PHOENIX ENVIRONMENTAL

MARINE TURTLE SURVEY OF MARDIE SALT PROJECT AREA – DECEMBER 2017, JANUARY 2018

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1 INTRODUCTION

Phoenix Environmental conducted a desktop review and site reconnaissance to investigate the feasibility of BC Minerals Ltd (BCI) developing the Mardie Salt Project between Cape Preston and Onslow in the Pilbara region of Western Australia. The preliminary site reconnaissance that they conducted in August 2017 found evidence of turtle nesting within the proposed area. The review and reconnaissance highlighted the area as being potentially important for marine turtles so Pendoley Environmental was contracted to conduct a snapshot survey of the area during the peak of the nesting season (December-January).

The boundaries of the mining tenements covered by this survey are show in **Figure 1** (red lines). Turtle surveys have been conducted in surrounding areas, including neighbouring coastal islands (Pendoley et al. 2003), Cape Preston to the north (Department of Environment and Conservation 2006) and Wheatstone/Onslow area to the south, however no data exists for the proposed site (Pendoley et al. 2016). Studies of nearby islands indicate that the area is important for flatback, hawksbill and green turtle nesting. For Flatback turtles are likely to forage over soft bottom habitat supporting sea pens or other infauna (Pendoley 2005). Green turtles are likely to forage around the coastal mangroves and tidal creeks (Pendoley 2005).

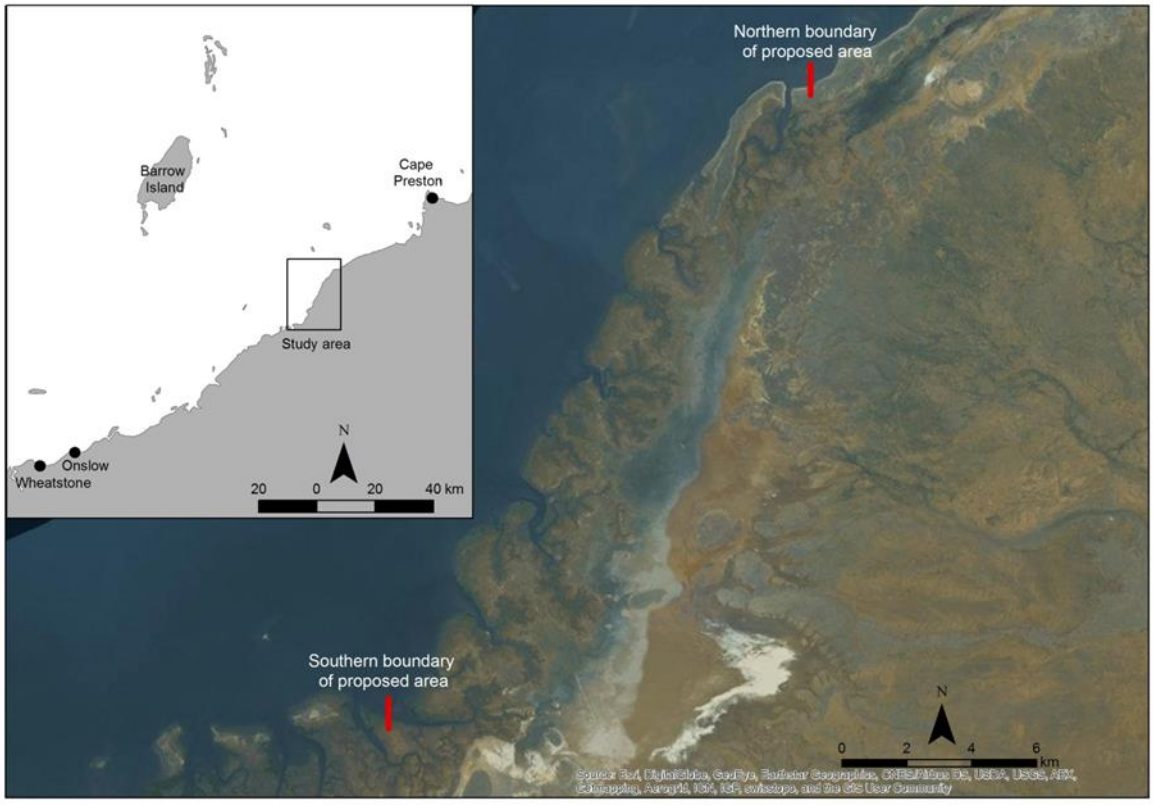

Figure 1: The location of the study area and the coastal boundaries of the BC Iron tenements (red lines).

