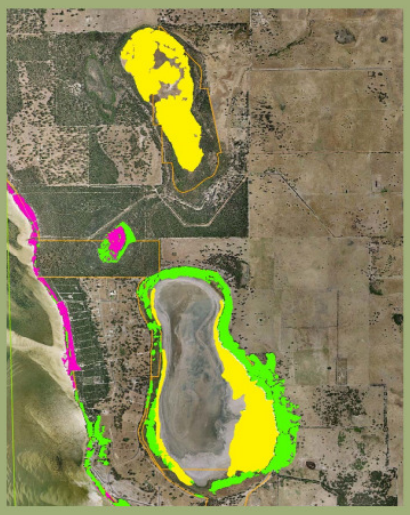

Peel-Yalgorup Ramsar Wetlands Monitoring: Littoral & Fringing Vegetation Mapping

March 2009

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1. Introduction

1.1 Objectives

The Peel-Yalgorup wetland system is designated as a wetland of international importance under the Ramsar Convention. Consistent with the obligations under this convention, an Ecological Character Description (ECD) and Management Plan (MP) have recently been completed for the site.

One of the key recommendations of the ECD and actions in the MP is monitoring of critical components and processes to inform and assess against Limits of Acceptable Change (LAC). A monitoring and evaluation guide forms a part of the MP and details recommended methods and priorities for monitoring at the Ramsar site. Assessing the extent and composition of littoral and fringing vegetation was identified as a priority.

The Peel-Harvey Catchment Council has commissioned the mapping of fringing and littoral vegetation within the Peel-Yalgorup Ramsar site and Lakes Goegrup and Black.

The objectives of the littoral and fringing vegetation monitoring program (as defined by the MP) are:

- To determine the extent and composition of littoral vegetation and paperbark communities at Lakes McLarty and Mealup to set a baseline against which change can be assessed;
- To determine the extent and composition of samphire and paperbark communities fringing the Peel Harvey Estuary to set a baseline against which change can be assessed; and
- To monitor the extent and composition of samphire and paperbark communities at Lakes Goegrup and Black to assess against LAC.

In addition, comparisons have been made with saltmarsh mapping undertaken in the 1990s (Glasson et al. 1995) to report on changes in saltmarsh extent.

1.2 Study area

The Peel-Yalgorup Ramsar site comprises the Peel-Harvey Estuary, The Yalgorup Lakes and Lakes McLarty and Mealup in southwest Western Australia. In addition to the officially designated Ramsar site, the ECD, MP and this littoral vegetation mapping includes lakes Goegrup and Black, which are planned as extensions to the site in the near future (Hale and Butcher 2008).

Littoral or fringing vegetation was identified in the ECD as a critical component of the Peel-Yalgorup Ramsar site (Hale and Butcher 2007). A summary of the dominant littoral vegetation components at each of the areas in the study area is provided in Table 1. For a full description, refer to the ECD (Hale and Butcher 2007).

Table 1: Summary description of littoral and fringing vegetation in the study area (adapted from Hale and Butcher 2007).

Location	Critical component	Description
Peel-Harvey Estuary	Saltmarsh	Fringing the Peel Inlet and parts of the Harvey Estuary within the intertidal zone. Dominated by Samphire (*Sarcocornia quinqueflora*) with *Juncus kraussii* at higher elevations.
	Paperbark	On the landward edge of saltmarsh, Saltwater Paperbark *(Melaleuca cuticularis*) and other salt tolerant trees form a narrow band. Along the inflowing Harvey River, within the Ramsar site, freshwater riparian vegetation occurs, dominated by Swamp Paperbark (*Melaleuca rhaphiophylla*).
Yalgorup Lakes	Saltmarsh	Small areas around some of the lakes (data deficient).

Location	Critical component	Description
	Paperbark	Paperbark Swamp dominated by *Melaleuca cuticularis* and *Melaleuca rhaphiophylla,* occurs around the edges of the lakes in a narrow band.
Lakes McLarty and Mealup	Freshwater emergent vegetation	*Typha* spp. and freshwater sedges were once dominant across large areas of Lake McLarty and Mealup
	Saltmarsh	Saltmarsh communities dominated by *Juncus kraussi* have replaced freshwater littoral vegetation at Lake Mealup.
	Paperbark	On the landward extent of the margins of the lakes, where inundation is less frequent, stands of *Mealueca raphiophylla* and *M. preissiana* occur.
Lakes Goegrup and Black	Saltmarsh	Samphire (*Sarcocornia quinqueflora*) at lowest elevations around lakes.
	Paperbark	Two communities – Saltwater Paperpark behind saltmarsh and freshwater paperbark at higher elevations.

1.3 Limits of Acceptable Change

The act of designating a wetland as a Ramsar site carries with it certain obligations, including managing the site to retain its 'ecological character' and to have procedures in place to detect if any threatening processes are likely to, or have altered the 'ecological character'. Central to this is the development of an ECD, which provides a detailed description of the site and sets Limits of Acceptable Change (LAC). LACs are defined as the variation within specific ecosystem components and processes that are considered acceptable for maintaining the ecological character of the site (Phillips 2006). Simply stated they are "the lines in the sand" with respect to specific components and processes (e.g. water quality, waterbird communities) within which the system must be managed.

The ECD for the Peel-Yalgorup Ramsar site (Hale and Butcher 2007) contains a number of LACs that are relevant to the littoral and fringing vegetation (Table 2). The current mapping serves to form a baseline for many of these.

Table 2: LACs relevant to the fringing and littoral vegetation in the study area (Peel-Harvey Catchment Council in prep)

Location / Component	Baseline / Supporting Evidence	Limit of Acceptable Change
Peel-Yalgorup / Samphire and Paperbark	Current extent and health of samphire and paperbark communities unknown	Baseline must be set before limits can be made.
Lakes McLarty and Mealup / Littoral vegetation	Dominated by freshwater reeds, but encroachment of *Typha* sited as a problem at both wetlands. Sedges are an important habitat component for some waterbirds	*Typha* limited to < 20 % of the wetland area Freshwater sedges covering a minimum of 20% of the wetland area
Lakes McLarty and Mealup / Paperbark	Fringing freshwater paperbark community which is an important habitat for waterbirds No quantitative information	No decline in paperbark health No net loss of extent of paperbark community.
Lakes Goegrup and Black / Samphire	Approximately 83 hectares when mapped in 2006. However, there is no information on the natural variability in this community	Extent and distribution of samphire within patterns of natural variation.
Lakes Goegrup and Black / Paperbark	Fringing areas of both freshwater (47 ha) and saltwater paperbark (145 ha) communities. These perennial woody vegetation complexes would have low natural variability in extent	No change in the condition of paperbark communities. No loss of extent of paperbark communities.

2. Methodology

2.1 Historical mapping

Glasson et al. (1995) determined the extent of saltmarsh vegetation around the Peel-Harvey Estuary (including Goegrup and Black Lakes) from aerial photography for five points in time: 1957, 1965, 1977, 1986 and 1994. The 1994 data was only available as raster images at a 5m pixel resolution and not in a format that was immediately compatible with modern software and current imagery. However the following conversions have been made:

- Data was exported from ERDAS Imagine 7.5 to the ENVI 4.5 format;
- Data was reprojected from UM50S WGS84 to MGA94 Zone 50, GDA 1994; and
- Layer was clipped to the Peel-Yalgorup Ramsar site boundary.

The historical 1994 mapped data is now in a format where it can be read by modern software packages (e.g. ArcMap; ENVI) and comparisons between current extent of saltmarsh and those in 1994 have been made (included with the data package associated with this report).

2.2 Mapping recent extent of littoral vegetation

The Peel-Harvey Catchment Council supplied ECW normal colour aerial photography mosaic for mapping of current vegetation extent within the Peel-Yalgorup Ramsar site. This aerial photography spanned a number of points in time from 2005 to 2007 (Figure 1). It was considered that these images, collected over a 2 – 3 year time span were sufficient to create a map of fringing vegetation against which future change can be measured (in 5 to 10 years time).

Manual identification and mapping of broad vegetation groups (saltmarsh, paperbark and freshwater reeds) has been undertaken for parts of the site. Mapping was done using ENVI 4.5 and the following Intelligent Digitiser tools (edge identification):

- Linear feature width 10 pixel;
- Snap tolerance 5 pixels; and
- High smoothing factor.

