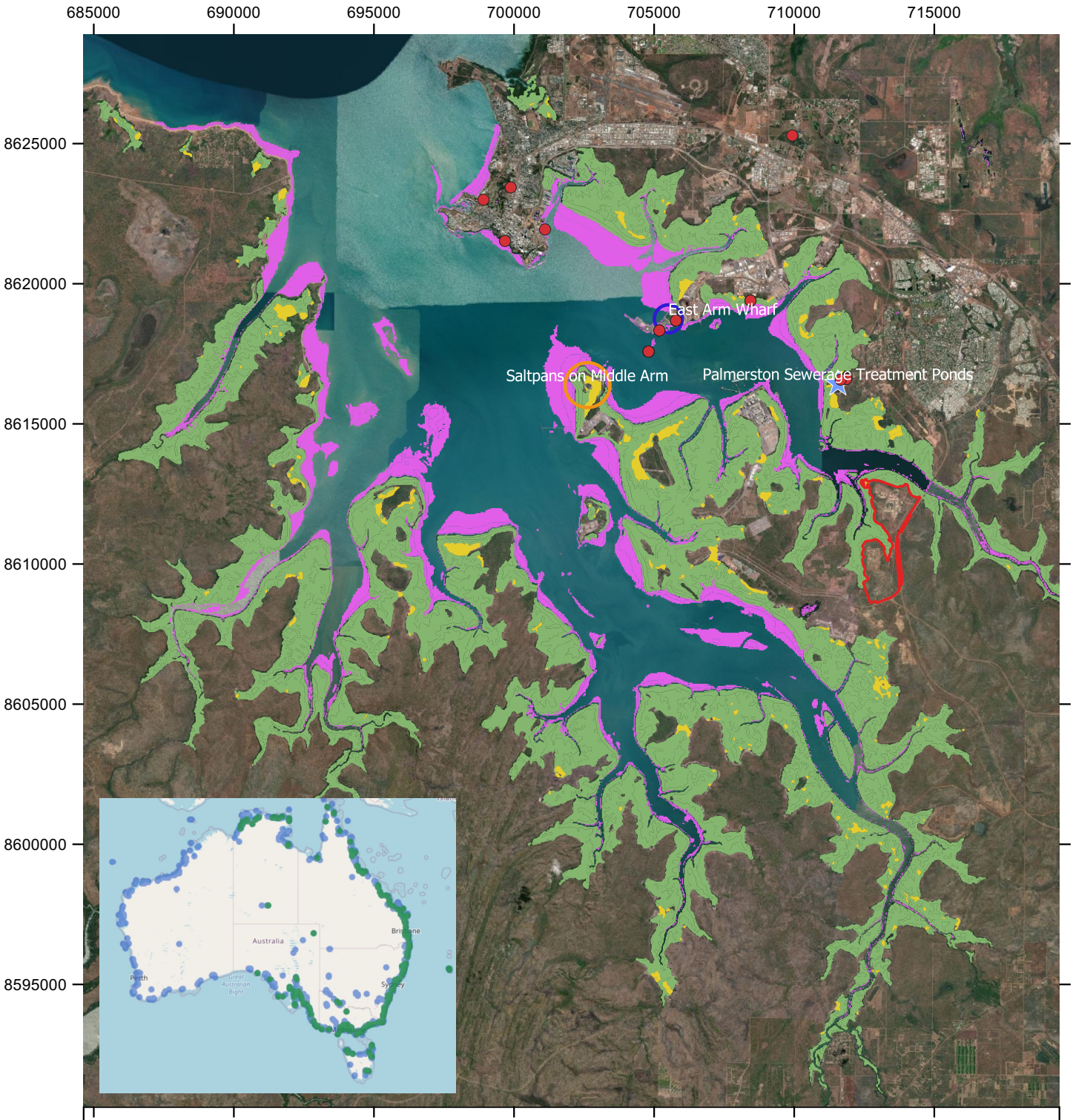

Figure 3-10. Distribution of Red Knot records in Darwin Harbour Proper and (inset) in Australia

Legend

Shorebird habitats
- Mangrove
- Saltpan
- Intertidal layer

DENR Database records
- Red Knot
- Lot 1817 boundary

Inset (Source: Atlas of Living Australia)
- All records
- Records 2010-2020

0 2.5 5 km

eleanor@animalplantmineral.com.au
date: 21/07/2020
CRS: GDA94 MGA Zone 52
basemap: ESRI

Calidris canutus regularly feed in flocks mixed with *C. tenuirostris, Limosa lapponica,* and *Tringa brevipes*, as well as with *C. ferruginea* and *C. ruficollis* (DAWE 2020).