2 METHODS

On the 5th December 2017, the area between the northern and southern tenement boundaries was surveyed for turtle activity. This involved aerial and land-based surveys.

2.1 Aerial Survey

A helicopter was used to identify potential nesting sites and to access the site. It was flown along the coastal boundary of the tenement (see **Figure 1**) at low water (0630) to identify turtle nesting habitats for the land-based survey. During this flight, any sightings of turtles in the water were recorded and identified where possible. Opportunistic sightings of turtles were also recorded at high water from the helicopter when flying around coastal creeks (going to and from site and while conducting bird surveys).

2.2 Land-based survey

Daytime track surveys were conducted of potential nesting sites identified from the aerial survey. The start and end of the sites were marked with a GPS and the number of turtle tracks recorded. Any other evidence of turtle activity was also recorded, including old nesting sites (craters without tracks), turtle remains (bones), emerged nests and any sightings of turtles in the intertidal area or in the water. The physical characteristics of the study site were also noted.

2.3 Survey limitations

The coastal area was surrounded by tidal creeks and mangroves with a large intertidal muddy platform that was exposed at low water and covered at high water. There was a 4 m difference in high and low water at the time of the survey (it was conducted on the spring tide, just after the full moon) which meant that the water was turbid, making it hard to see and identify turtles in the water.

We flew over the creek close to northern tenement boundary at low water which was when turtles were more visible from the air. Many turtles were seen here at low water, but at high water there were few. It is expected that this was due to water clarity and water depth at high water. All remaining creeks were only surveyed at high water so very few turtles sighting were recorded. This information must be interpreted with caution as these sites are also likely to be just as important to turtles as the creek.

This survey comprised a single snapshot survey day on 5 December 2017 and 13 January 2018. This survey effort was sufficient to confirm marine turtle nesting activity only, it cannot confidently quantify the nesting population size. Factors influencing the ability to detect marine turtle nesting along this part of the mainland coast include fine sand grain size, wind and rain erasing tracks, low dentistry nesting, day to day variation in nesting effort, shallow body pits left by flatback and hawksbill turtles and the 14 day inter-nesting interval of these species.

3 RESULTS

3.1 Aerial survey

At low water the helicopter was flown along the entrance of the main creek and along the coastline to identify nesting habitat. The only available turtle nesting habitat identified in the survey area was along the northern tenement boundary (yellow shaded area, **Figure 2**) as coastal mangroves lined the coast in all other areas. A large number of adult turtles (15 - 20) were sighted in the water at the entrance to the creek at low water (**Figure 2a**). Similarly, a large number of turtles (20 - 30) were sighted further up the creek in a deeper hole adjacent to an exposed sand bank at low water (**Figure 2a**). They were mostly adult turtles, but juveniles (*n* = 5) were also seen. We expect that they were green turtles but they may have also been flatback turtles, but due to water turbidity we cannot identify to species level with any confidence. One green turtle was seen in a creek further south (**Figure 2b**).

At high water only green turtles were seen in the aerial survey (**Figure 2b**). Five were sighted in the creek and one was noted just south of the southern tenement boundary. Very few sightings were recorded at high water due to water clarity and water depth.

3.2 Land-based survey

Land-based surveys were conducted on the morning of the 5th December 2018 at two sites: 1) west of the main creek inlet and 2) east of the creek (**Figure 2**). No evidence of turtle activity was recorded east of the creek (**Figure 3**). This site was characterised by a low dune system with a narrow (1 m-long) supratidal zone (dunes to high-water line of spring high-tide) available for nesting (**Figure 4a**). Nesting by flatback turtles was evident on the beach west of the creek (**Figure 3**). The supratidal zone was wider (~5 m) so it had a greater amount of nesting habitat for turtles (**Figure 4b**). Flatback turtle tracks (*n* = 4) were identified in the sampling area and a large number (49 depressions) of old turtle nesting sites were evident (**Figure 3** and **Figure 4c,d**). These old nesting sites may be up to a year old and cannot be identified to species level.

