • 2015/2016 – 36 t

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Aquaculture	Pearl oyster (*Pinctada maxima*) culture and Barramundi farming (*Lates calcarifer*) including sea cucumber (trepang), giant clams and freshwater plants.	Possibly.	Assumed all year-round.	A large number of pearl oysters for seeding is obtained from wild stocks and supplemented by hatchery-produced oysters with major hatcheries operating at Broome and the Dampier Peninsular (Gaughan & Santoro, 2021). Wild shell collection occurs in shallow coastal waters. All the leases are within 35 m diving depth. Pearl farm sites are located mainly along the Kimberley coast, particularly in the Buccaneer Archipelago, in Roebuck Bay and at the Montebello Islands. Developing marine aquaculture initiatives in the Kimberley region include farming barramundi in the Kimberley Aquaculture Development Zone located in Cone Bay, situated approximately 200 km north-east of Broome (Gaughan & Santoro, 2021). Another focus is the Broome Tropical Aquaculture Park where a commercial pearl oyster hatchery is located along with the Kimberley Training Institute aquaculture facility (Gaughan & Santoro, 2021).	No data available.

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Aquarium Fishery (Figure 11.105).	Freshwater and marine species including fish, plants and invertebrates.	Yes - fishery extends from the NT inland estuarine and marine waters out to the outer boundary of the Australian Fishing Zone (excluding Aboriginal sacred sites and other closed areas) (see Figure 11.105).	All year-round.	Methods of collection are by hand or small scoop nets. In 2016, there were 11 licences with only 3 boats active.	Catch data for the 2022 calendar year revealed a catch of 19.1 t valued at $2.2 million.
Mollusc Fishery	Molluscs and shellfish (excluding pearl oysters or cephalopods such as squid, octopus, cuttlefish and nautilus).	Possibly.	Assumed all year-round.	Operates in intertidal waters from the high-water mark out to the low water mark. Molluscs are collected by hand. There is only one commercial licence allocated.	No data available.
Mud Crab Fishery (Figure 11.106)	Giant mud crab (*Scylla serrata*).	Yes – fishery extends mainly around coastal areas and tidal waters (excluding Aboriginal sacred sites and other closed areas or closed waters) (see Figure 11.106).	All year-round, except during the wet season (November to April).	Crab fishing is generally confined to coastal mudflats and estuaries. commercial crabbing is banned from Darwin, most creeks adjoining Shoal Bay and waterways of Kakadu National Park. Method of catch via dinghies using rigid metal crab pots. Crabs are transported live to Darwin. In 2021, there were 49 licences for crab fishing, each licence is allowed 60 pots.	Catch data for the 2022 calendar year revealed a catch of 342.5 t valued at $8.1 million.

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Pearl Oyster Fishery (Figure 11.107)	Pearl Oyster (*Pinctada maxima*).	Most likely – fishing operates from the high-water mark to the outer boundary of the Australian fishing zone, 200 nautical miles offshore. (Figure 11.107)	All year-round.	Pearl oysters are collected by hand. There are currently 5 licences in the fishery.	A total of 138,000 oysters can be collected by hand only each year.
Small Pelagic Developmental Fishery	Blacktip sharks (*Carcharhinus tilstoni*, *C. limbatus* and *C. sorrah*).	Possibly.	Assumed all year-round	Method is pelagic long lines or pelagic nets. There are currently three active licences.	In 2017, a commercial catch of 0.1 tonnes was reported.
Aboriginal Coastal Licence	Does not specify.	Possibly.	Assumed all year-round	If you're an Aboriginal person living full time in an Aboriginal community and have the agreement and support of your community, you can apply for this licence. With this licence you can catch and sell fish to people such as community members, visitors, community shops or fish wholesalers using the following methods: • Vertical line. • Troll line. • Cast net. • Scoop net. • 100m net with mesh size of 65mm or less. • Hand spear.	Catch data for the 2022 calendar year revealed a catch of 3,328 kg valued at $20,080.

Fishery	Target species	Fishing activity in the spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Fishing Tour Operator Fishery	Target fish include barramundi, golden snapper, stripey snapper, saddletail snapper and grass emperor.	Possibly - fishery operates in non-tidal and tidal waters from the NT boundary to the outer limit of the Australian Fishing Zone generally in areas that are accessible to the general public.	Assumed all year-round	Primary method is hook and line. Commercial fishing tour operators (FTOs) are managed by the NT Government and operate under specific licence conditions including reporting of catch and effort statistics.	No data available.

Sources: NT Government (pers. com., February 2024), NT Government (2022a, 2022b, 2022c, 2022d, 2022e, 2022f, 2022g, 2022h, 2021a, 2020, 2019), NTSC (2022a, 2022b, 2022c, 2022d, 2022e, 2022f, 2022g), DPIR (2021, 2019, 2018). FRDC (2022).