3.2.1.6 Threatening Processes

Like other migratory shorebirds, *C. canutus* exhibits high site fidelity and a tendency to aggregate, has high energy demands, and requires connected roosting and foraging habitat, making it susceptible to development. In Australia, the key threats facing this species include habitat los and degradation, human disturbance (including from fishing, boating, four wheel driving, noise, and artificial lighting), diseases (e.g. avian influenza), and direct mortality (e.g. from wind farms or hunting). Threats tend to be synergistic in nature. Notably, roosting and foraging birds are susceptible to disturbances, such as light and noise, and will discontinue using habitat if these disturbances are prolonged (DAWE 2020).

Internationally, the species is listed as Near Threatened by the IUCN. The key threat facing this species is loss of stopover habitat in the Yellow Sea, where up to 65 % of intertidal habitat has been lost in the past 50 years. Most of this habitat loss is due to urban, industrial, and agricultural expansion in the region (BirdLife International, 2018a). Other recognised threats include:

- Residential and commercial development
- Human intrusions and disturbance (such as tourism, foot traffic on beaches, recreational activities, and overflying aircraft)
- Agriculture and aquaculture
- Biological resource use (e.g. hunting)
- Invasive and other problematic species, genes, and diseases
- Pollution; and
- Climate change and severe weather (BirdLife International, 2018a).

3.2.2 *Calidris ferruginea* – Curlew Sandpiper

3.2.2.1 Description

Calidris ferruginea is a small, slender shorebird, reaching 23 cm in length, a wingspan up to 41 cm, and weight of 57 grams (**g**). It has a long, black bill, with a down-curved end. The breeding plumage includes chestnut-red colouration from the head, down the neck, and along the underbody to rear body. The back and upper rump are dark brown/mottled chestnut. Black markings appear on the belly and flanks, crown, and mantle and scapulars. The non-breeding plumage is a non-descript mottled grey upper body and paler underbody. Both sexes are similar in appearance, although females tend to have slightly larger and longer bills and are slightly paler on the underbody in breeding plumage.

3.2.2.2 Distribution and Habitat

This species largely breeds in Artic regions of northern Siberia. During the non-breeding period, populations are present in parts of Africa, Asia, and Australia. Approximately 13 % (90,000 birds) of the global population uses the EAAF. It is estimated that 44,000 birds are in Australia, where the species is widespread around the coasts, and in smaller numbers inland. The population that visits the NT is estimated to be 17,800 birds (Chatto 2003).

This species is considered likely to be an occasional visitor to the suitable habitat in the Elizabeth River adjacent to the Project. The NT Fauna Atlas includes 85 records within the Darwin Harbour, shown in **Figure 3-11**, with the closest record being in the Elizabeth River within 1 km of Lot 1817. The species is frequently recorded at the Palmerston Sewage Treatment Ponds, 4 km north of Lot 1817. The species was not recorded in the Project area during avifauna surveys by GHD and APM in 2016, 2018 and 2019. The species is known to occur in low numbers at the East Arm Wharf (Lilleyman *et al.,* 2020).

Calidris ferruginea predominantly inhabits intertidal mudflats in sheltered coastal areas, including estuaries, bays, inlets, and lagoons, as well as non-tidal swamps and lakes near the coast, and saltworks and sewage farms.

It is less frequently recorded inland, around ephemeral and permanent water bodies, usually with bare edges of mud or sand. It utilises both fresh and brackish waters. It forages on intertidal mudflats and the edges of nearby shallow water. At hight tide, it may forage among low sparse emergent vegetation. This species roosts in open areas with damp substrate, particularly on beaches, or sandspits and islets near coastal lagoons and other wetlands. It has also been recorded roosting in dunes during very high tides, in saltmarsh, and in mangroves (DoE, 2015a).