Turtle remains were found at four locations in the survey area (**Figure 5**). In-water sightings were recorded at the mouth of the creek, including six juvenile green turtles seen swimming along the shoreline, close to the mangroves which lined the creek, and two adults which were in similar areas, but in slightly deeper water (**Figure 5**).

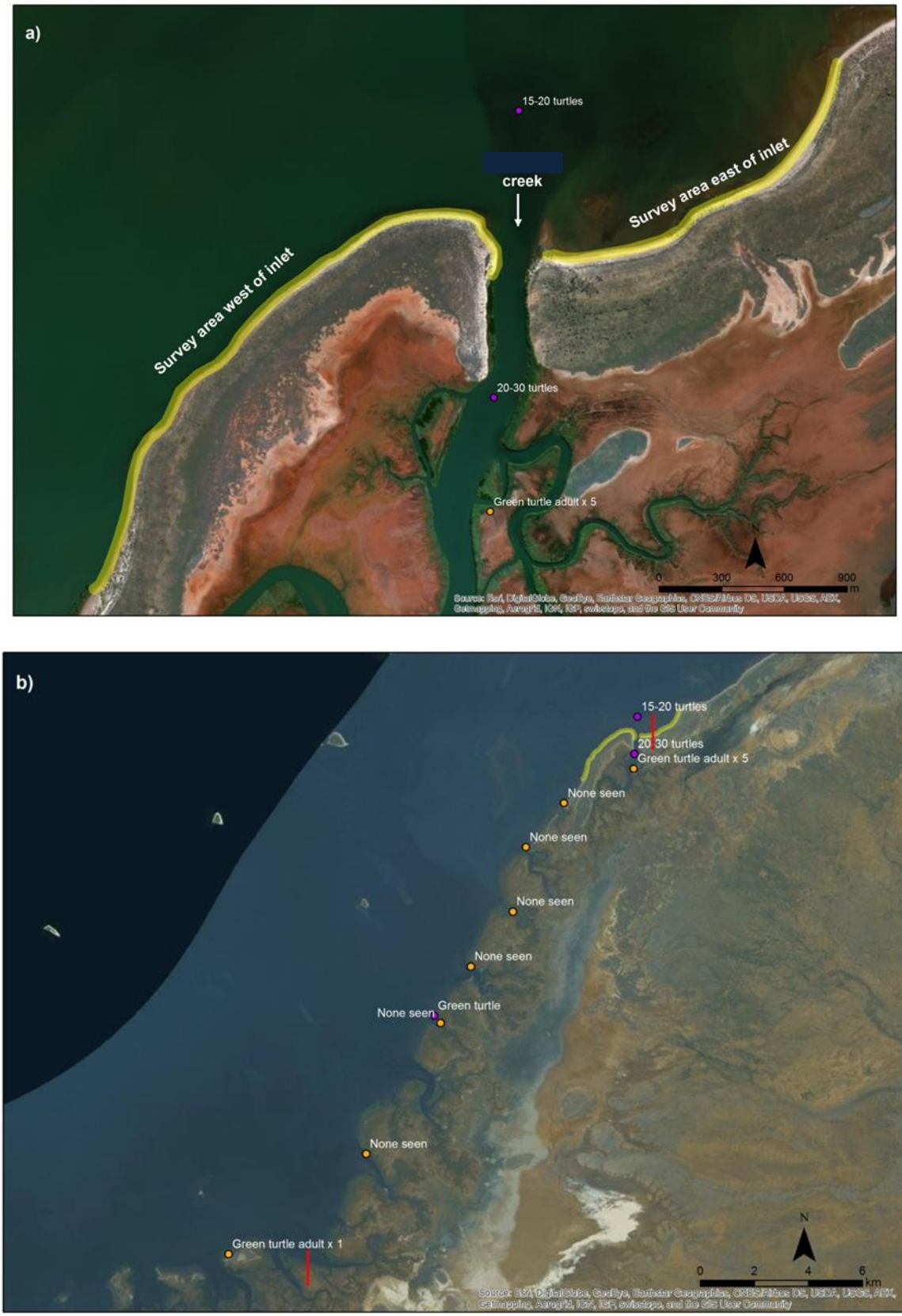

Figure 2: Sightings of turtles in the water at high water (orange circles) and low water (purple circles). The area identified as available turtle nesting habitat (yellow shaded area) within the tenement boundaries (red lines).