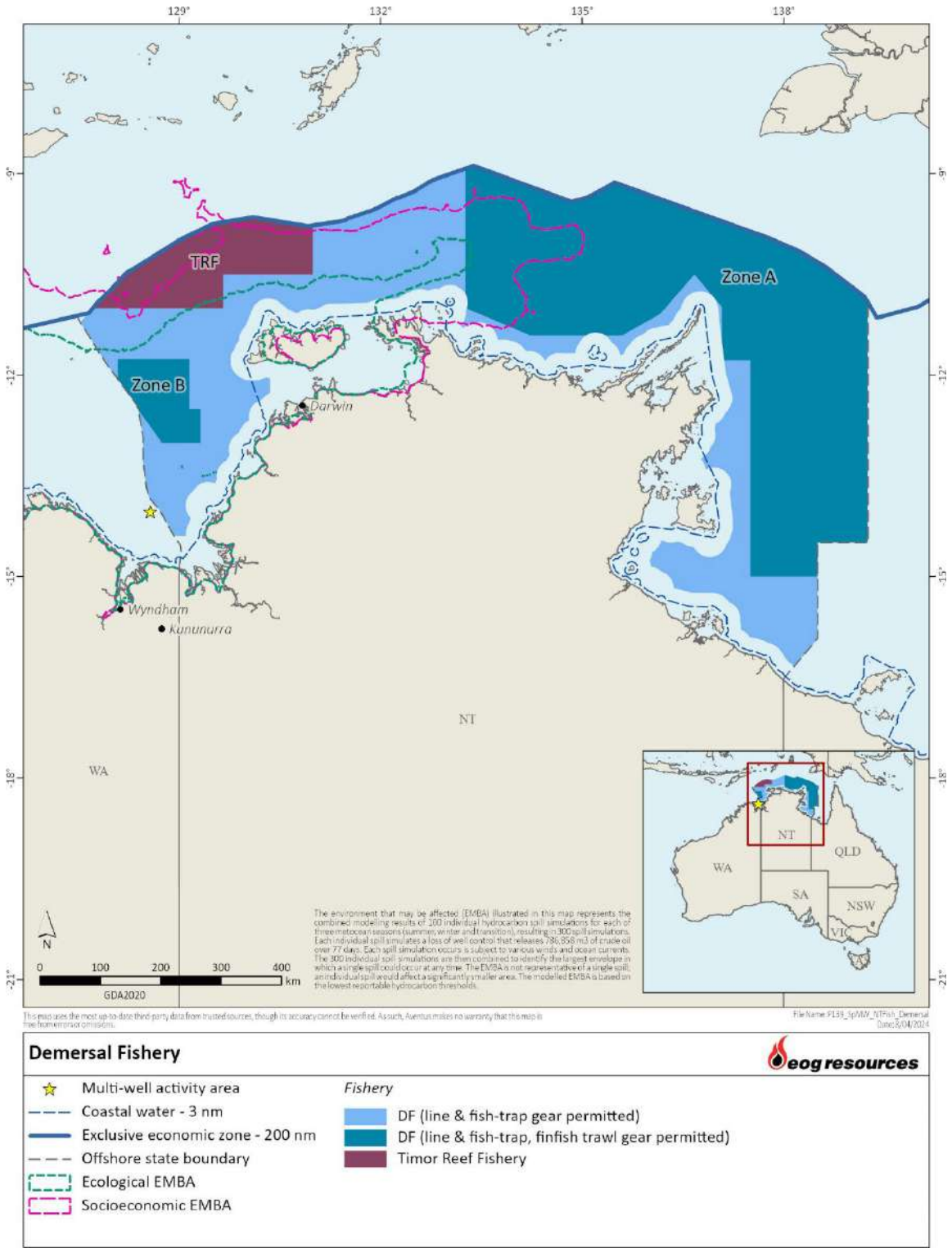


Figure 11.100 NT Demersal Fishery overlapped by the spill EMBA

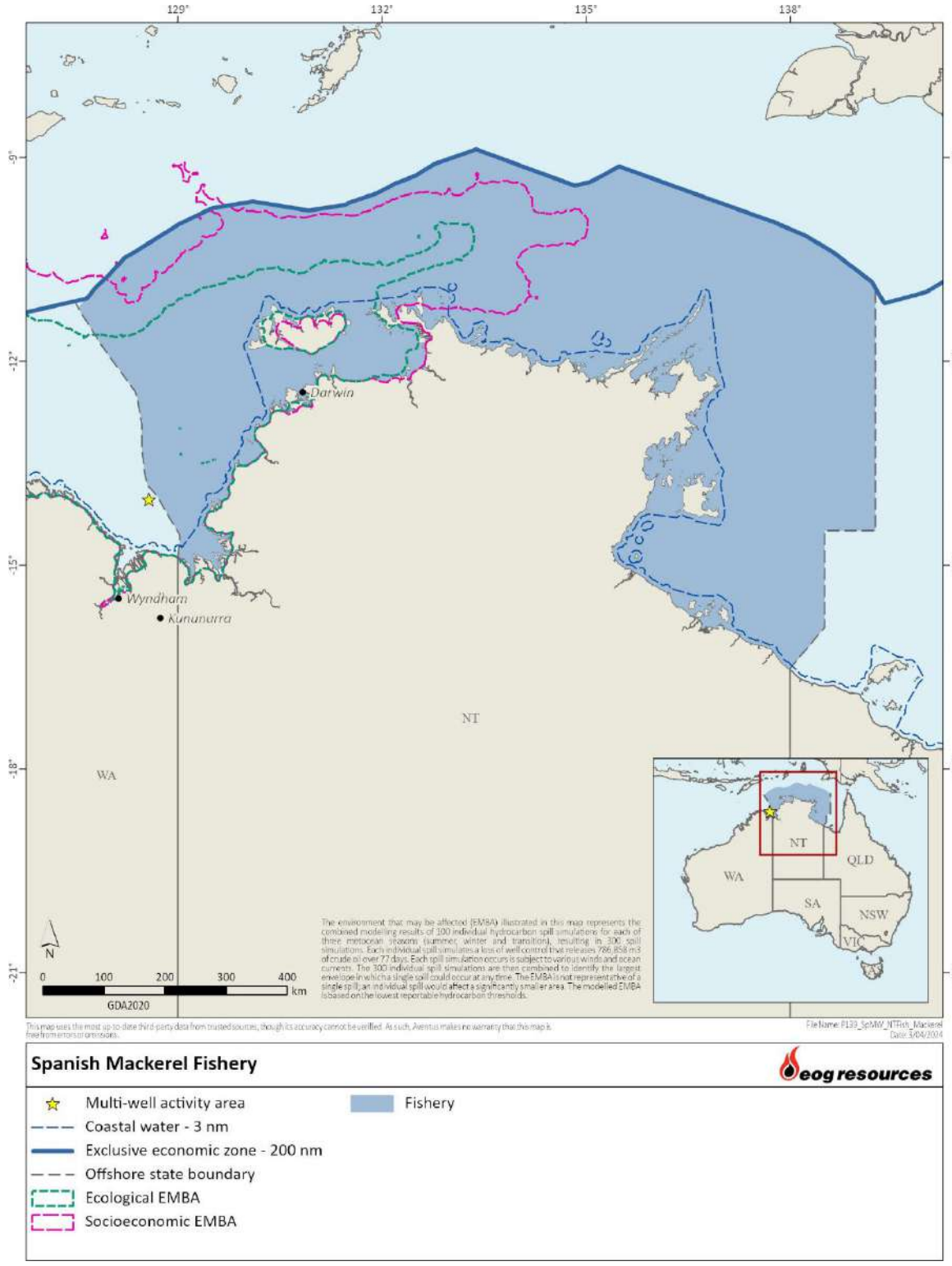


Figure 11.101 NT Spanish Mackerel Fishery overlapped by the spill EMBA

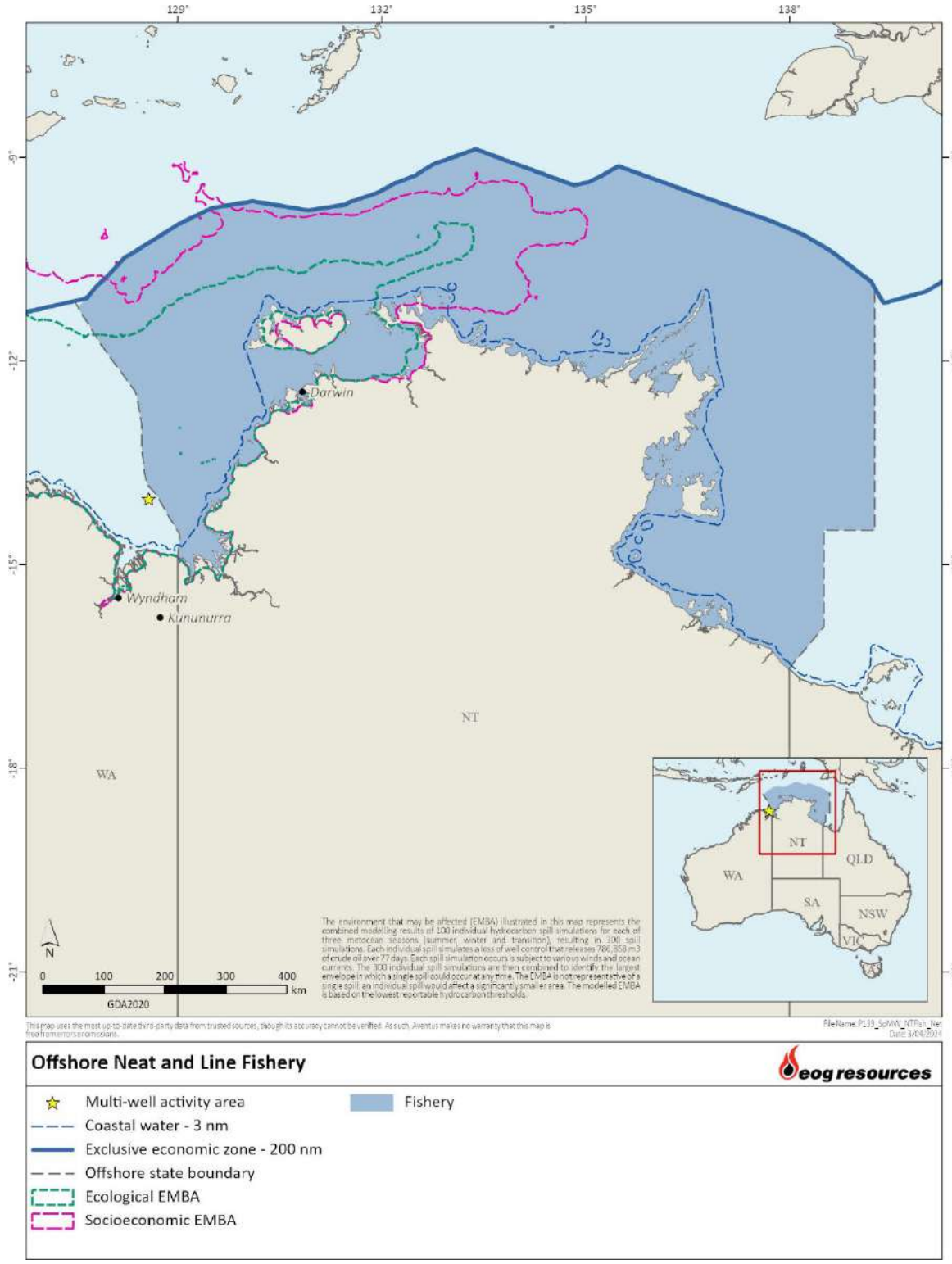


Figure 11.102 NT Offshore Net and Line Fishery overlapped by the spill EMBA

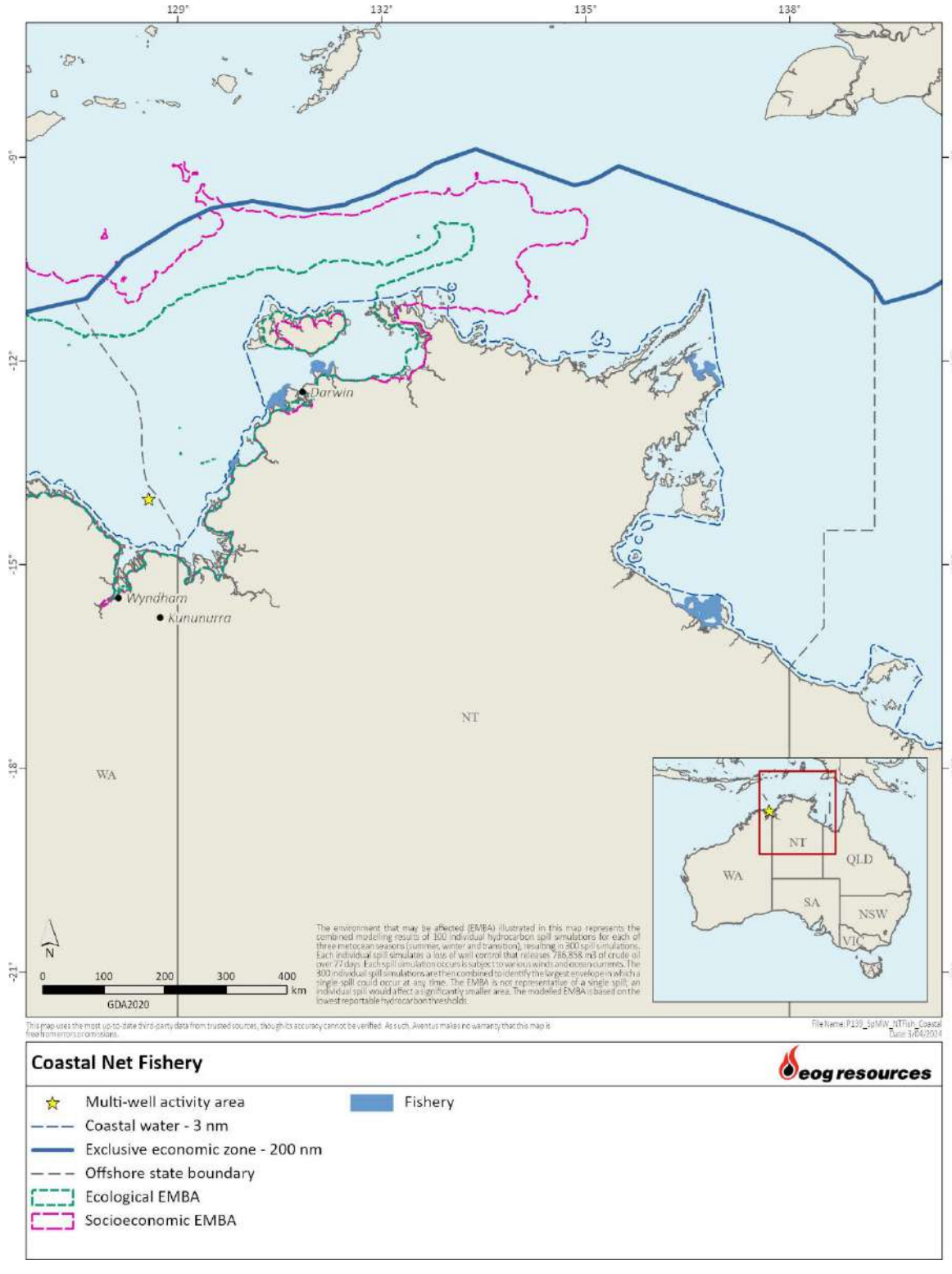


Figure 11.103 Coastal Net Fishery overlapped by the spill EMBA

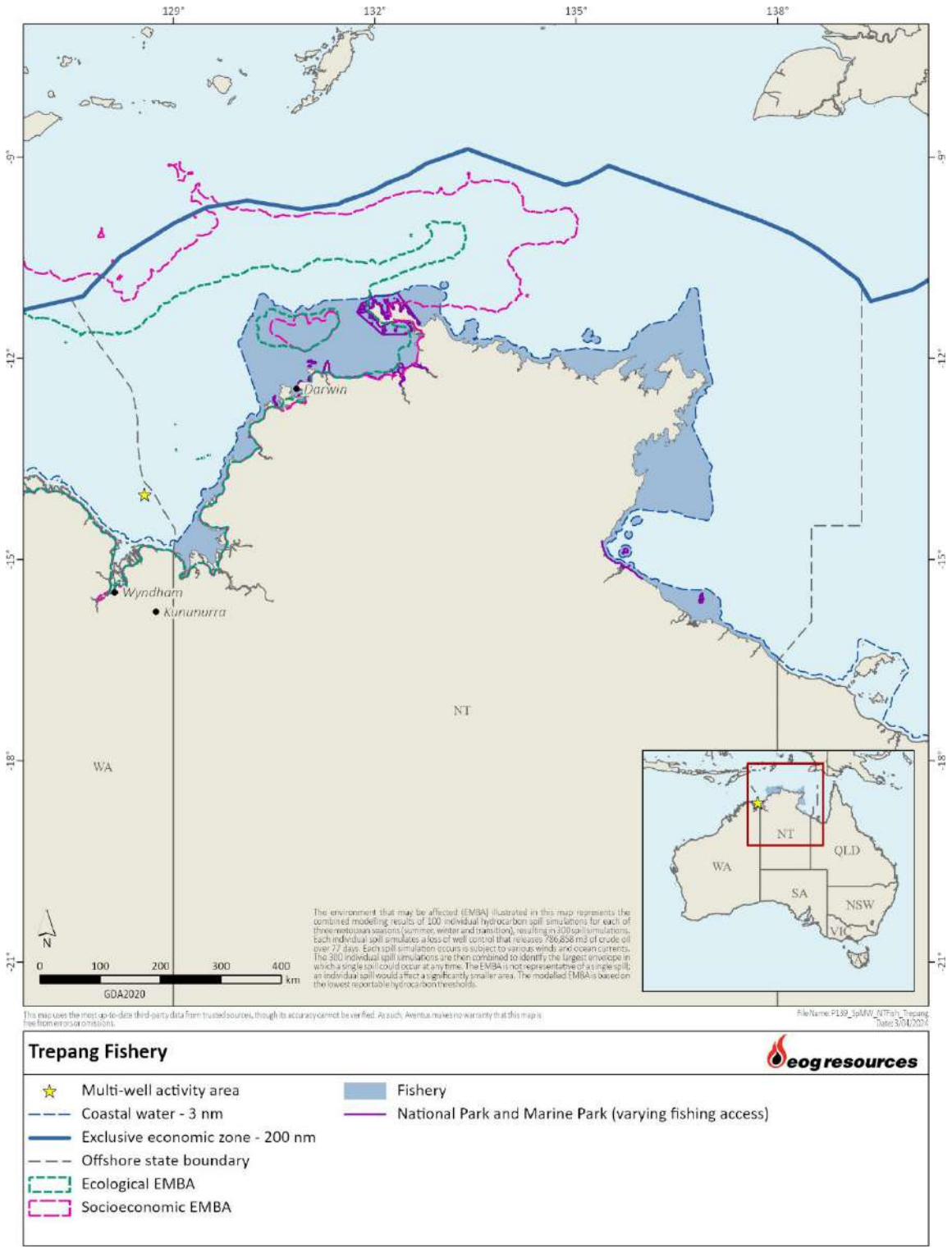


Figure 11.104 Trepang Fishery overlapped by the spill EMBA

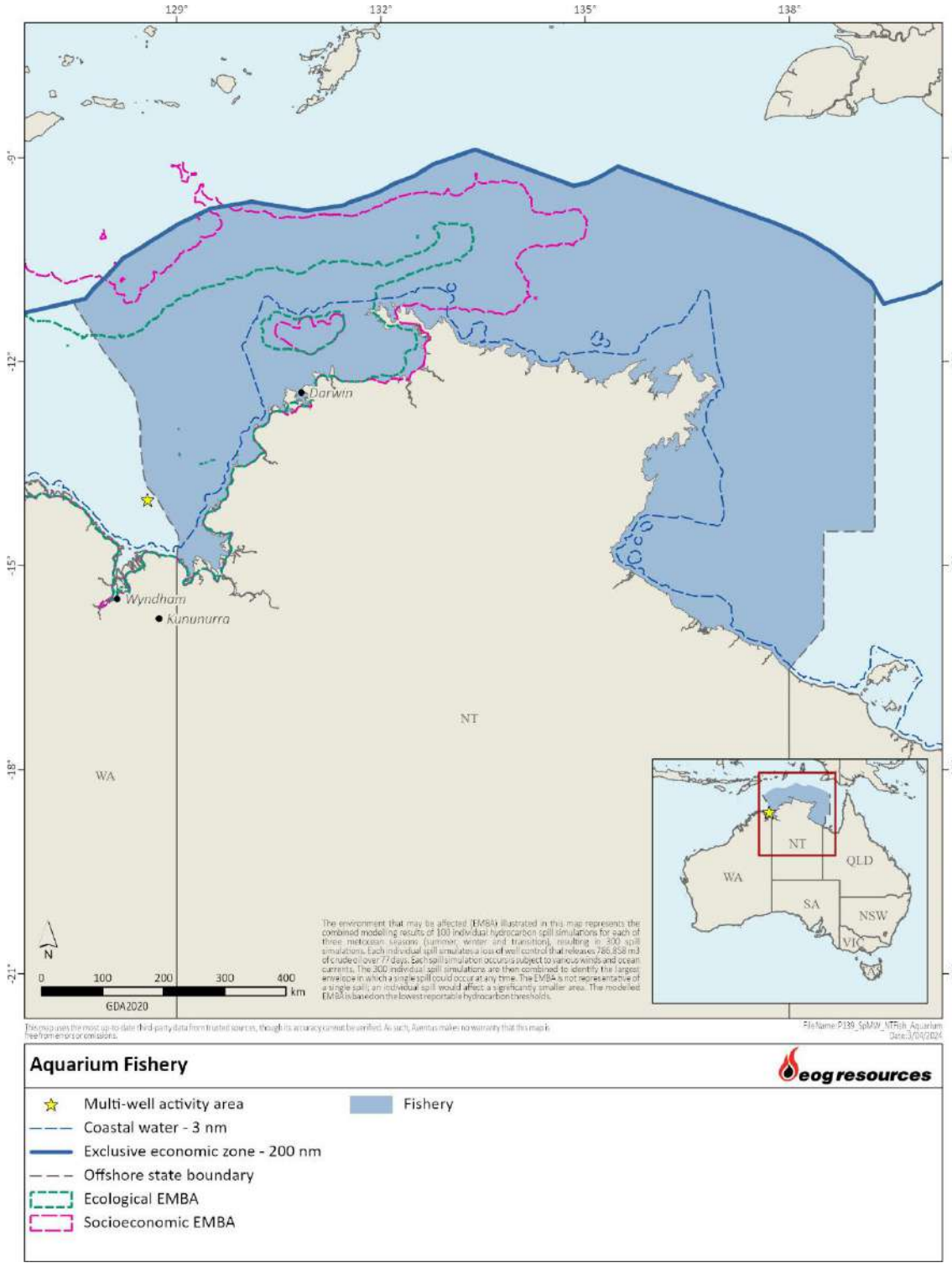


Figure 11.105 Aquarium Fishery overlapped by the spill EMBA

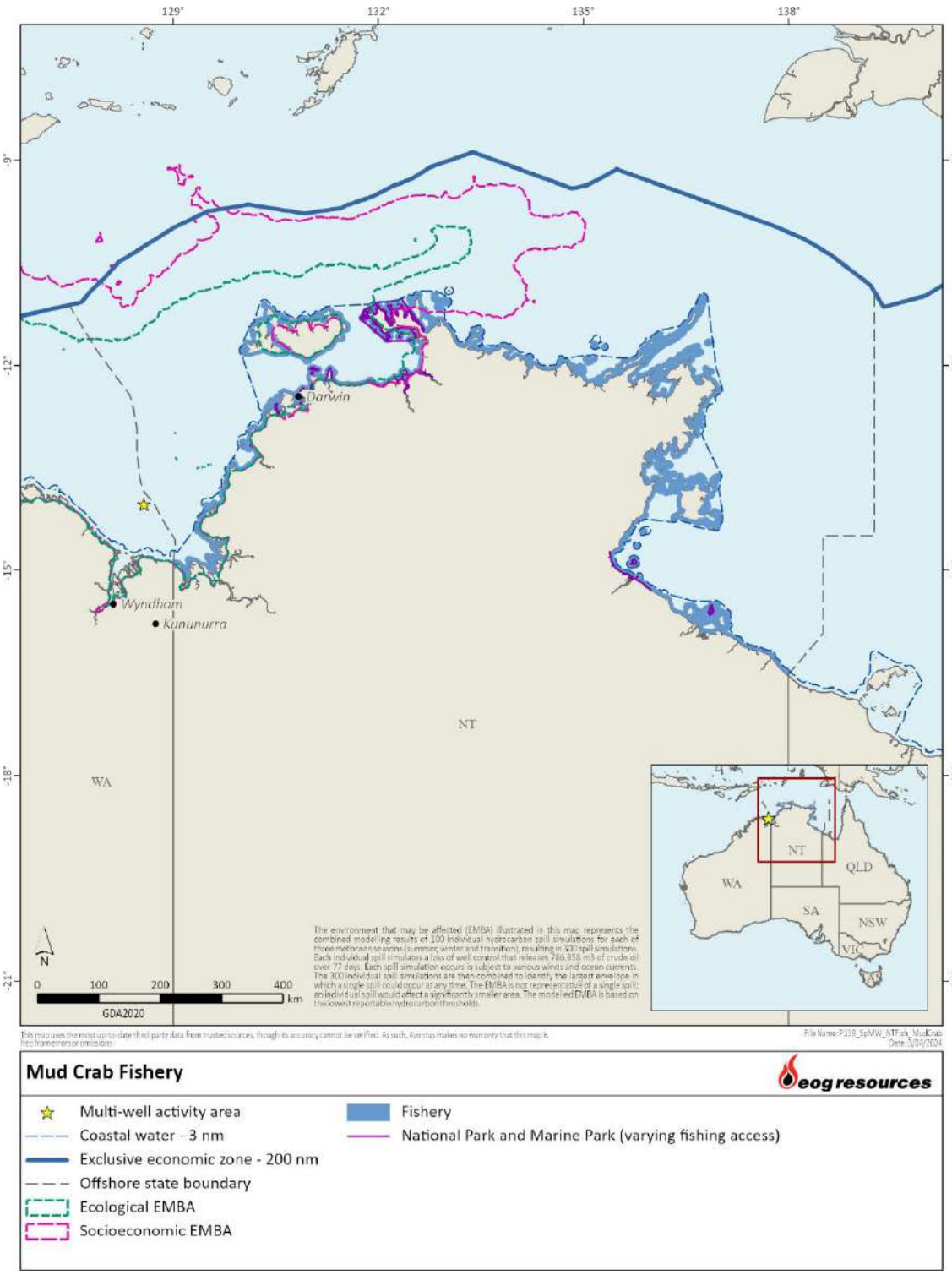


Figure 11.106 Mud Crab Fishery overlapped by the spill EMBA

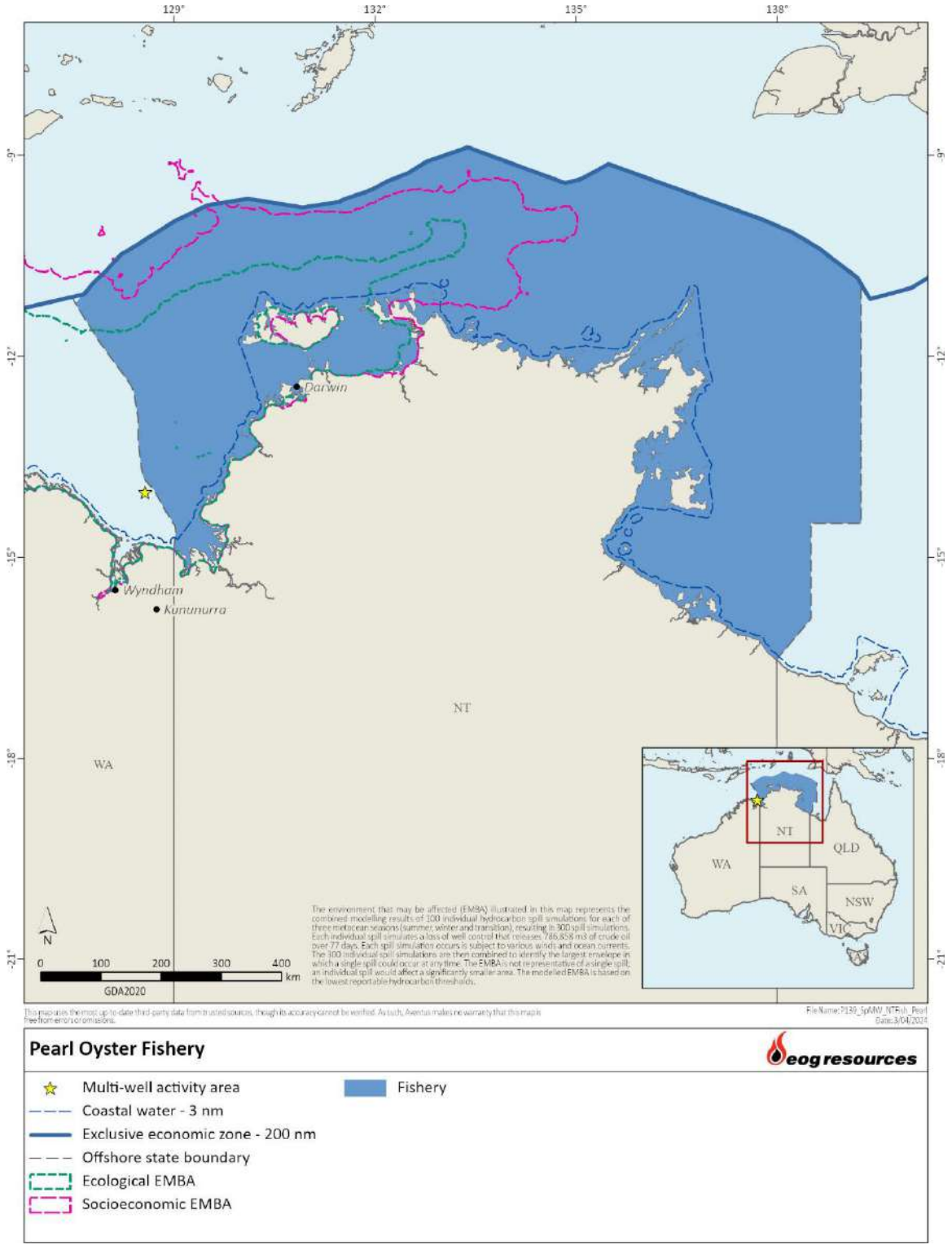


Figure 11.107 Pearl Oyster Fishery overlapped by the spill EMBA

Indonesian Commercial and Subsistence Fishing

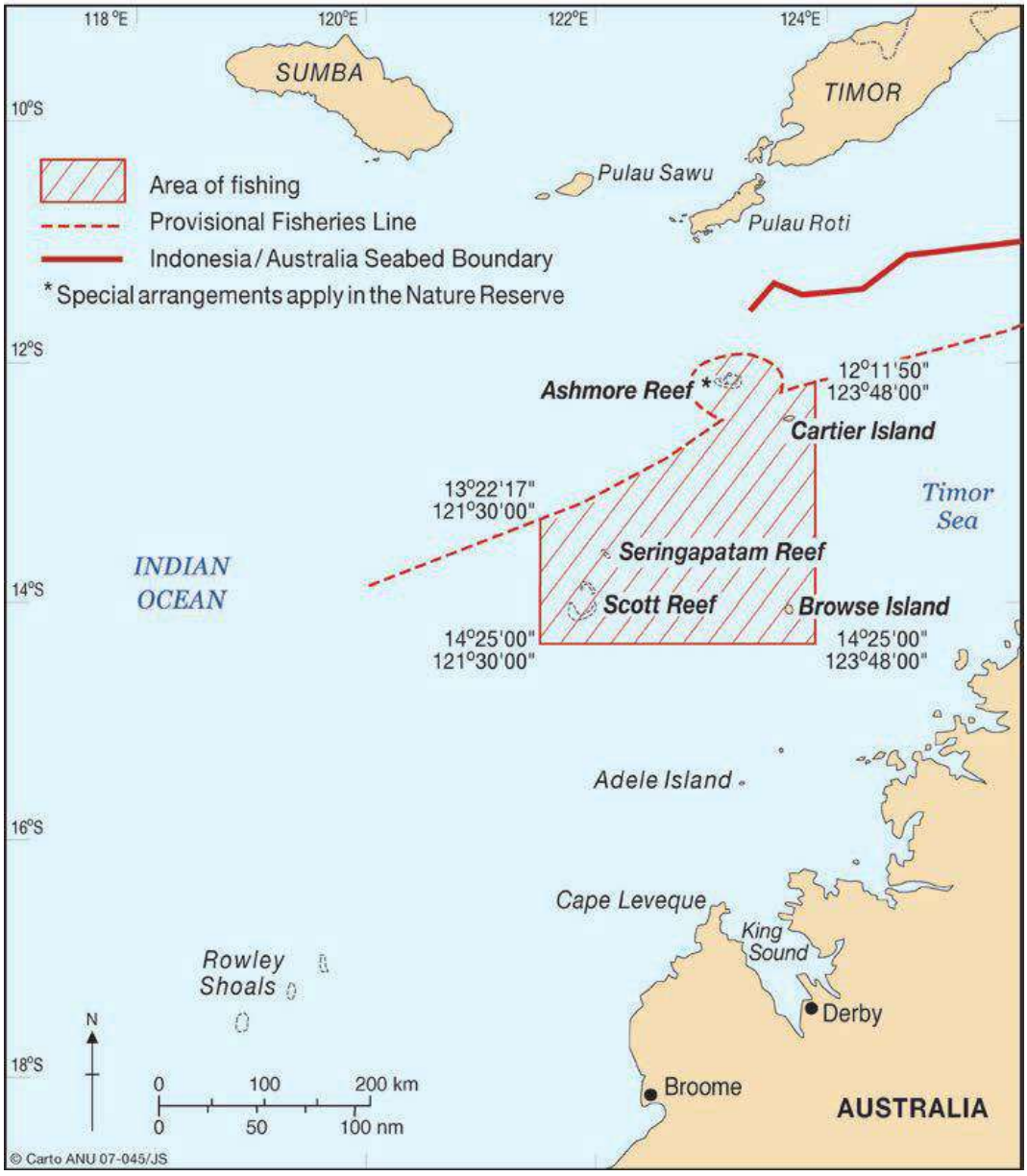
Indonesian fishers have sailed to and actively fished Australia's northern waters, particularly in and around the shallow lagoons of Scott Reef, primarily targeting trepang (sea cucumber), shark fin and other marine resources such as trochus shells. They also catch fish largely for subsistence purposes although the average fish catch per lete-lete (traditional Indonesian fishing vessel) in 2008 increased to commercial volumes. Although deeper waters are more plentiful in trepang, deep diving is generally not undertaken by the fishers due to the MoU stipulation on the exclusive use of traditional equipment only (Woodside, 2011).