3.2.2.3 Suitable Habitat in Relation to the Project Area

The intertidal mudflats and sandflats in the Elizabeth River adjacent to Lot 1817 are suitable foraging habitat for *C. ferruginea*. The saltpan area within Lot 1817 and the mangroves adjacent are likely to be suitable roosting habitat for this species. It does not breed in Australia so there is no suitable breeding habitat. Aggregations (*i.e*. occurrences of ≥ 0.1 % of the total global population) are not known to occur in the Darwin Harbour.

Habitat in the intertidal mudflats and sandflats in Darwin Harbour Proper are considered to be in pristine condition. The saltpan area within Lot 1817 is intact, and the mangroves adjacent to Lot 1817 are also in Excellent condition, however it is unknown how the condition or suitability of these habitats has been previously impacted by the historic use of Lot 1817 for extractive industries and the unregulated access of humans, dogs, motorbikes and invasive fauna such as cats and pigs. The site hydrology has been altered by the former extractive industry where the upper lateritic aquifer material has been removed and soil bunding has been left in many places which is likely to have altered the natural surface and subsurface hydrological processes on the site.

3.2.2.4 Life History and Migration Patterns

The species can breed by two years of age and live more than 19 years. Individuals do not begin return migrations northwards until 2 years old. Breeding occurs in Siberia over June and July, during which time a clutch of four eggs is laid. It is gregarious and is often recorded in mixed-species flocks (TSSC, 2016a).

Calidris ferruginea migrates south of 35 °N for the non-breeding season, to many different areas. Migration from breeding grounds begins in early July, with males departing one month earlier than females, and juveniles a few weeks later than females. Southern migration is thought to occur overland. Those migrating to Australia for the non-breeding season tend to reach the coast by late August or early September. Northern migration begins in March. The return pathway is different to the southern route, typically being further east, with birds first arriving in Russia during late May and early June. Juveniles are known to remain in Australia during the breeding season (DoE, 2015a).

3.2.2.1 Diet and Feeding Behaviour

Within Australia, *C. ferruginea* preys on invertebrates, such as worms, molluscs, crustaceans, and insects, and forages seeds (DoE, 2015a). Foraging is influenced by the tide, with individuals following the receding tide to feed on the water's edge, as well as in areas that have been exposed for longer periods. Individuals will occasionally feed near the roost at high tide. Individuals tend to wade in water 15-30 millimetres (**mm**) deep, but will wade as deep as 60 mm. While foraging, individuals will peck or probe (inserting the slightly open bill to its full length) into wet mud and shallow water, often with their head submerged, or jab (inserting less than half the length of the bill into the substrate) at the edge of water. This species will forage in mixed flocks, with other species including the *C. ruficollis* (DoE, 2015a).