Mapping is at a scale of 1:5000 and identifies dominant vegetation cover. Features that are < 5m x 5m or comprise < 10% of any contiguous patch have not been mapped separately.

Vegetation types that were identified from field transects undertaken in October / November 2008 (DEC unpublished) were used to help in the identification of broad vegetation groups. In addition, 1994 mapping (Glasson et al. 1995) was used as a guide to the probable location of saltmarsh communities. Areas of trees and shrubland that could not be immediately confirmed as paperbark were flagged in the first instance for further investigation.

In February 2009, “ground truthing” was undertaken by visual assessment in a light aircraft flying at 500 ft above the study area. Note that comprehensive, field based, ground truthing was beyond the scope of this project. As a consequence mapping was limited to broad groups and species identification was not possible. The broad categories included in the mapping are:

- Saltmarsh (includes samphire communities dominated by *Sarcocornia, Halosarcia* and *Juncus kaussii*);
- Paperbark (includes both saltwater and freshwater paperbark communities); and
- Freshwater emergent sedges (includes Typha and other freshwater communities).

The Ramsar boundary was used as a guide for the extent of mapping. However, as the boundary often follows the shoreline of various waterbodies, a common sense approach was adopted. Littoral or fringing vegetation communities that were dissected by the Ramsar boundary were mapped in their entirety. However, an overlay of the Ramsar boundary was

also undertaken and as such extent of broad vegetation groups can be reported both as a whole and as the area that lies within the Ramsar site.

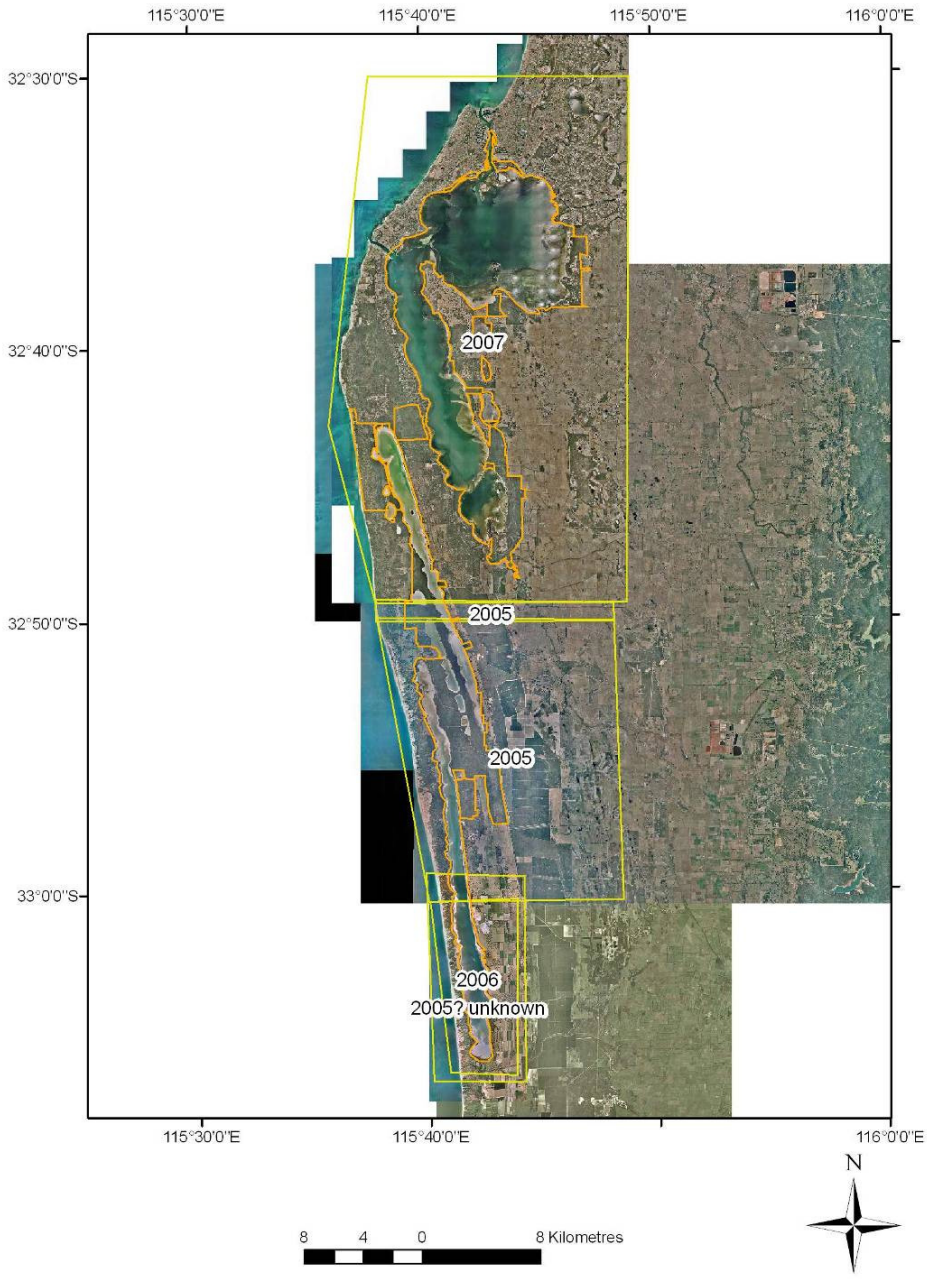

Figure 1: Extent of aerial photography used in current mapping of littoral and fringing vegetation.

The outputs of the current mapping (from 2005 - 2007 aerial photography) are provided as an ArcMap 9.2 geodatabase and shape files. In addition, summary maps and descriptions are contained here in this report. For clarity (and ease of comparison with previous saltmarsh mapping) the study area has been divided into a series of reporting regions (Figure 2). These are based on the wetland units used in the ECD (Hale and Butcher 2007) as well as the reporting areas used by Glasson et al. (1995) for saltmarsh. The reporting regions are:

- Peel-Harvey Estuary
    - Austin Bay
    - Creery wetlands
    - Harvey Delta
    - Roberts Bay
- Lakes McLarty and Mealup
- Yalgorup Lakes
- Lakes Goegrup and Black

Total extent of the broad vegetation groups is also provided for the entire area and within the Ramsar site.

Change in salt marsh extent (for the Peel-Harvey Estuary and Lakes Goegrup and Black) has been calculated by comparing 1994 extent from Glasson et al. (1995) with current mapping. However, as there is no historical mapping of paperbark communities in the Peel-Yalgorup Ramsar site and no quantitative mapping of vegetation from the Yalgorup Lakes or Lakes McLarty and Mealup, this current mapping represents the baseline data against which future changes can be measured.

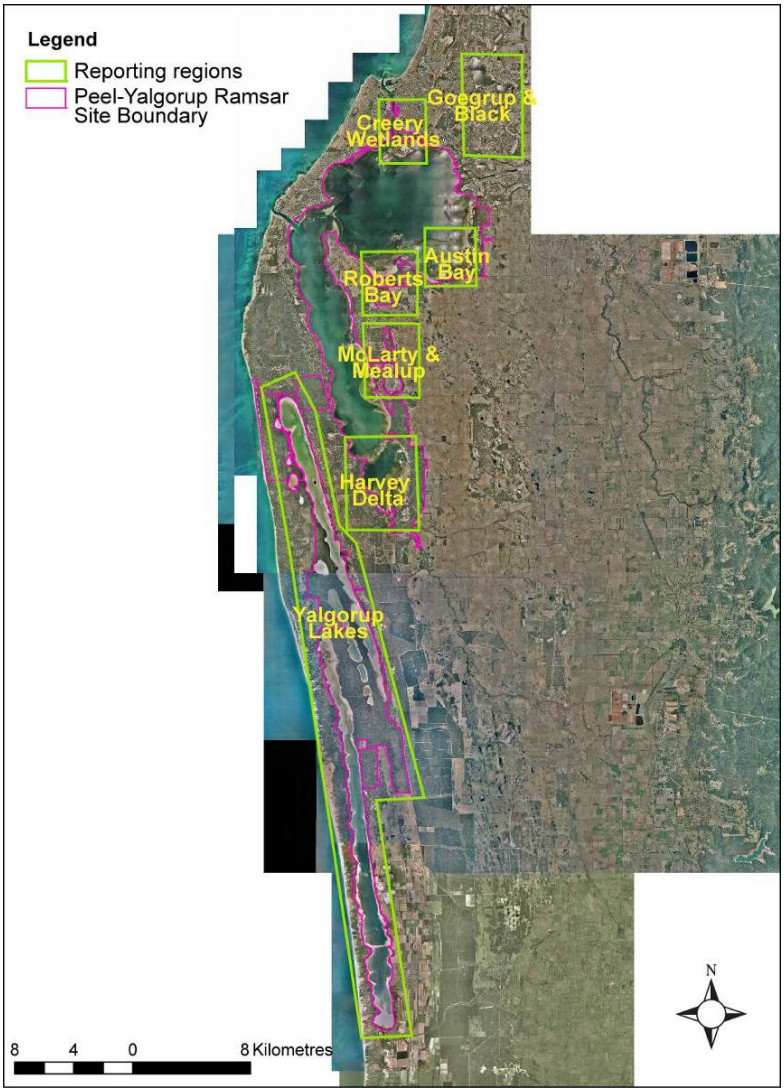

Figure 2: Reporting regions for littoral and fringing vegetation mapping in the study area.