Figure 3: Turtle nesting activity documented within this survey area. Turtle tracks (blue circles) and old nesting sites (yellow circles) were only found in the area west of the creek.

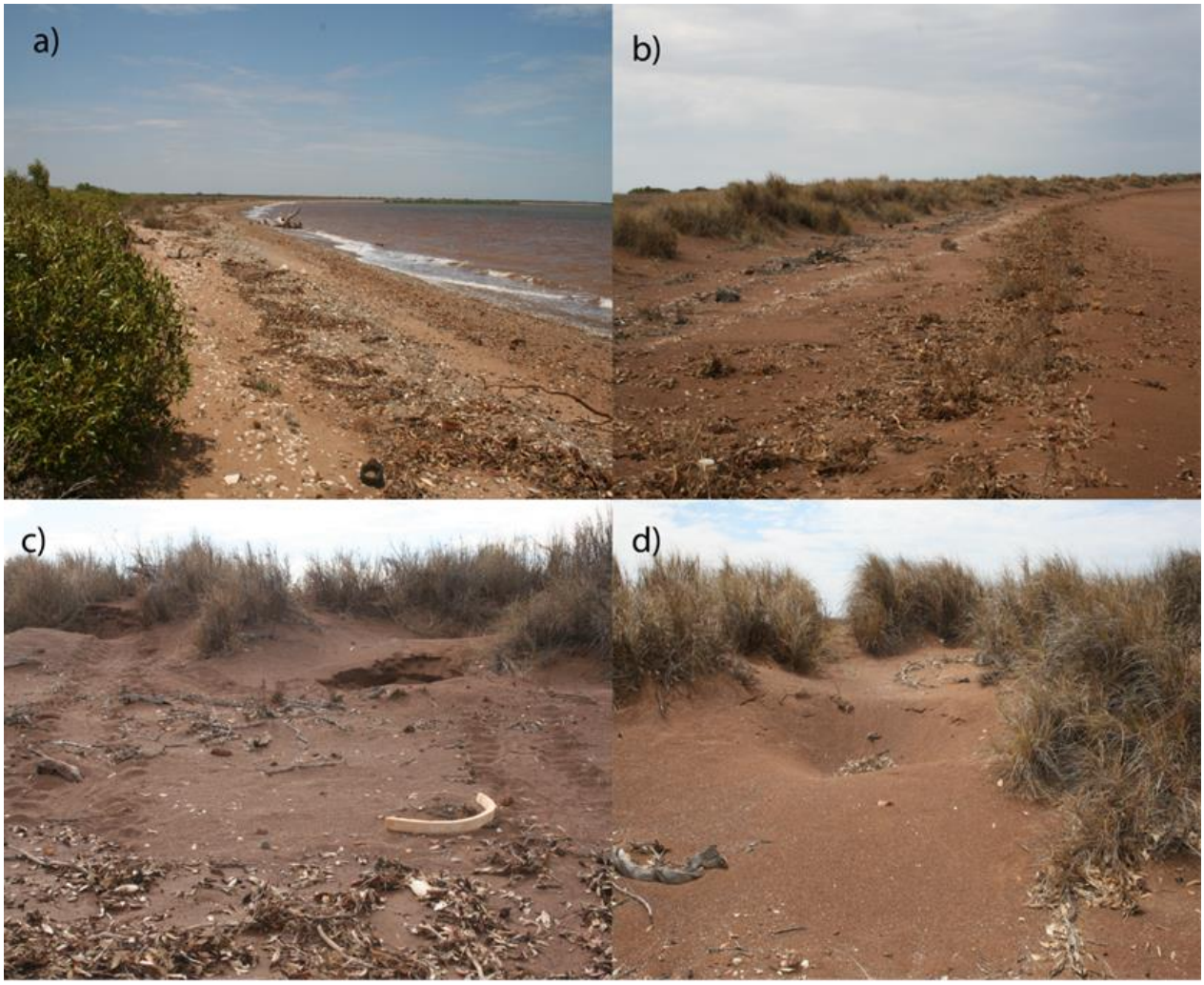

Figure 4: Photo taken from a) east of the creek looking west towards the creek, b) west of the creek looking to the south towards the main activity area, c) a flatback turtle track, and d) an old nesting site. Note the narrower supratidal zone east of the creek (a) compared to the wider supratidal zone west of the creek (b).