Within the northwest extent of the spill EMBA, there is a defined area where a Memorandum of Understanding (MoU) between the Government of Australian and the Government of the Republic of Indonesia Relating to Cooperating in Fisheries (1992) exists to allow Indonesian fishers (using traditional fishing methods) to operate in the Australian waters of the Timor Sea (Figure 11.108). The MoU is officially known as the Australia-Indonesia Memorandum of Understanding regarding the Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone and Continental Shelf – 1974 (DCCEEW, 2024a).

The MoU agreement provides the framework for fisheries and marine cooperation between Australia and Indonesia, and facilitates information exchange on research, management and technological developments, complementary management of shared stocks, training and technical exchanges, aquaculture development, trade promotion and cooperation to deter illegal fishing (DCCEEW, 2024a).

Cooperation under the MoU takes place under the auspices of the Working Group on Marine Affairs and Fisheries. Established in 2001, the Working Group on Marine Affairs and Fisheries is the primary bilateral forum to enhance collaboration across the spectrum of marine and fisheries issues relevant to the areas of the Arafura and Timor seas. The Working Group brings together the fisheries, environment and scientific research portfolios and agencies from both countries (DCCEEW, 2024a).

As part of negotiations to delineate seabed boundaries, Australia and Indonesia entered into the MoU which recognises the rights of access for traditional Indonesian fishers in shared waters to the north of Australia. This access was granted in recognition of the long history of traditional Indonesian fishing in the area. The MoU provides Australia with a tool to manage access to its waters while for Indonesia, it enables Indonesian traditional fishers to continue their customary practices and target species such as trepang, trochus, abalone and sponges. Guidelines under the MoU were agreed in 1989 in order to clarify access boundaries for traditional fishers and take into account the declaration of the 200 nm fishing zones (DCCEEW, 2024a).



Source: ResearchGate

Figure 11.108 Australia-Indonesia MoU Box

11.6.2 Recreational Fishing

Within the North Coast Bioregion, there is a distinct seasonal peak of recreational fishing during winter (Gaughan and Santoro, 2018). Offshore islands, coral reefs and the continental shelf provide species of major recreational interest, including tropical snapper, cods, coral and coronation trout, sharks, trevally, tuskfish, tunas, mackerels and billfish (Gaughan and Santoro, 2018).

Recreational fishing activities are primarily based out of Darwin. Given the long distance of the activity area from the mainland and key population areas, recreational fishing activities in much of the spill EMBA are not predicted. However, given the broad extent of the spill EMBA across northern Australia, it is likely that some recreational fishing does occur.

RecFish West and the AFANT have not raised any issues regarding recreational fishing for this project.

11.6.3 Coastal Settlements

The coastline adjacent to the spill EMBA is sparsely populated, with the townships of Broome (WA) (800 km southwest), Derby (WA) (637 km southwest), Wyndham, WA (162 km south), Wadeye, NT (99 km east) and the city of Darwin (297 km northeast of multi-well location) being the largest city within the spill EMBA.

Darwin is the capital of the NT and has a population of 139,902 (ABS, 2021). Of the people employed in Darwin, 65.7% work fulltime (ABS, 2021). The state government administration, hospitals and defence are the largest employment sectors, accounting for 17.6% of the workforce (ABS, 2021).

The population of Wadeye is 1,924, with Aboriginal and/or Torres Strait Islander people making up 85.8% of the population (ABS, 2021). Of the employed people in Wadeye, the education and local government administration sectors are the largest employment sectors, accounting for 21.4% of the workforce (ABS, 2021).

The population of Wyndham is 941 with Aboriginal and/or Torres Strait Islander people making up 56.6% of the population (ABS, 2021). Of the employed people in Wyndham, the social services and education are the largest employment sectors, accounting for 20.9% of the workforce (ABS, 2021).