3. Results and Discussion

3.1 General

The extent of littoral and fringing vegetation mapping is provided in Figure 3. In total 913 hectares of salt marsh were mapped of which 710 hectares was within the Ramsar site boundary. A total of 888 hectares of Paperbark were mapped, 652 hectares within the Ramsar site boundary. Areas outside the boundary were all of the littoral vegetation at Goegrup and Black Lakes as well as smaller areas along the shorelines of the Peel Inlet, Harvey Estuary and Yalgorup Lakes. Only 40 hectares of freshwater sedges rushes were identified all of which were at Lake McLarty.

More detailed descriptions of each of the vegetation groups are provided in the sections below. Limits of Acceptable Change (Table 2) are predominantly based on setting a current baseline (post opening of the Dawesville Channel) and as such cannot be assessed at this time. However, data presented here can act as a baseline against which future changes can be assessed.

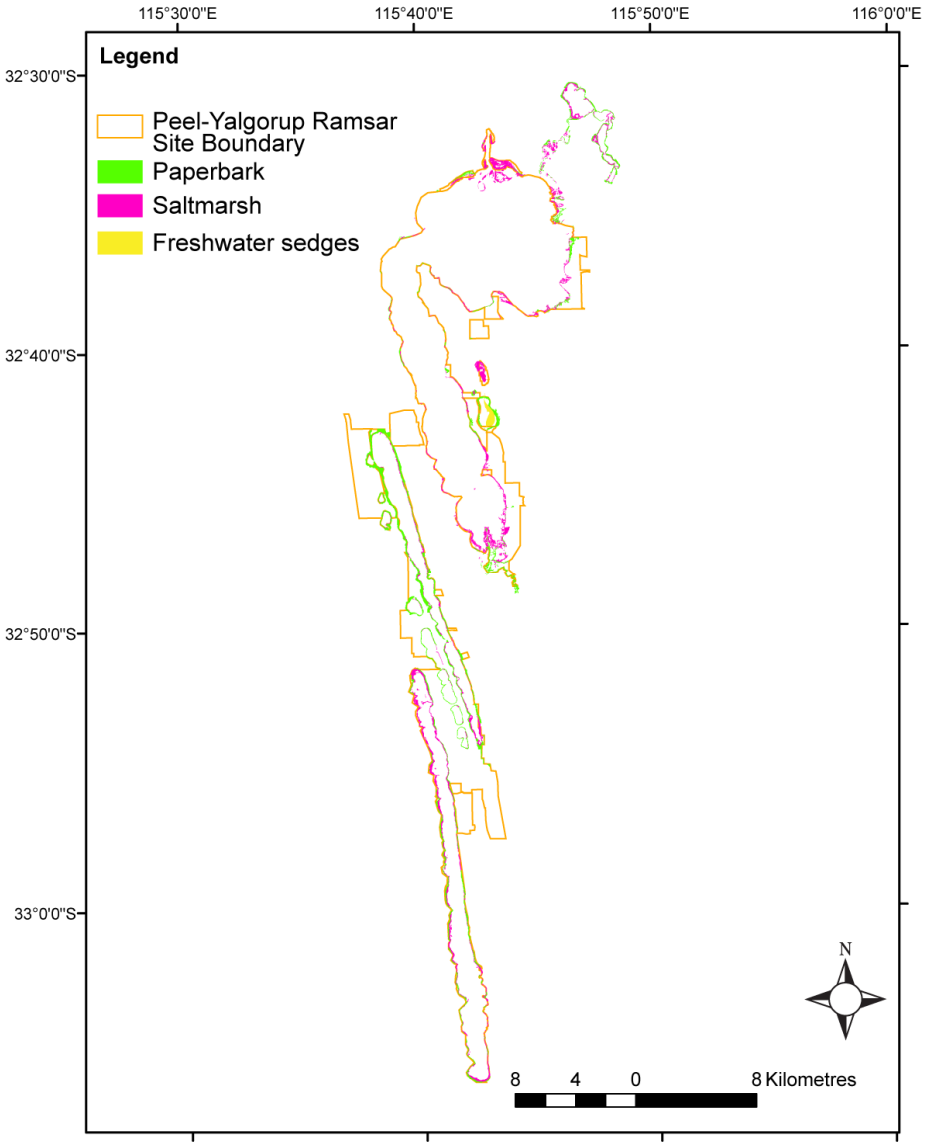

Figure 3: Littoral and fringing vegetation mapping extent across the study area (see Appendix A for maps of each of the reporting regions.

3.2 Saltmarsh

3.2.1 Current extent

Saltmarsh extent by reporting region is provided in Table 3 and maps in Appendix A for the area within the Ramsar boundary and the entire study area.

Table 3: Extent of saltmarsh (hectares) in each reporting region from current mapping.

Reporting region	Total area (hectares)	Area within Ramsar site boundary (hectares)
Austin Bay	26	25
Creery wetlands	109	97
Harvey Delta	119	111
Roberts Bay	21	6
Total Peel-Harvey*	383	287
Yalgorup Lakes	402	388
Lakes McLarty and Mealup	13	8
Lakes Goegrup and Black	73	0

*Includes areas outside the designated reporting regions used by Glasson et al. (1995).

3.2.2 Comparison with historical

Change in saltmarsh for each of the reporting regions mapped by Glasson et al. (1995) is provided in Table 4 and illustrated in Appendix B. There have been significant losses of saltmarsh from the shores of the Peel-Harvey Estuary over the past 15 years. The areas of greatest loss (in terms of absolute number of hectares are Creery Wetlands and the Harvey Delta. However, almost all of the saltmarsh from Roberts Bay was not detected in the 2007 mapping.

There was an increase in saltmarsh extent in the Goegrup and Black reporting region. This is due to saltmarsh identification around the shores of Black Lake in the current mapping. Whether this is the result of a change in vegetation community or simply that saltmarsh was present, but not mapped in 1994 is not known.

Table 4: Comparison of saltmarsh extent 1994 (Glasson et al. 1995) to 2007 (current mapping).

Location	1994 Saltmarsh Extent (ha)	2007 Saltmarsh Extent (ha)	Change in saltmarsh extent (%)
Austin Bay	36	26	-28%
Creery wetlands	142	109	-23%
Harvey Delta	152	119	-22%
Roberts Bay	81	21	-74%
Lakes McLarty and Mealup	13	13	0%
Lakes Goegrup and Black	44	73	+165%
TOTAL	468	402	-14%

3.3 Paperbark

The current mapping represents the baseline for paperbark extent in the Peel Yalgorup Ramsar site. Extent of paperbark both within the Ramsar site and the entire study area is provided in Table 5 and Appendix A.

Paperbark generally exists on the landward margin of saltmarsh, with the exception of the Yalgorup Lakes where the littoral zone was often bare sand, with a narrow band of paperbark directly behind (Figure 4). The current mapping was not able to distinguish freshwater from saltwater species as the canopy colour and form appeared similar both on the aerial photos and during the “ground truthing” conducted at 500 feet. It is expected however, that with the exception of the areas along the freshwater rivers, the majority of the paperbark mapped is saltwater communities. The areas of greats extent and density were around the northern edges of the Yalgorup Lakes (mostly around Lake Clifton) and the margins of Lake McLarty.