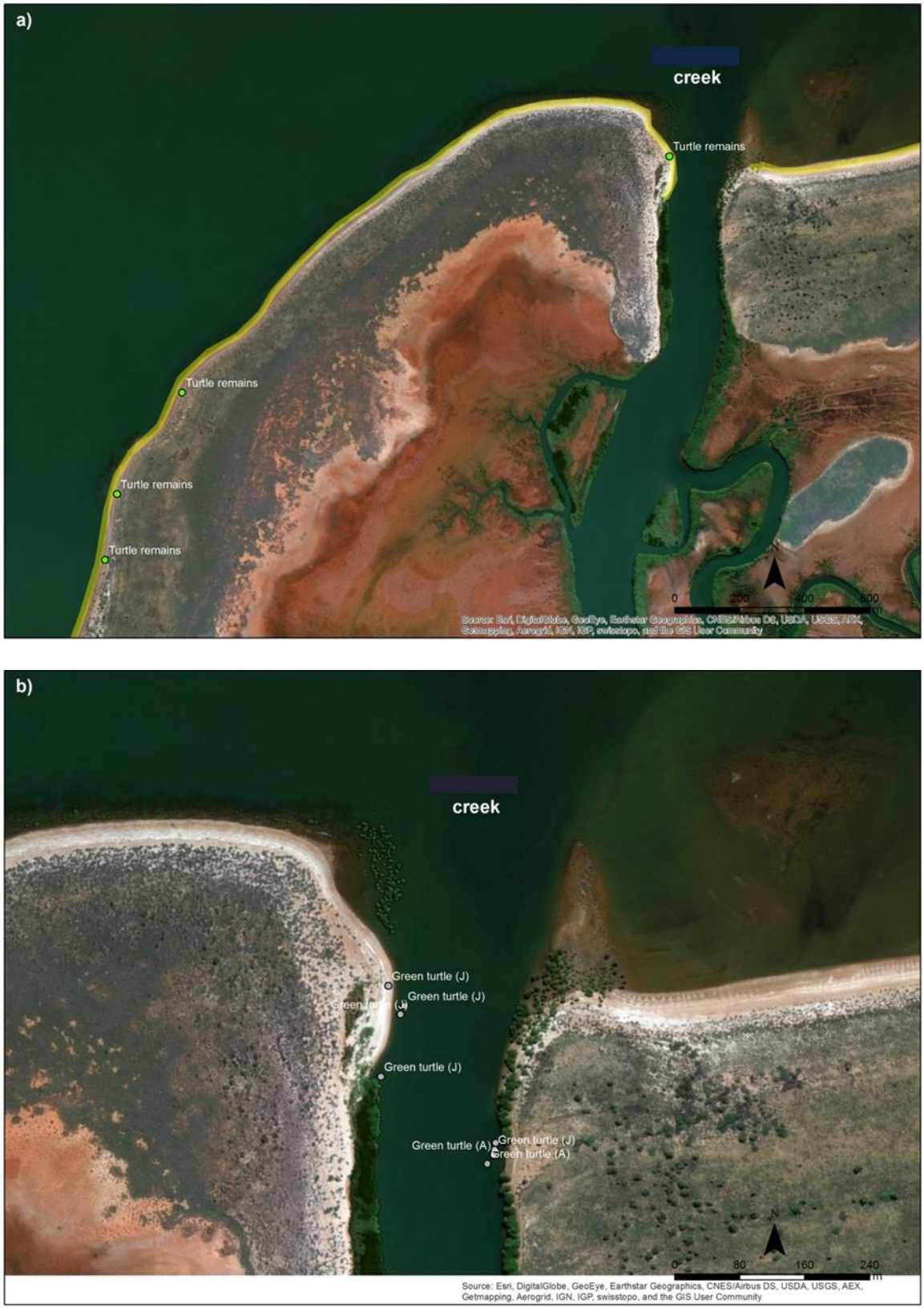

Figure 5: a) Locations of turtle remains found during the land-based survey (green circles) and b) in-water sightings from the creek of adult (A) and juvenile (J) green turtles (grey circles).