The population of Broome is 16,959, with Aboriginal and/or Torres Strait Islander people making up 28.6% of the population (ABS, 2021). Of the employed people in Broome, hospitals, accommodation, and primary education, are the largest employment sectors, accounting for 14.8% of the workforce (ABS, 2021).

The population of Derby is 3,222 people, with Aboriginal and/or Torres Strait Islander people making up 41.5% of the population (ABS, 2021). Of the employed people in Derby, hospitals, correctional and detention and secondary education sectors are the largest employment sectors, which account for 24.4% of the workforce (ABS,2021).

Apart from Kalumbaru (205 km east of the multi-well location , inland of the coast) is located on the western side of Cape Londonberry (179 km northwest of the multi-well location) there are no coastal settlements on the western coast of the JBG until Cambridge Gulf where the Oombulgurri community is located, approximately 138 km south of the multi-well location . The towns of Wyndham (as described above) and Kununurra (190 km south from multi-well location) are also located in the Cambridge Gulf.

The population of Kununurra is 5,494 people, with Aboriginal and/or Torres Strait Islander people making up 24.9% of the population (ABS, 2021). Of the employed people in Kununurra, hospitals, secondary education and other social assistance services are the largest employment sectors, which account for 14.2% of the workforce (ABS, 2021).

The population of the Tiwi Islands is 2,348 people, with Aboriginal and/or Torres Strait Islander people making up 86.5% of the population (ABS, 2021). Of the employed people in the Tiwi Islands, local government, primary and secondary education are the largest employment sectors, accounting for 34.6% of the workforce (ABS, 2021).

11.6.4 Tourism

The JBG and adjacent lands are remote with very little infrastructure (such as roads, airports, accommodation) and therefore has not been developed for tourism. For up to five months of the year, access to the JBG region is restricted to boat or helicopter due to wet season rains, and road access to areas of Aboriginal freehold land requires prior permission from the Northern Land Council (NLC) (Woodside, 2004).

Expedition cruise boats operate in the North Kimberley Marine Park in the dry season (April to October), between Broome and Wyndham or Darwin, and offer multi-day tours (DPW, 2016b). Vessels range from small fishing and sightseeing tour boats to large luxury cruise ships carrying up to 100 passengers (DPW, 2016b). Access to the coast is possible although only by using a four-wheel drive. Scenic flights and fishing expeditions operate in connection with coastal accommodation or cruise boats as well as from Broome, Derby and Kununurra (DPW, 2016b).

Charter fishing and tourism activities operate from Darwin and the Kimberley and target areas of high scenic value and/or offshore coral reef areas (Woodside, 2004). These attributes are sparse in the JBG, and therefore, given the isolated nature of the area, the likelihood of charter fishing and tourism is also anticipated to be low (Woodside, 2004) though restricted to are located within a few kilometres from the coast, and mainly in estuarine waters. Charter boats operating out of Darwin and Broome/Derby may occasionally visit or pass through the JBG.

Tourism accommodation and operations in the Kimberley include Berkeley River Lodge, Faraway Bay Lodge, Honeymoon Bay and Kimberley Coastal Camp. All camps close during October and reopen during March following the wet season.

Swimming tends to be limited to guided excursions to freshwater pools and waterfalls on land, given the presence of saltwater crocodiles and other dangerous fauna in northern WA and NT. Known dive sites in the wider Kimberley region are near Broome, the Lacepede Islands and the Rowley Shoals.

11.6.5 Offshore Energy Exploration and Production

The Bonaparte Basin is an established hydrocarbon province with a number of commercial operations. The closest operation is the Blacktip Gas Field, located in adjacent permit WA-33-L and operated by ENI Australia (Figure 11.109). The Blacktip Gas Field consists of an unmanned wellhead platform, two producing wells, flowlines and a subsea gas export pipeline (GEP) that runs from the platform to shore near Wadeye, NT. The Blacktip GEP is located 10 km northeast of multi-well location. Vessels servicing the Blacktip platform pass through the spill EMBA (see Section 5.6.7 of Chapter 5).

The Bonaparte Basin contains several oil and natural gas fields, amounting to 18% of Australia's known reserves of natural gas. The basin had produced 11 GL of oil to end-2000 but only 0.11 BCM of gas. Remaining known reserves are 33.42 GL of oil and 668.55 BCM of gas (Geoscience Australia, 2022).

There are numerous petroleum exploration and production permits located within the spill EMBA, operated by companies including ENI Australia, Woodside Energy Limited, Melbana Energy, Neptune Energy Bonaparte Pty Ltd, Santos Ltd, BP Developments Australia Pty Ltd, Chevron Australia Pty Ltd and Kufpec. Petroleum activities include production from platforms, FPSOs, export pipelines and exploration (seismic surveys and drilling), with most concentrated in the southern-most extent of the spill EMBA, as shown in Figure 11.109.

11.6.6 Commercial Shipping

Commercial shipping in the activity area is outlined in Section 5.7.7 of Chapter 5. Shipping traffic in the spill EMBA is relatively low given the large extent of the spill EMBA, with major shipping lanes concentrated in and out of Darwin Port and the North West Shelf, as illustrated in Figure 11.110.

11.6.7 Submarine Cables

Submarine telecommunication cables provide telephone and internet connections across the world; they are laid on the ocean floor and are often thousands of kilometers in length.

The western-most extent of the spill EMBA overlaps the Australia- Singapore cable and the Indigo-West cable (Figure 11.111).