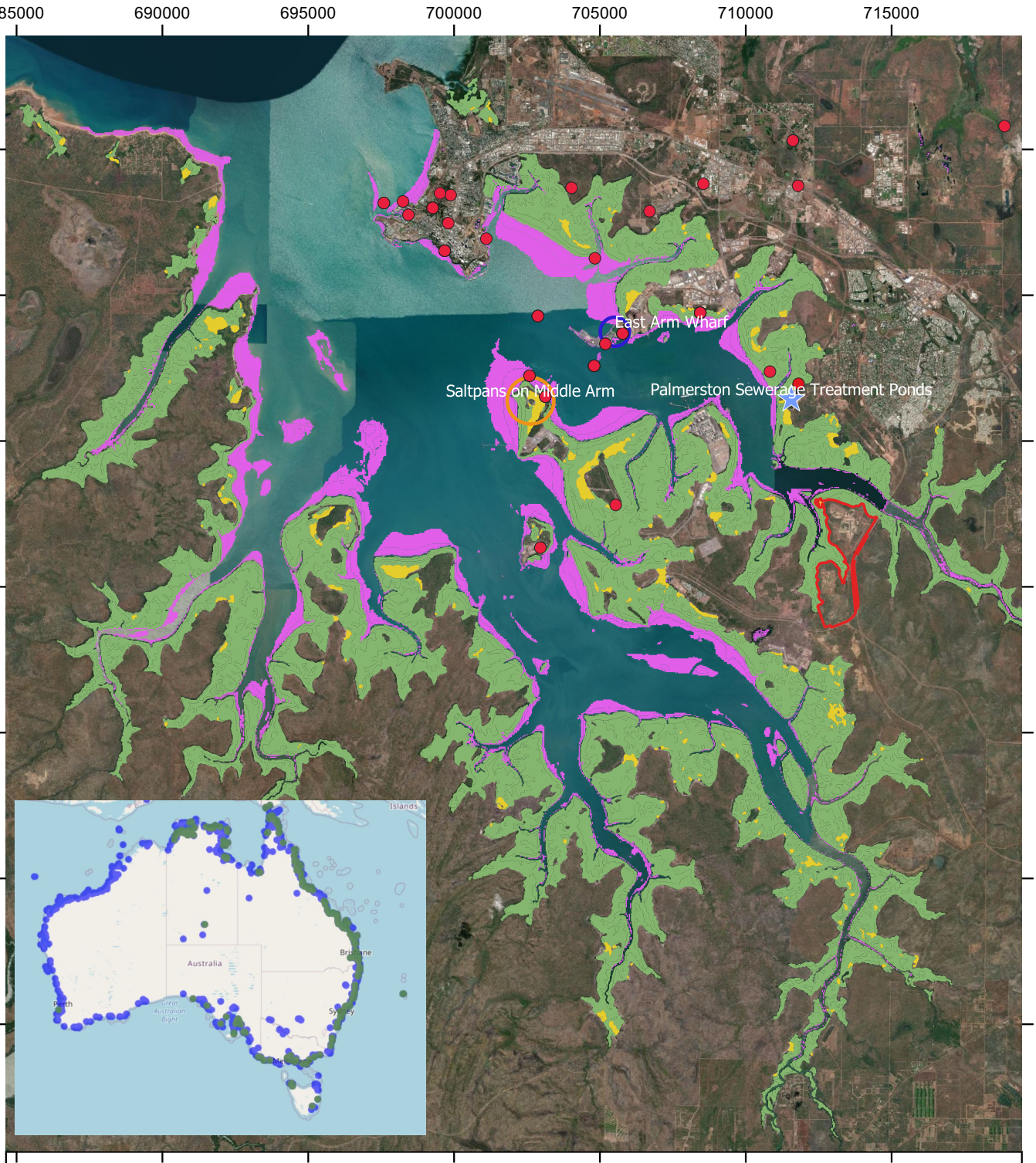

Figure 3-11. Distribution of Curlew Sandpiper records in Darwin Harbour Proper and (inset) in Australia.

Legend

Shorebird habitats

- Mangrove
- Samphire/Salt Flat
- Intertidal sandflats/mudflats

Inset (Source: Atlas of Living Australia)

- All records
- Records 2010-2020

DENR Database records

- Great Knot

Lot 1817 boundary

0 2.5 5 km

eleanor@animalplantmineral.com.au
date: 21/07/2020
CRS: GDA94 MGA Zone 52
basemap: ESRI

3.2.2.2 Threatening Processes

Within Australia, this species is threatened by ongoing human disturbance, habitat loss and degradation, pollution, changes to water regimes, and invasive plants. Population declines were noted at 49 sites in Australia, between 1983 and 2007, with an average decline in population size of 82%. It has been hypothesised that the declines were a consequence of increased adult mortality rates (DoE, 2015a).

Internationally, the species is listed as Near Threatened by the IUCN. As with *C. canutus*, the key threat facing the species is loss of stopover habitat in the Yellow Sea due to development in the region, in particular loss of habitat from the key staging site at Bohai Bay (BirdLife International, 2017a; DoE, 2015a). Other recognised threats include:

- Residential and commercial development
- Transportation and service corridors
- Human intrusions and disturbance (especially from recreational activities)
- Invasive and other problematic species, genes, and diseases (e.g. avian flu and avian botulism)
- Agriculture and aquaculture
- Biological resource use (e.g. hunting)
- Natural system modifications (e.g. dams and water management/use)
- Climate change and severe weather (BirdLife International, 2017a).

3.2.3 *Calidris tenuirostris* – Great Knot

3.2.3.1 Description

Calidris tenuirostris is the largest species in the genus *Calidris*. It is a medium-sized charadriiform bird, reaching lengths up to 28 cm and a wingspan up to 58 cm. It has a straight, slender bill that curves downward slightly. Females are slightly larger than males. The breeding, non-breeding, and juvenile plumages are distinct. Non-breeding plumage is mottled grey on the upper body and white on the underbody, with heavy patterning on the neck and breast. Breeding plumage includes a black band across the chest, and black, white, and red patterning on the upper body. Juvenile plumage is darker and browner than the non-breeding plumage of adults (TSSC, 2016b).