3.3 Follow-up survey: 13th January 2018

This survey was carried out as a result of the findings of the December 2017 survey which suggested low dispersed marine turtle nesting was occurring on the coastline adjacent to the proposed project site. Beaches to the north east were inspected on foot and by helicopter (**Figure 6**) on the 13th January 2018.

The beach type and grain size were similar to the more southern beaches; flat, low energy, low profile beaches with gentle rising dunes.

The survey results are shown in **Attachment 1**. The survey found evidence of flatback and hawksbill nesting. Sixteen adult flatback tracks were recorded and included two false crawls, seven with nesting attempts (all abandoned egg chambers) and seven with successful nests. One adult hawksbill track was recorded with an abandoned egg chamber. One track and two body pit craters were also recorded where a species could not be determined. These results suggest this section of the mainland coast supports low level and dispersed flatback nesting and very low level hawksbill nesting.

One juvenile green turtle was found stranded on the intertidal platform (**Figure 6**), confirming this species is present in the nearshore coastal waters.

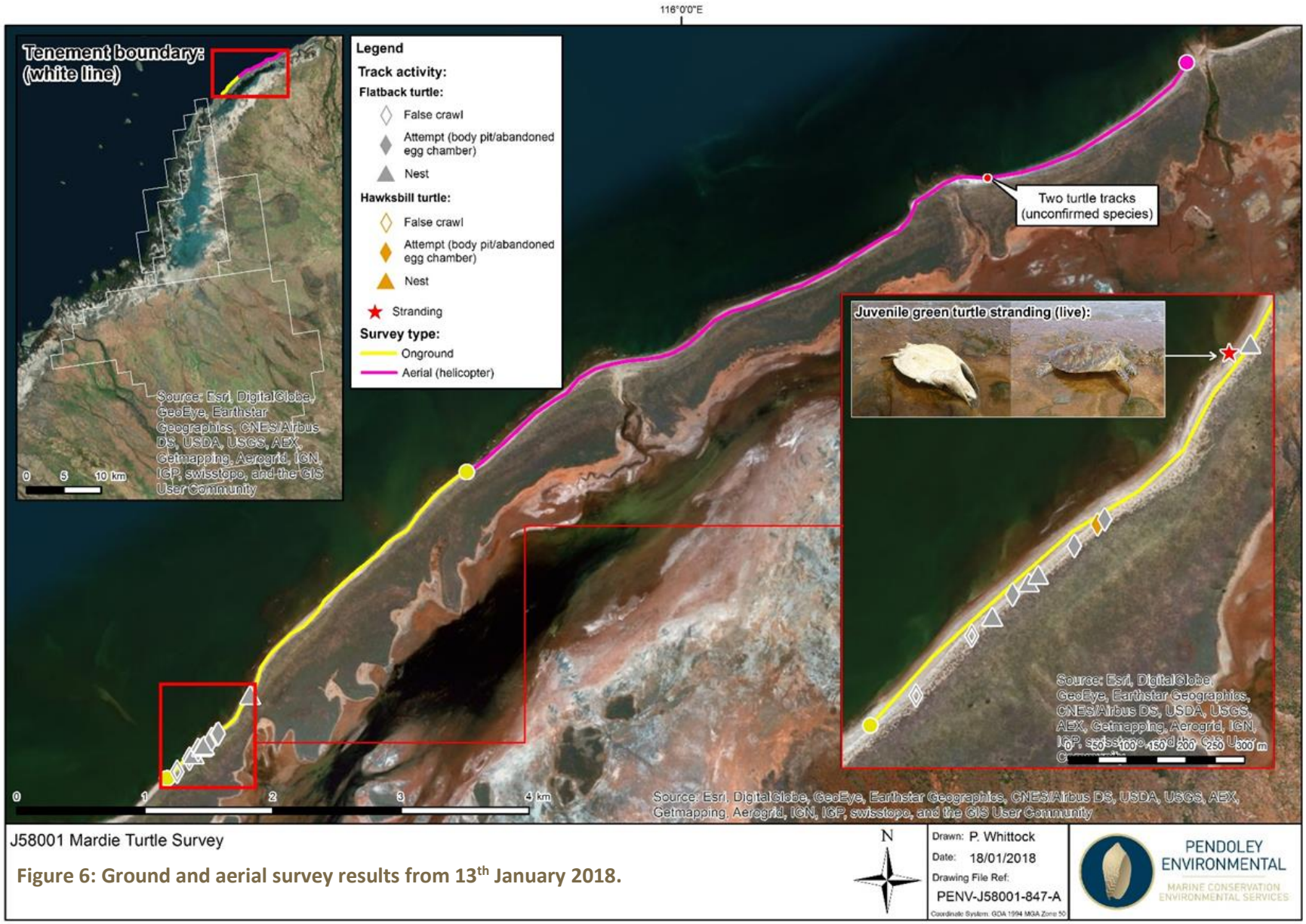

Figure 6: Ground and aerial survey results from 13th January 2018.

4 SUMMARY AND RECOMMENDATIONS

The combined survey area covered a large stretch of coastline between Onslow and Cape Preston. Only a small area of the coastline was identified as available turtle nesting habitat but the entire coastline is likely to be important habitat for marine turtle foraging, resting and breeding. The coastline was lined with numerous tidal creeks and mangroves which are important nursery areas for juvenile marine turtles, but also for adult turtles as large numbers were sighted utilising these creeks. The creek was the most surveyed area and was therefore where most turtle sightings were recorded, but other creeks are likely to be equally important to juvenile and adult turtles in the area. The tidal creeks are clearly important to turtles in the area, particularly green turtles, so this will need to be considered if any alterations are made to the creeks with pipelines and brine discharge.