Areas of dead trees were observed during the "ground truthing" along the western shoreline of the Harvey estuary. However, in the aerial photography from 2007, this phenomenon was less clear and areas appeared blackened and indistinct. There were areas with individual dead trees along the shores of much of the Peel-Harvey Estuary. However, these were not evident at the scale of mapping and are not detailed in the database. A more field based assessment is required to assess tree health and the number of location of individual dead trees.

Table 5: Extent of paperbark (hectares) in each reporting region from current mapping.

Reporting region	Total area (hectares)	Area within Ramsar site boundary (hectares)
Austin Bay	26	25
Creery wetlands	109	97
Harvey Delta	119	111
Roberts Bay	21	6
Total Peel-Harvey*	383	287
Yalgorup Lakes	402	388
Lakes McLarty and Mealup	54	37
Lakes Goegrup and Black	73	0

*Includes areas outside the designated reporting regions used by Glasson et al. (1995) for saltmarsh.

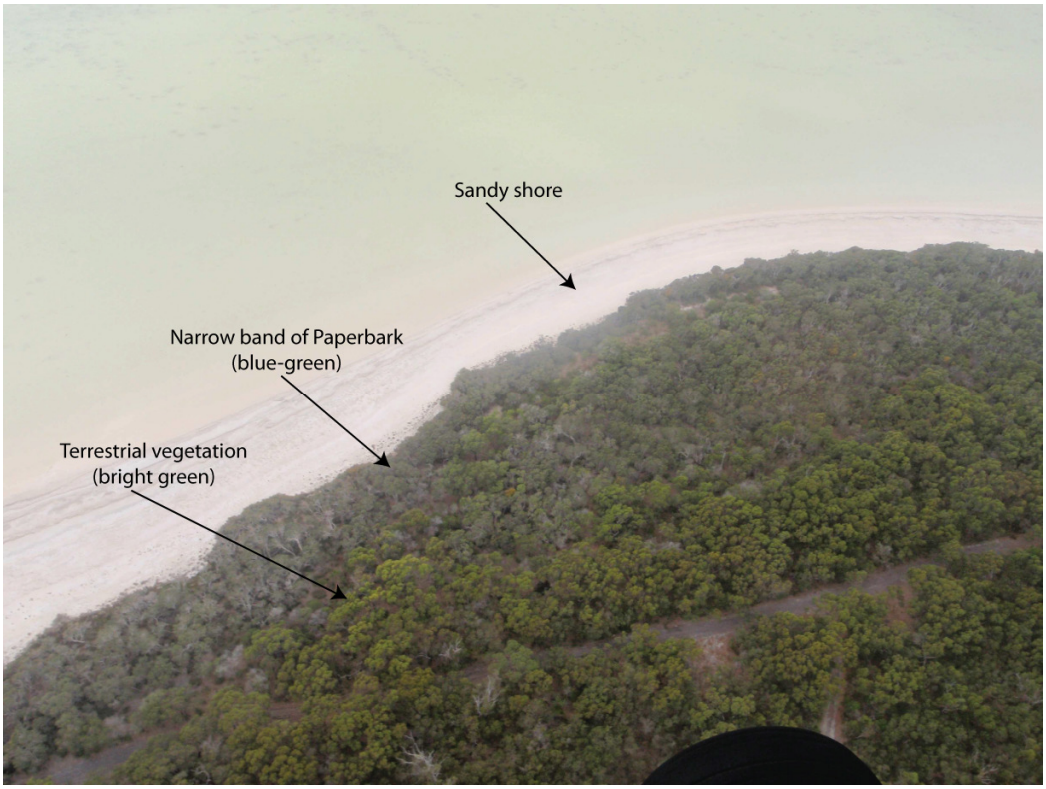

Figure 4: Pattern of vegetation along the shores of Lake Clifton (Yalgorup Lakes) in February 2009 (photo H. Kobryn).

3.4 Freshwater reeds and sedges

The only location within the study area where extensive freshwater reeds and sedges were obvious was within Lakes McLarty and Mealup. A total of approximately 40 hectares was mapped in the inner margins Lake McLarty and 51 hectares at Lake Mealup (Appendix 1). This vegetation was indistinct from aerial photography, but large stands of what appeared to be dead Typha were evident from the "ground truthing". The photography and ground truthing were all from summer / autumn months when water levels were either very low or the

wetland was completely dry. It is possible that more extensive freshwater vegetation may be present during winter and spring.

The Limits of Acceptable Change for freshwater reeds and sedges are not based on setting a current baseline, but are based on total percentages as follows:

- *Typha* limited to < 20 % of the wetland area; and
- Freshwater sedges covering a minimum of 20% of the wetland area.

Freshwater sedges (which may be predominantly *Typha*) currently cover 20% of the bed of Lake McLarty and 58% of Lake Mealup. No other significant areas of freshwater reeds or sedges were identified in the current mapping for either wetland.

4. Limitations and Recommendations

The current mapping of littoral and fringing vegetation in the Peel-Yalgorup Ramsar site and associated areas was conducted almost exclusively by remote sensing. Limited ground truthing and validation of vegetation communities was undertaken and as such there is a degree of uncertainty associated with vegetation identification. Therefore, while this mapping may be used as a broad scale baseline for reporting against future changes in littoral and fringing vegetation, it is not suitable for site specific purposes. In addition, current mapping does not provide an indication of density or condition of the vegetation communities identified. This information must be collected from ground surveys.

It is recommended that vegetation be re-mapped in approximately 5 years time to assess against Limits of Acceptable Change. At this point in time, if resources permit and more comprehensive ground truthing of vegetation communities should be included.