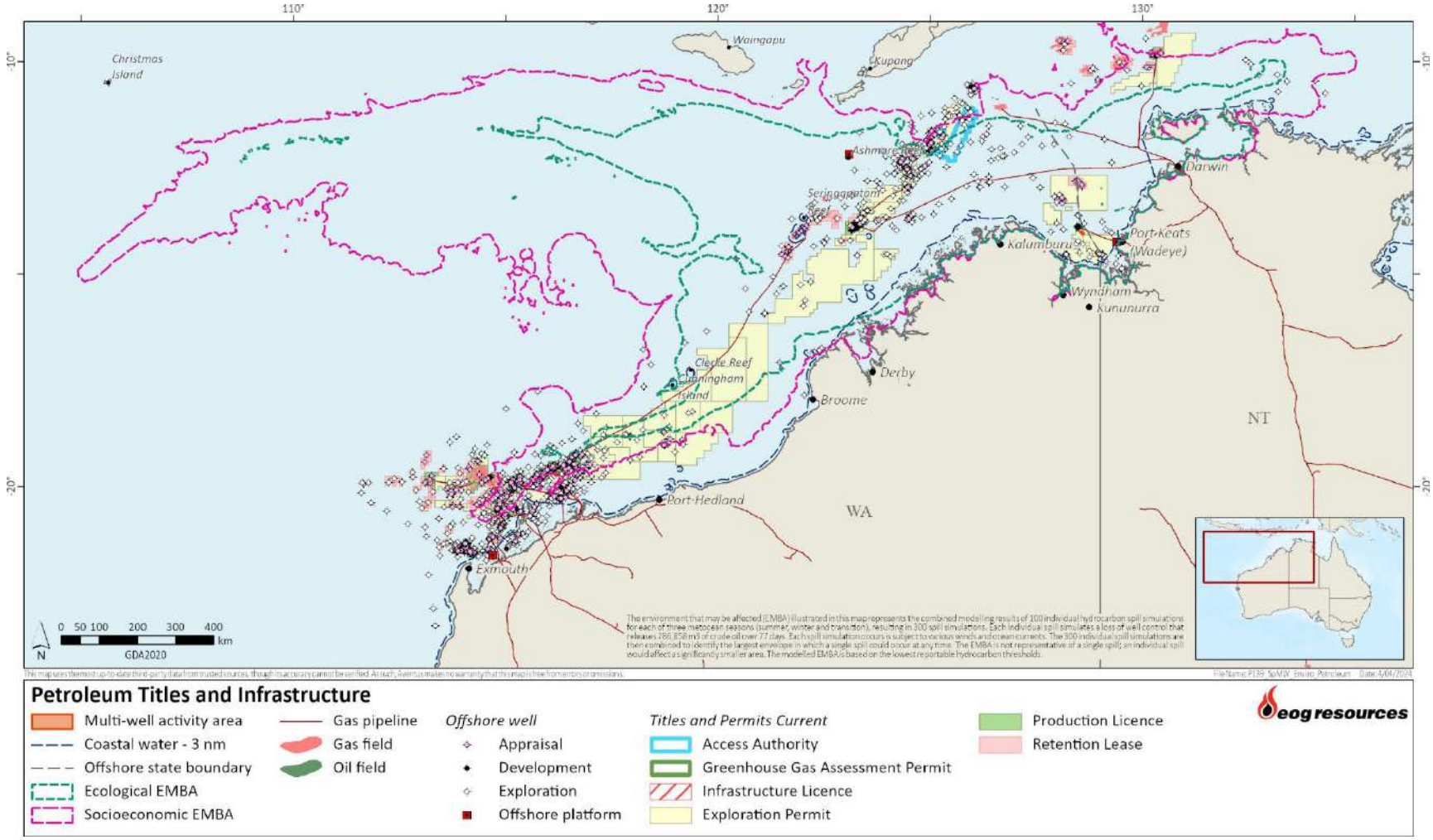


Figure 11.109 Petroleum titles and infrastructure in the spill EMBA

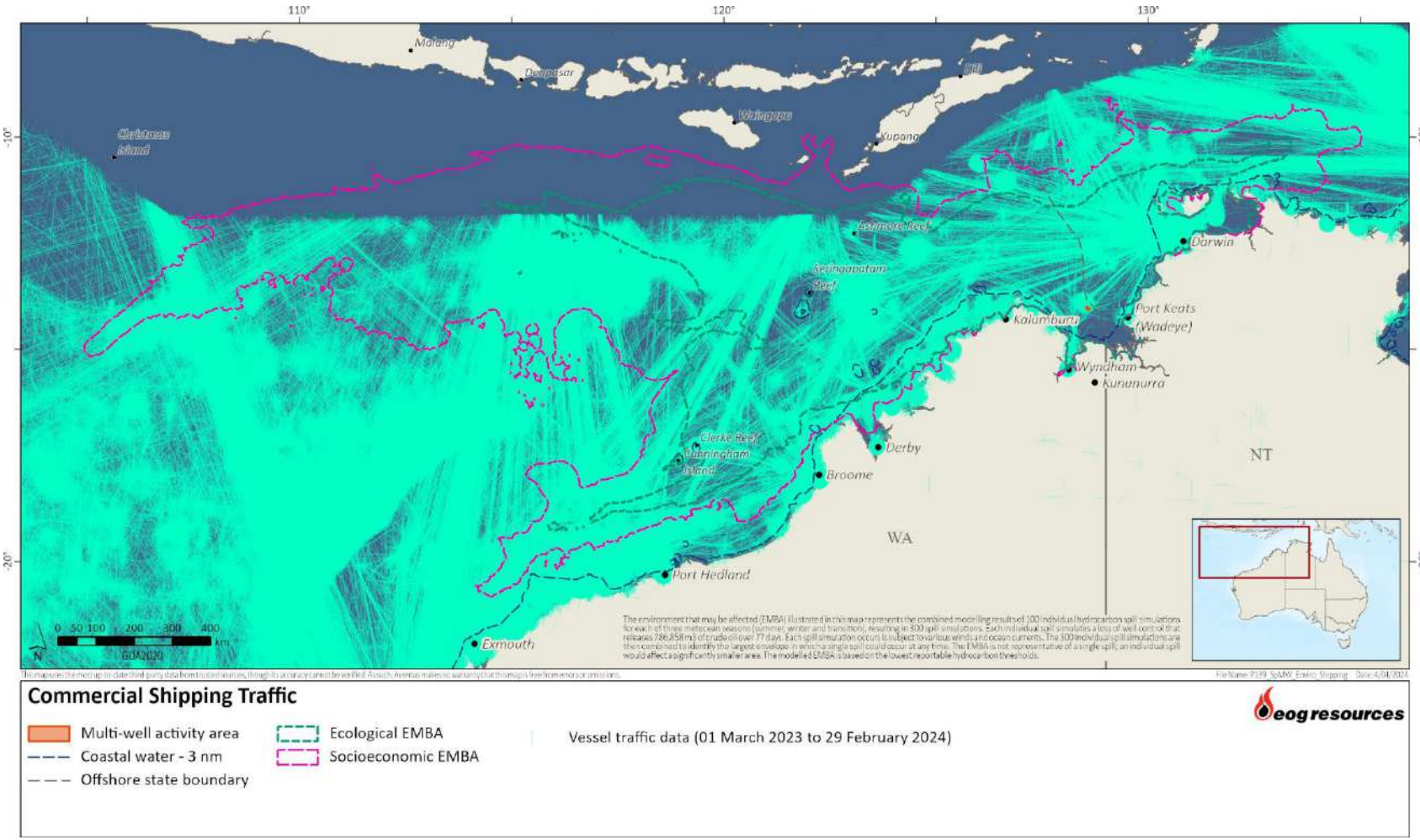


Figure 11.110 Commercial shipping in the spill EMBA

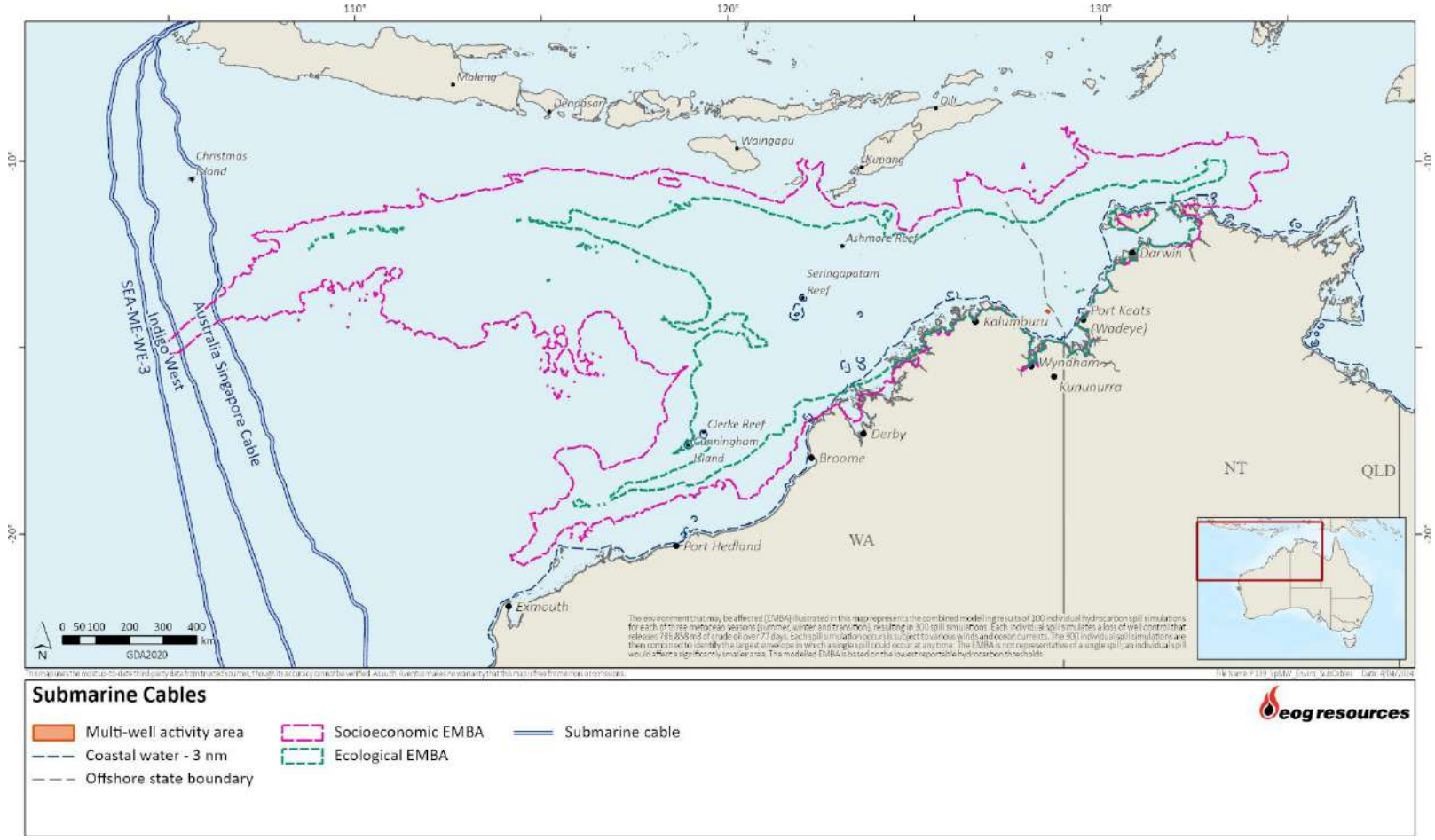


Figure 11.111 Submarine cables in the spill EMBA

11.6.8 Defence Activities

The spill EMBA is overlapped by a defence training area, which is a maritime military zone administered by the Australian Defence Force (Figure 11.112). This is an area where exercises such as operational flying training or live weapon firing may occur. Training areas along the coastline of the spill EMBA include the Yampi Sound Training Area, Bradshaw Field Training Area and Kangaroo Flats Training Area (Figure 11.112).

Australian Border Force and Australian Defence Force vessels undertake civil and maritime surveillance within the region with the primary purpose of monitoring the passage of illegal entry vessels and illegal fishing activity within these areas. The area is a known area for travel between Indonesia and Australia for refugees seeking asylum in Australia.