Small numbers of recent flatback turtles tracks were recorded on the beach west of the creek and numerous old turtle body pits were also sighted here. Recent flatback tracks were also recorded on the beaches to the north east of the tenement area. The single hawksbill track recorded is consistent with findings from Cape Preston to the north east, which also supports flatback and hawksbill nesting (K Pendoley pers obs). Although small numbers of tracks were seen, they represent one of the very few confirmed mainland turtle rookeries for flatback and hawksbills, between Onslow and Dampier (Department of Environment and Conservation 2006; Kregor et al. 2005; Pendoley et al. 2016).

The coastal islands are also very important nesting habitat for green, flatback and hawksbill turtles (Kregor et al. 2005; Pendoley et al. 2003) so any development in this area that includes the use of artificial lighting means that impacts of light to marine turtles will need to be appropriately managed. Artificial light attracts hatchlings towards it and interferes with their finding the sea (Pendoley, 2005) and given the low elevation and low lying dune system noted at this site, any light inland of this area will likely be visible from the mainland beaches and surrounding islands.

While the engineering designs are still in early stages the project will require an inlet for water to fill the salt ponds and a discharge for bitterns. Given the high use of the creeks, inlets and nearshore shallow waters by juvenile green turtles and adult internesting flatback turtles (Whittock et al 2016) we recommend that any water inlets be screened to prevent ingress by hatchling, juvenile and adult turtles and that the bitterns discharge line be located offshore into a minimum of 5-10m water depth in a free flowing channel (as opposed to an enclosed slow moving creek).