5. References

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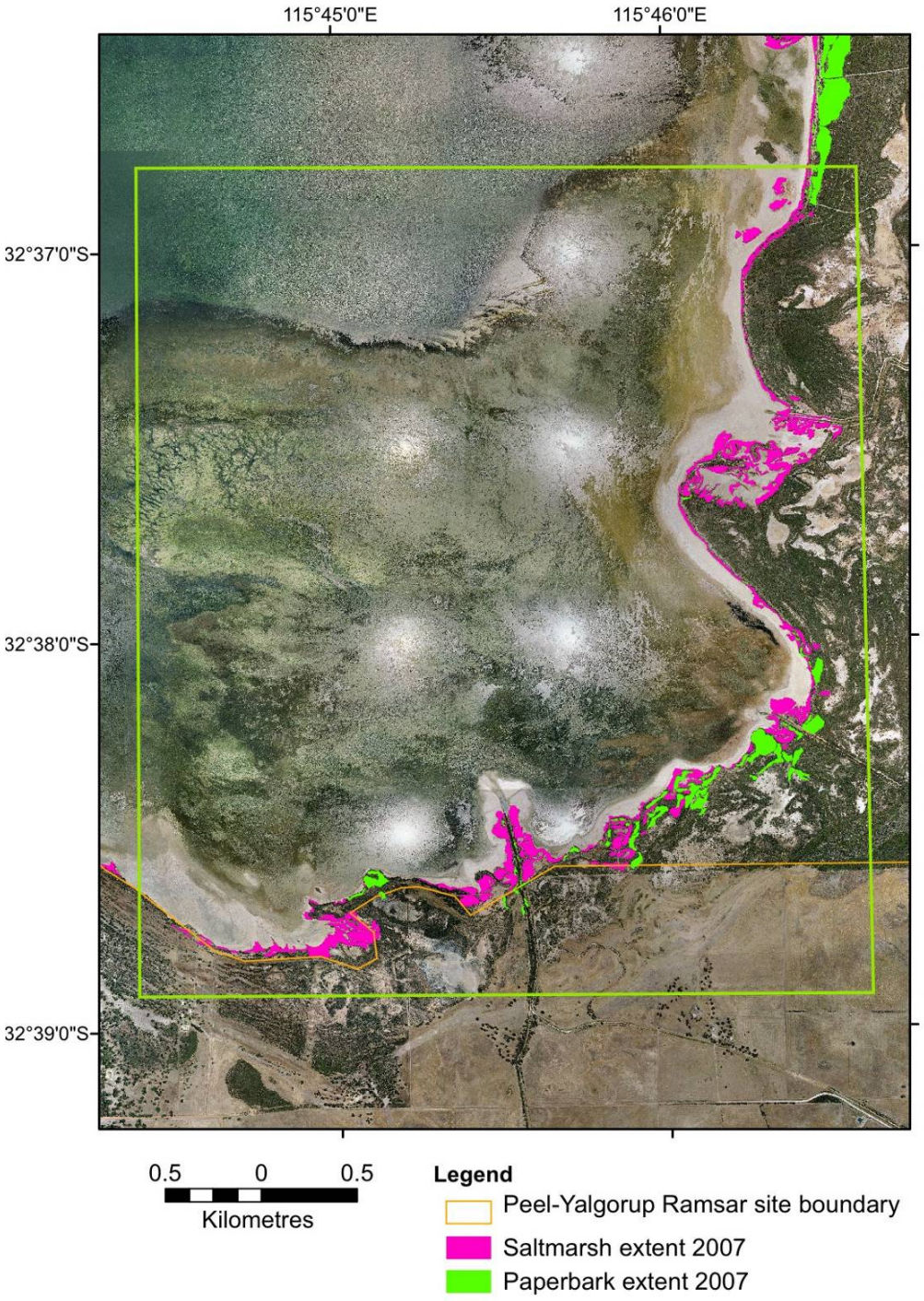
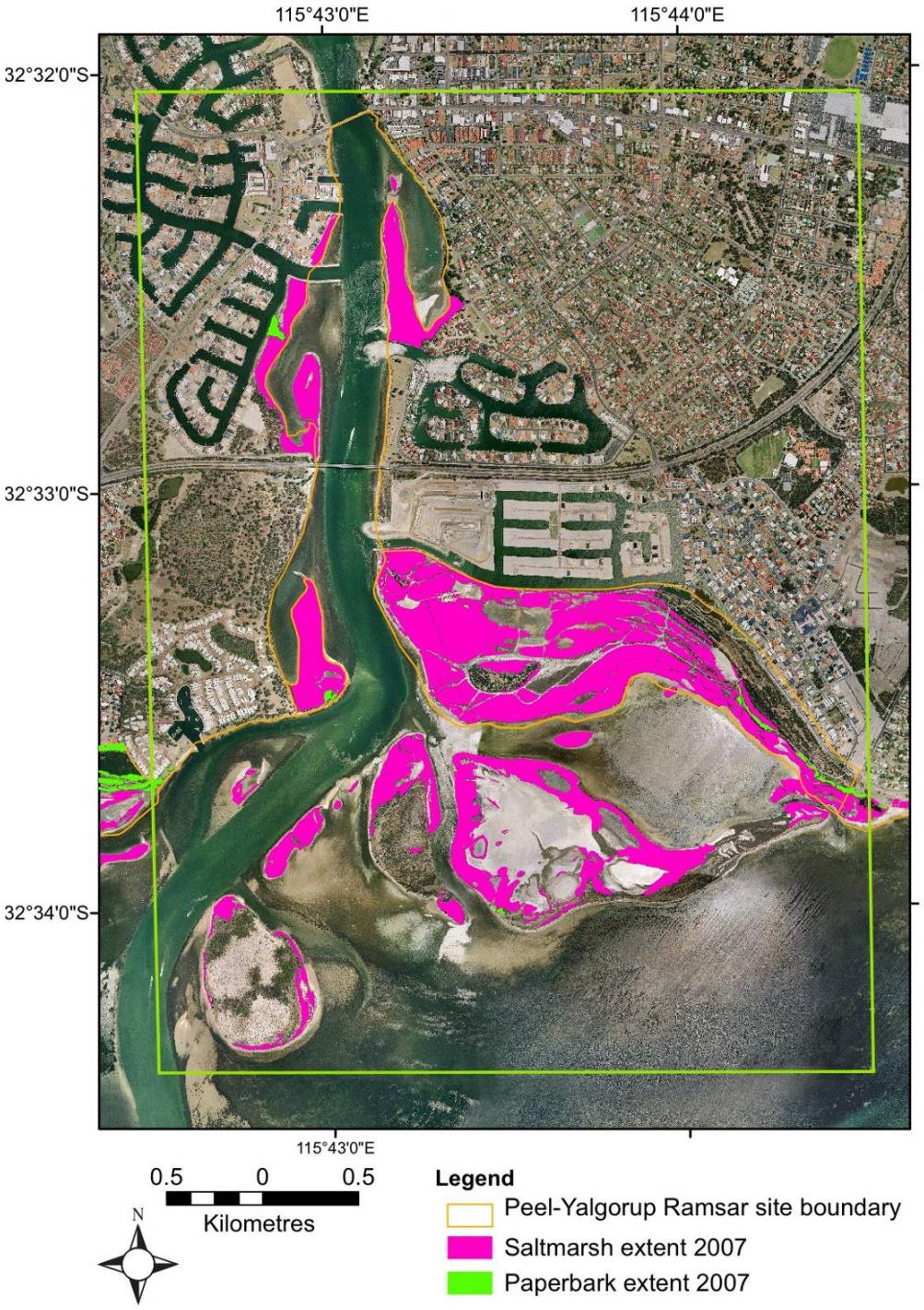
Peel-Harvey Catchment Council, in prep., Peel-Yalgorup System Management Plan. Peel-Harvey Catchment Council, Mandurah.

Phillips, B. 2006. Critique of the Framework for describing the ecological character of Ramsar Wetlands (Department of Sustainability and Environment, Victoria, 2005) based on its application at three Ramsar sites: Ashmore Reed National Nature Reserve, the Coral Sea Reserves (Coringa-Herald and Lihou Reeds and Cays), and Elizabeth and Middleton Reeds Marine National Nature Reserve. Mainstream Environmental Consulting Pty Ltd, Waramanga ACT.

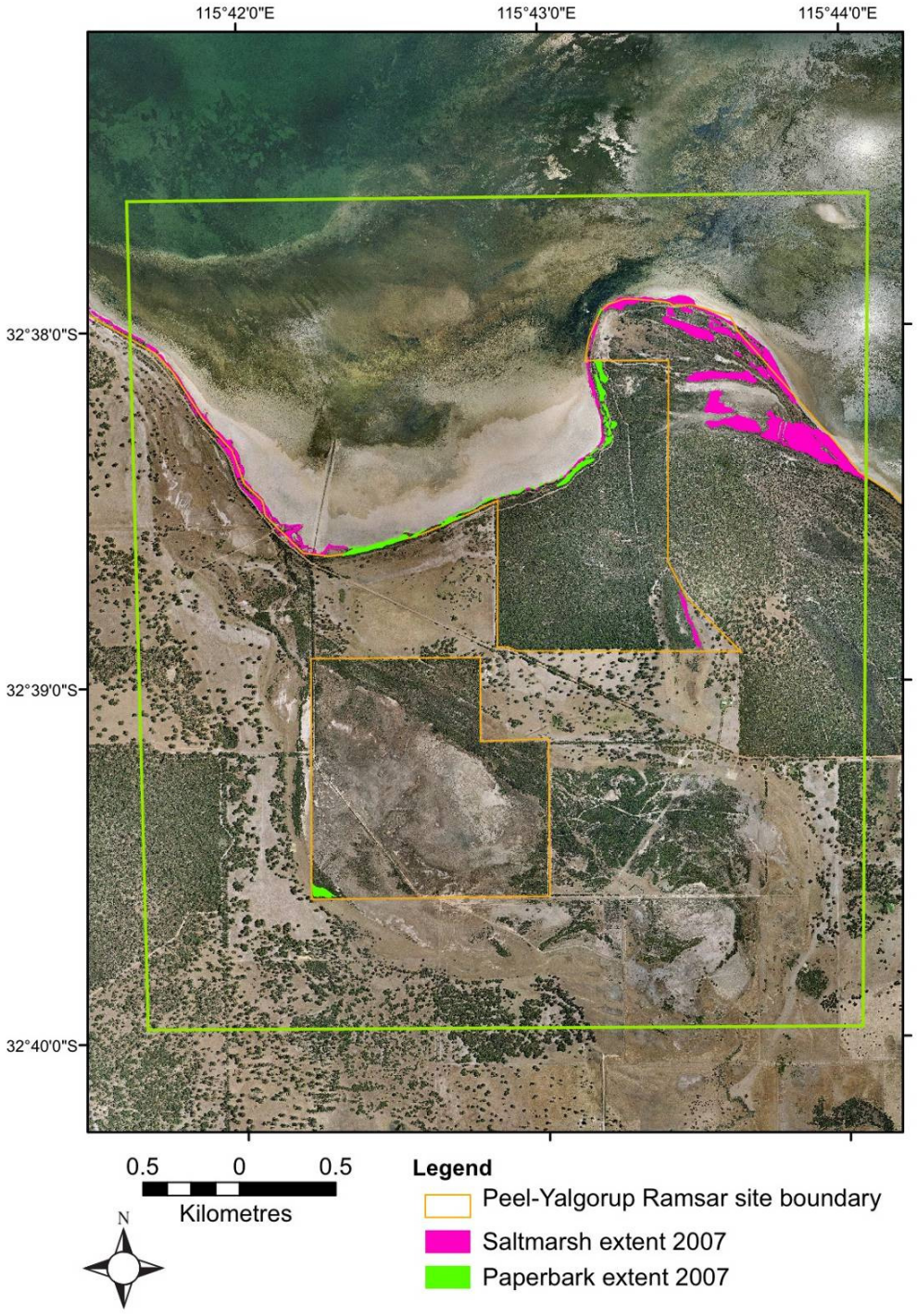
Appendix A: Vegetation maps by reporting region