The spill EMBA overlaps the exercise and training areas that comprise the North Australian Exercise Area (NAXA), a maritime military zone administered by the Australian Defence Force, as well as restricted airspace used for operations including live weapons and missile firings. The NAXA location of the KAKADU training exercise that operates biennially. The exercise involves numerous naval ships from various countries participating in the waters off Darwin and Northern Australia. Exercise KAKADU is Australia's premier international maritime exercise bringing together multiple navy and air forces from the Asian, Pacific and Indian Ocean regions to test integration and war fighting abilities.

During Exercise KAKADU, access may be restricted to all vessels and aircraft. Avoidance of the area during exercises is requested by Defence.

There is also an Air-to-Air Refuelling (AAR) and Airborne Early Warning and Control (AEW&C) airspaces that overlap the activity area and EMBA.

The spill EMBA (but not the activity area) overlaps an area with potential for unexploded ordnance (UXO), illustrated in Figure 11.113.

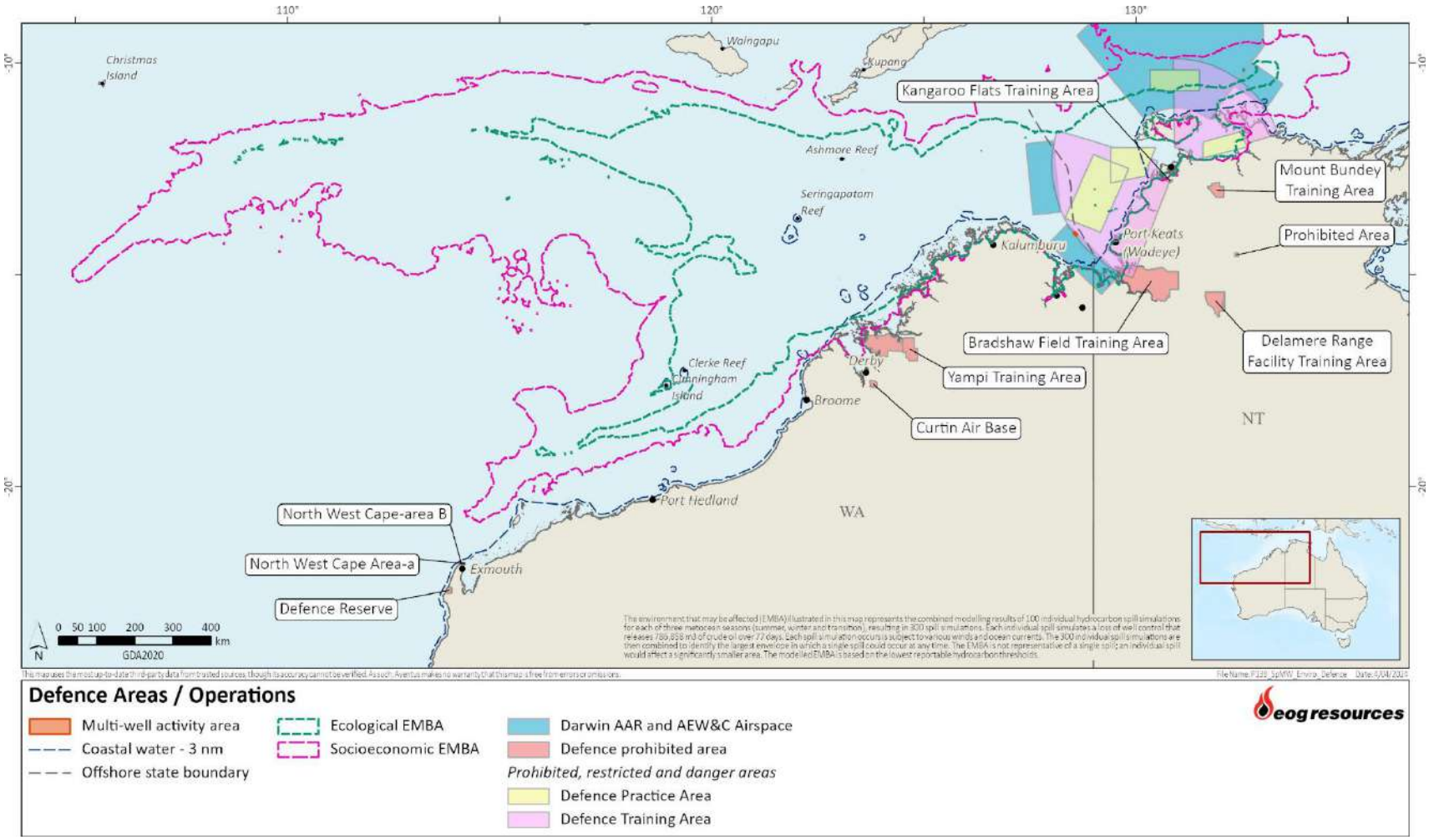


Figure 11.112 Defence exercise and training areas overlapped by the spill EMBA

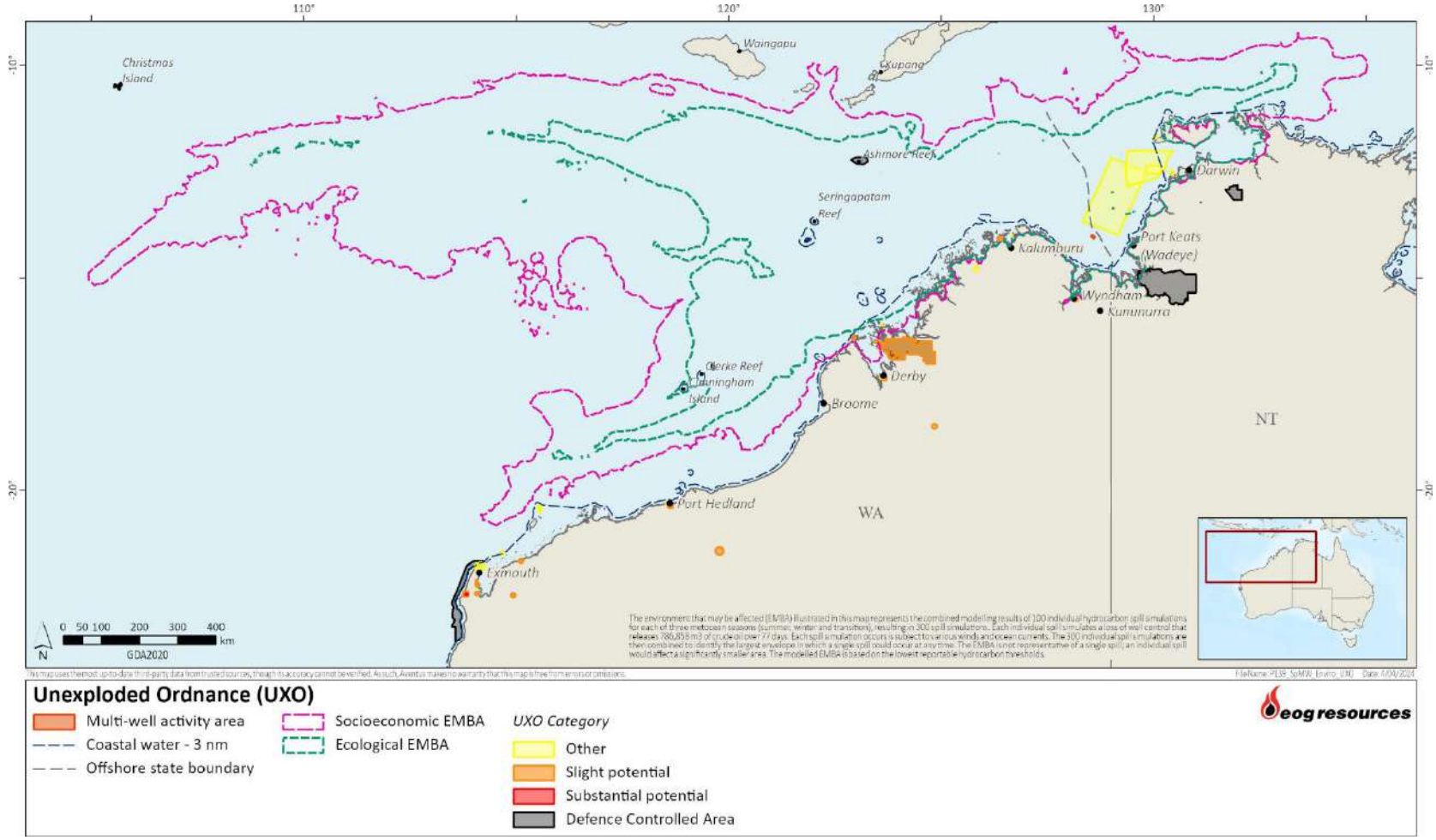


Figure 11.113 Unexploded ordnance risks in the spill EMBA