3.2.3.2 Distribution and Habitat

This species breeds in northeast Siberia and far northeast Russia. It migrates south each boreal winter following the EAAF and returns north along the same migration pathway. There are an estimated 425,000 birds in the EAAF population. Much of the population (expected ~90 %; estimated 343,000 birds) spends the non-breeding period in Australia. The species has been recorded around the Australian coast, although most records are from the northern coast, particularly northern WA and the NT. A population of 122,000 birds are estimated in the NT, with records largely from Darwin and Melville Island, through Arnhem Land to southeast Gulf of Carpentaria (TSSC, 2016b), and sites of significance including Roper River area, Fog Bay and adjacent islands, Boucat Bay, and Castlereagh Bay (DAWE 2020).

Calidris tenuirostris inhabits coastal areas with large intertidal mudflats or sandflats. It is occasionally recorded on exposed reefs or rock platforms, shores near mangroves, swamps near the coast, salt lakes, and non-tidal lagoons. It is often recorded in mixed congregations with other small shorebirds. The species roosts in open areas, typically near the edge of the water close to feeding grounds. Roosting sites house large groups (TSSC, 2016b). In hot conditions, the species will seek roost sites with damp substrates that lower the local temperature (DAWE 2020).

This species is considered likely to occur in the Elizabeth River adjacent to the Project. The NT Fauna Atlas includes 75 records within the Darwin Harbour, shown in **Figure 3-12**, the closest record being at the Palmerston Sewage Treatment Ponds, four km north of Lot 1817. The species was not recorded in the Study Area during avifauna surveys by GHD and APM in 2016, 2018 and 2019. The species is a frequent user of the East Arm Wharf

where a maximum of 124 birds have been counted in one year over the 2013-2018 period, with the highest monthly counts occurring in February and September (Lilleyman & Garnett, 2019). Aggregations (*i.e*. occurrences of ≥ 0.1 % of the total global population) are not known to occur in the Darwin Harbour Proper, but consistently occur in the Greater Darwin area, specifically at Lee Point (Lilleyman *et al.* 2020a).

3.2.3.3 Suitable Habitat in Relation to the Project Area

The intertidal mudflats and sandflats in the Elizabeth River adjacent to Lot 1817 provide suitable foraging habitat for *C. tenuirostris*. The saltpan area within Lot 1817 and the mangroves adjacent are likely to be suitable roosting habitat. This species does not breed in Australia so there is no suitable breeding habitat.

Habitat in the intertidal mudflats and sandflats in Darwin Harbour Proper are considered to be in pristine condition. The saltpan area within Lot 1817 is intact, and the mangroves adjacent to Lot 1817 are also in Excellent condition, however it is unknown how the condition or suitability of these habitats has been previously impacted by the historic use of Lot 1817 for extractive industries and the unregulated access of humans, dogs, motorbikes and invasive fauna such as cats and pigs. The site hydrology has been altered by the former extractive industry where the upper lateritic aquifer material has been removed and soil bunding has been left in many places which is likely to have altered the natural surface and subsurface hydrological processes on the site.

3.2.3.4 Life History and Migration Patterns

This species can breed before two years of age and live for nearly 20 years. Individuals display high fidelity to breeding sites and are monogamous. Eggs are laid in late May to late June, with three to four eggs per clutch and incubation taking approximately 21 days. Females depart the breeding grounds once eggs have hatched, leaving males to care for the chicks, until fledging occurs after 20-25 days. Fledglings are independent after a few days. It is gregarious, congregating with other small shorebird species, and is seen in large flocks of several hundred or thousand individuals (TSSC, 2016b).

Calidris tenuirostris departs breeding grounds from late June until early September. Departure occurs in stages, according to sex or life stage. Birds arrive in northwest Australia from late August to early September, although males and juveniles may not arrive until October or November. Most birds stay in northern Australia, although some may move as far south as New Zealand (where vagrants have been recorded). As for breeding areas, individuals show high fidelity for non-breeding sites. Birds begin the northward migration from March to April. Most fly directly from northern Australia to the Yellow Sea. Birds arrive back in breeding grounds around late May, with males returning before females (DAWE 2020; TSSC, 2016b).