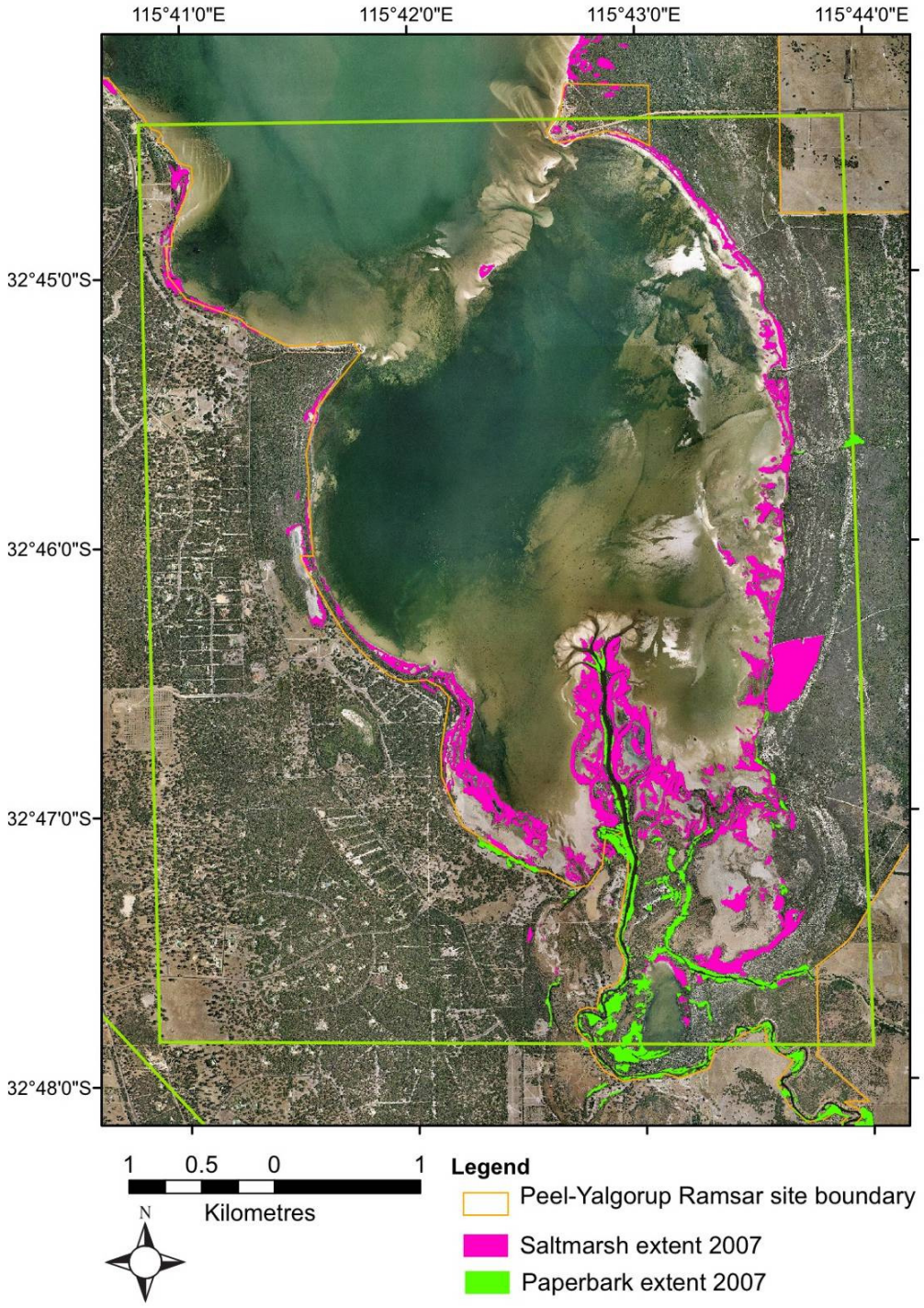
Extent of littoral and fringing vegetation at Austin Bay in the Peel Inlet 2007



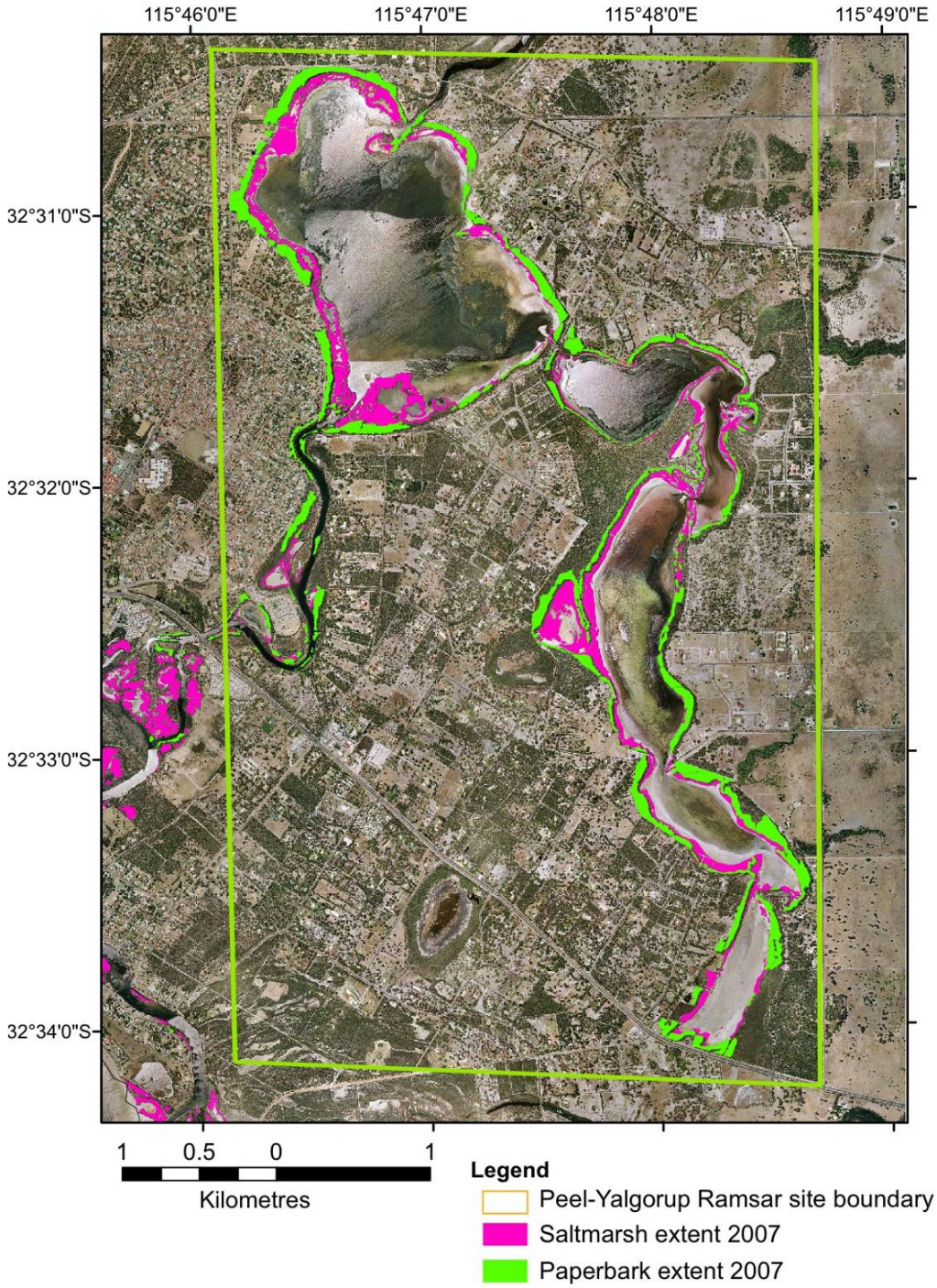
Extent of littoral and fringing vegetation at Creery Wetlands in the Peel Inlet 2007