Metocean data is currently being collected and the recommendations regarding the impact on in-water turtles and the rookery beaches from the water intake and bitterns discharge pipelines can be better assessed once this information is available

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ATTACHMENT 1: Pendoley marine turtle survey results (13th January 2018)

Date	Time (hours)	Latitude	Longitude	All Data	Track Species	Activity	Zone	Marked for nest success?	Evidence of Predation?	Comment
13/01/2018	8:20:53 AM	-21.08676287	115.9099184	Comment						Low profile, dune roughly 100m behind beach, spinifex, beach debris (sponges), mangrove at Eastern end, rocky intertidal area
13/01/2018	8:23:28 AM	-21.08563056	115.910605	Comment						Fox tracks
13/01/2018	8:25:01 AM	-21.08540861	115.9110944	Adult Turtle Track	Flatback	Abandoned Egg Chamber	Dune crest			
13/01/2018	8:26:35 AM	-21.08499155	115.911345	Adult Turtle Track	Flatback	Abandoned Egg Chamber	Dune face			
13/01/2018	8:28:18 AM	-21.08488016	115.911487	Adult Turtle Track	Unknown		Dune crest			
13/01/2018	8:37:31 AM	-21.08234337	115.9138979	Adult Turtle Track	Flatback	Nest	Dune face	No	No	
13/01/2018	8:38:31 AM	-21.08238749	115.9139371	Adult Turtle Track	Flatback	Nest	Dune face	No	No	
13/01/2018	8:39:40 AM	-21.08231166	115.9138626	Comment						Photo 101-0053
13/01/2018	8:40:47 AM	-21.08221601	115.913874	Comment						Photo 101-0054
13/01/2018	8:41:06 AM	-21.08225201	115.9139298	Adult Turtle Track	Flatback	Nest	Dune face	No	No	
13/01/2018	8:43:36 AM	-21.08188316	115.9142401	Adult Turtle Track	Flatback	Abandoned Egg Chamber	Base of dune			
13/01/2018	8:44:09 AM	-21.081853	115.9142196	Comment						Photo 101-0056
13/01/2018	8:56:10 AM	-21.07770608	115.9191488	Adult Turtle Track	Flatback	Abandoned Egg Chamber	Base of dune			
13/01/2018	9:30:57 AM	-21.06384942	115.9541681	Adult Turtle Track	Flatback	False Crawl	HT to vegetation line			

13/01/2018	9:34:32 AM	-21.06305339	115.9552196	Adult Turtle Track	Flatback	False Crawl	Vegetation line to dune			
13/01/2018	9:35:10 AM	-21.06299778	115.9551886	Comment						Photo 101-0058
13/01/2018	9:37:41 AM	-21.0629119	115.9552686	Comment						Low profile, dune height 1-2m, spinifex, wide Beach roughly 50m, no rocks offshore, some rocky bays and headlands, photo 101-0059
13/01/2018	9:39:08 AM	-21.06280938	115.955601	Adult Turtle Track	Flatback	Nest	Base of dune	No	No	
13/01/2018	9:40:59 AM	-21.06254168	115.9559449	Crater (no track)	Unknown					
13/01/2018	9:41:26 AM	-21.06251538	115.9559836	Adult Turtle Track	Flatback	Abandoned Egg Chamber	Vegetation line to dune			
13/01/2018	9:42:22 AM	-21.06236509	115.9562788	Adult Turtle Track	Flatback	Nest	HT to vegetation line	No	No	
13/01/2018	9:43:25 AM	-21.06231104	115.956401	Crater (no track)	Unknown					
13/01/2018	9:44:08 AM	-21.06226681	115.9564488	Adult Turtle Track	Flatback	Nest	Vegetation line to dune	No	No	
13/01/2018	9:45:44 AM	-21.0619059	115.9571082	Adult Turtle Track	Flatback	Abandoned Egg Chamber	Base of dune			
13/01/2018	9:47:03 AM	-21.06180851	115.9570403	Comment						Higher dune, 2-3m, closer to back of beach, photo 61
13/01/2018	9:49:04 AM	-21.06162708	115.9575379	Adult Turtle Track	Hawksbill	Abandoned Egg Chamber	Vegetation line to dune			
13/01/2018	9:50:07 AM	-21.06156626	115.9576683	Adult Turtle Track	Flatback	Abandoned Egg Chamber	Base of dune			
13/01/2018	9:58:02 AM	-21.05920015	115.9604653	Adult Turtle Track	Flatback	Nest	Vegetation line to dune	No	No	
13/01/2018	10:10:22 AM	-21.05494377	115.9648412	Comment						Low dunes, maybe 1m in height further back off the beach, low profile beach, 50m wide, sloping offshore, overcast, light breeze, photo 66 and 67