3.2.3.5 Diet and Feeding Behaviour

Calidris tenuirostris preys on bivalves, gastropods, crustaceans, and other invertebrates. Prey are extracted by birds pecking at, or just below, the surface of moist mud or sand (TSSC, 2016b).

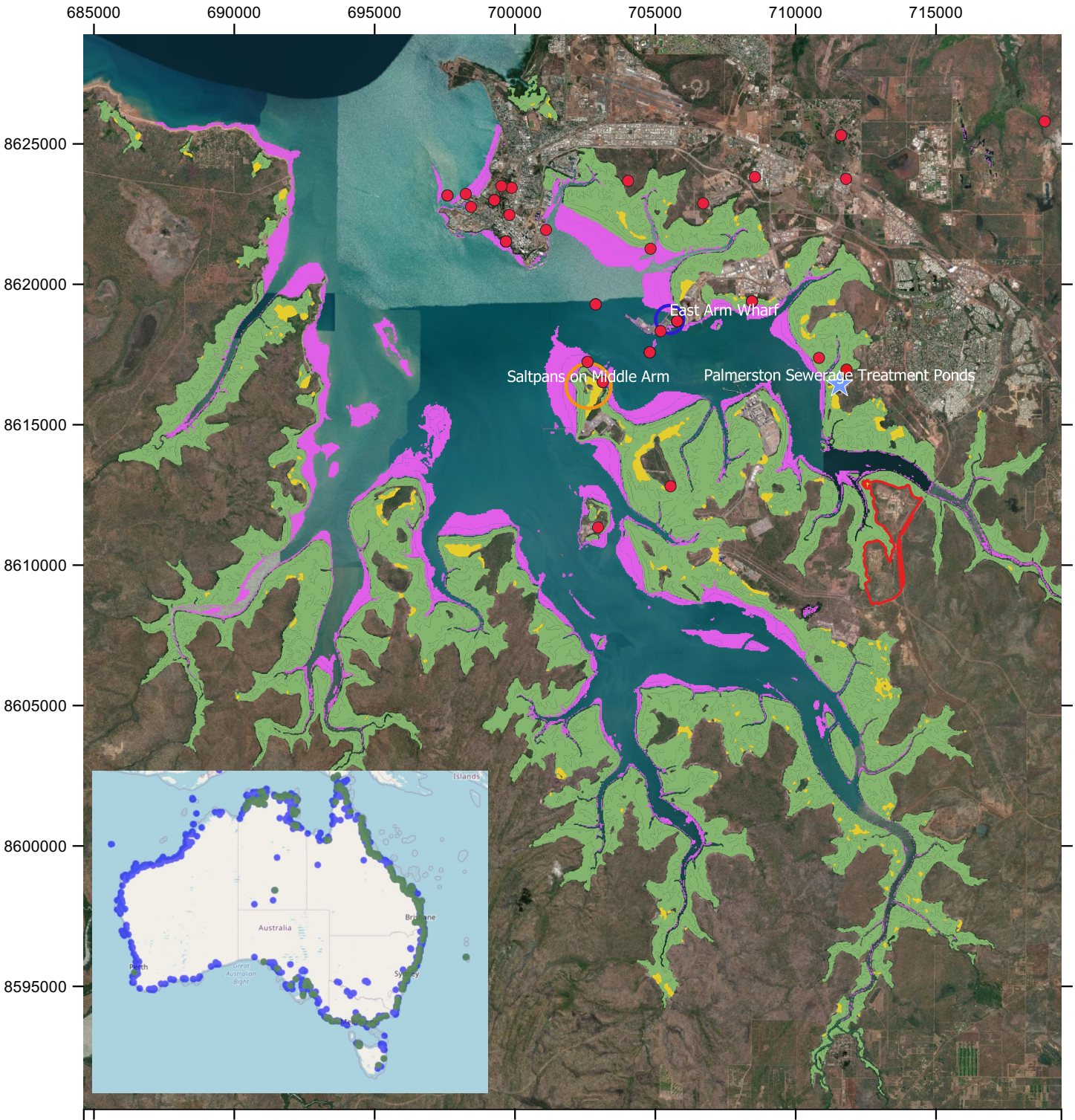

Figure 3-12. Distribution of Calidris tenuirostris (Great Knot) in Darwin Harbour and (inset) in Australia.