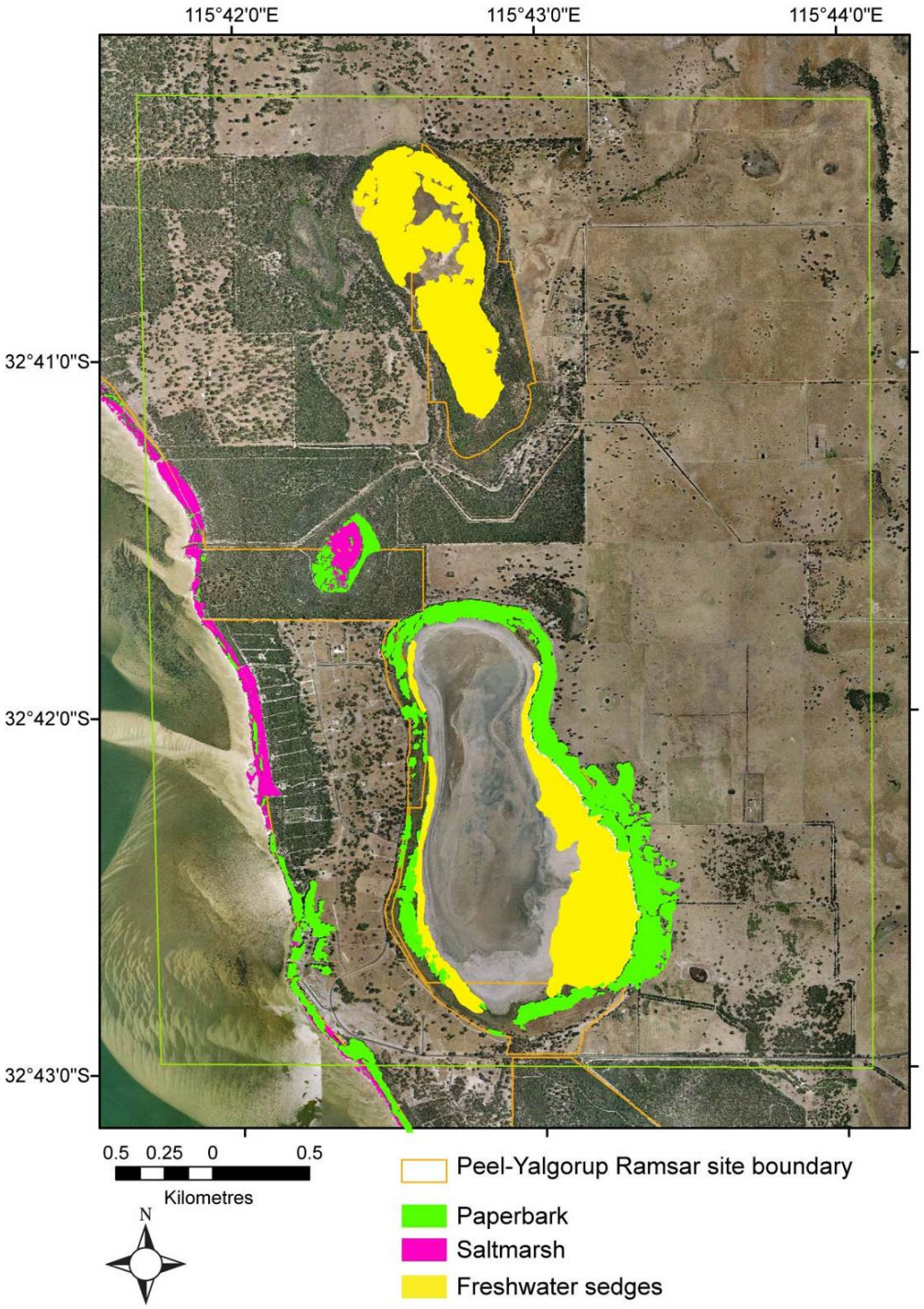
Extent of littoral and fringing vegetation at Roberts Bay in the Peel Inlet 2007



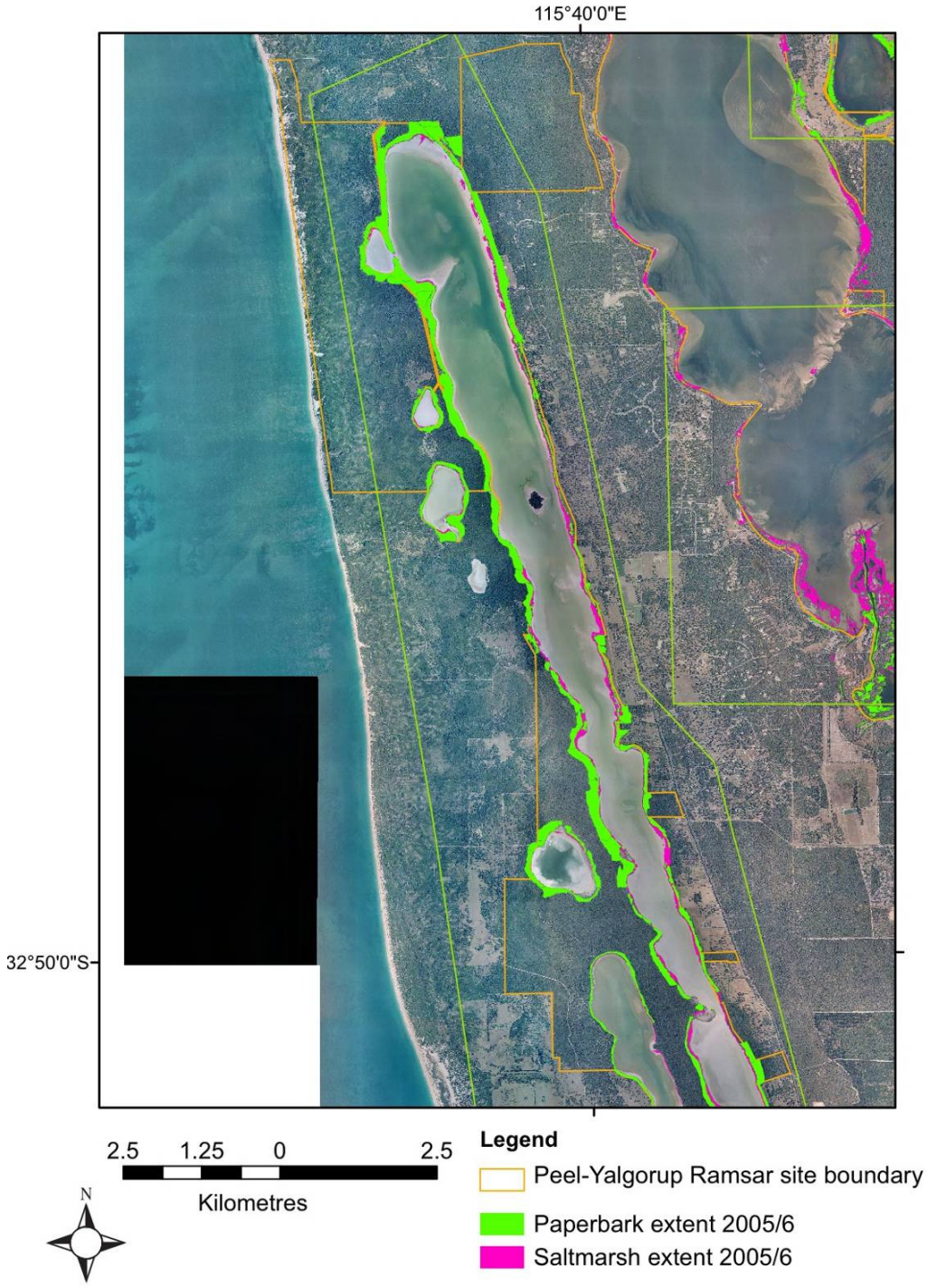
Extent of littoral and fringing vegetation at the Harvey Delta in the Harvey Estuary 2007