Legend

Shorebird habitats
- Mangrove
- Samphire/Salt Flat
- Intertidal sandflats/mudflats

Inset (Source: Atlas of Living Australia)
- All records
- Records 2010-2020

DENR Database records
- Great Knot

Lot 1817 boundary

0 2.5 5 km

eleanor@animalplantmineral.com.au
date: 21/07/2020
CRS: GDA94 MGA Zone 52
basemap: ESRI

3.2.3.6 Threatening Processes

As with other migratory shorebirds, *C. tenuirostris* is sensitive to development due to its high site fidelity (for both breeding and non-breeding sites), tendency to aggregate, high energy demands, and need for habitat connectivity between roosting and foraging sites. In Australia, major threats to *C. tenuirostris* include habitat loss and degradation in foraging habitat from development, pollution, changes to water regimes, and invasive plants, and disturbance from people or vehicles (TSSC, 2016b).

Internationally, the species is listed as EN by the IUCN. As with other calidrid species, the key threat facing the species is loss of stopover habitat in the Yellow Sea, an area that supports over 80 % of the population. Other recognised threats include:

- Residential and commercial development
- Energy production and mining
- Natural system modifications (e.g. dams and water management/use)
- Pollution (e.g. industrial and military effluents)
- Agriculture and aquaculture (e.g. from annual and perennial non-timber crops, and marine and freshwater aquaculture)
- Biological resource use (e.g. hunting)
- Invasive and other problematic species, genes, and diseases; and
- Climate change and severe weather (BirdLife International, 2016a).

3.2.4 *Charadrius mongolus* – Lesser Sand Plover

3.2.4.1 Description

Charadrius mongolus is a small shorebird, reaching lengths of up to 21 cm and a weight of 71 g. Its bill is short and black. The non-breeding plumage is grey-brown, with white underparts. Male breeding plumage is red on the breast, through to the forehead and back of neck. Female breeding plumage is similar, but with dark grey-brown or rufous colouration replacing the red of the males. Juvenile plumage is similar to non-breeding adults, but with buff fringes on the feathers (TSSC, 2016d).

3.2.4.2 Distribution and Habitat

The species breeds in the northern hemisphere and migrates south, with 180,000-220,000 birds using the EAAF. Hansen *et al.* (2016) estimated 27,500 birds overwintering in Australia. Within Australia, it is widespread in coastal regions, but mainly occurs in northern and eastern Australia. It has been recorded from most of the coastline of the NT, with Chatto (2003) estimating 39,000 birds using the coast from Anson Bay to Murgenella Creek, northern Arnhem coast, Blue Mud Bay, and the Port McArthur area (TSSC, 2016d). Although the Chatto (2003) data is cited in Hansen (2016) as the source of abundance data for the NT, there is a significant discrepancy in the estimated NT and Australian population sizes. This may be due to the difference in time period between the 2003 NT bird counts and the 2016 estimate of global habitat availability. The Greater Darwin area is a nationally significant aggregation, where maximum counts have recorded 1,440 birds (DAWE 2020).

In non-breeding grounds, *C. mongolus* inhabits coastal areas, especially sandy beaches, mudflats of coastal bays and estuaries, sandflats, and dunes near the coast. It also occasionally utilises mangrove mudflats. It forages on the exposed water edges of intertidal sand- and mudflats, and occasionally on coral reefs, or sandy or muddy river margins. It roosts on beaches, banks, and spits near foraging areas (TSSC, 2016d).

This species is considered likely to occur in the Elizabeth River adjacent to Lot 1817. The NT Fauna Atlas includes 88 records within the Darwin Harbour, shown in **Figure 3-13**, the closest record being at the Elizabeth River adjacent to Lot 1817. The species was not recorded in the Project area in the 2018 and 2019 field surveys. The species is a frequent user of the East Arm Wharf, where a maximum of 260 birds were counted in one year in 2013. Between 2014 and 2018, numbers declined below 50 per year (Lilleyman & Garnett, 2019). The decline in