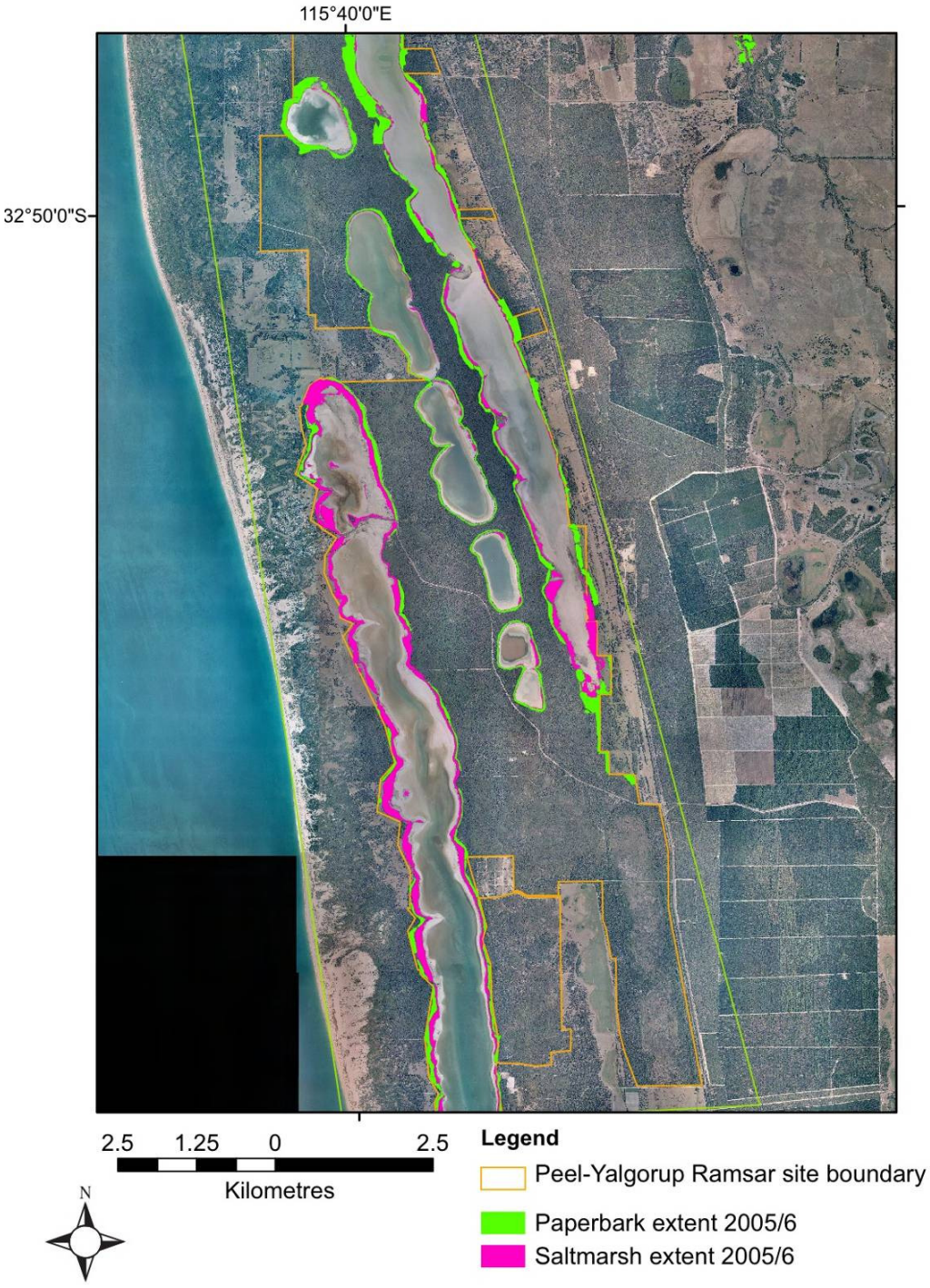
Extent of littoral and fringing vegetation at Goegrup and Black Lakes 2007.



Extent of littoral and fringing vegetation at Lakes McLarty and Mealup in 2007



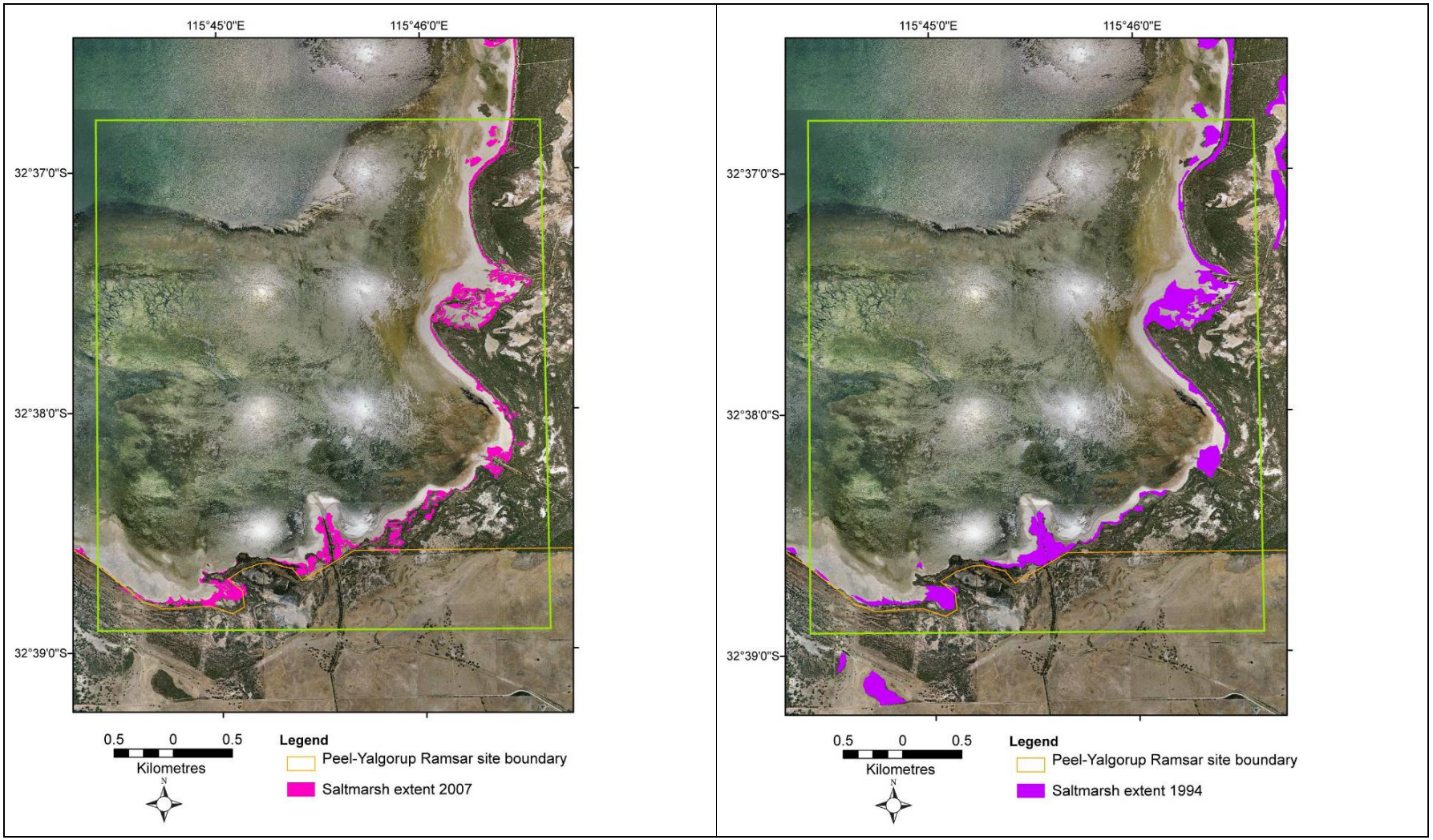
Extent of littoral and fringing vegetation at Yalgorup Lakes (northern portion) in 2005/6



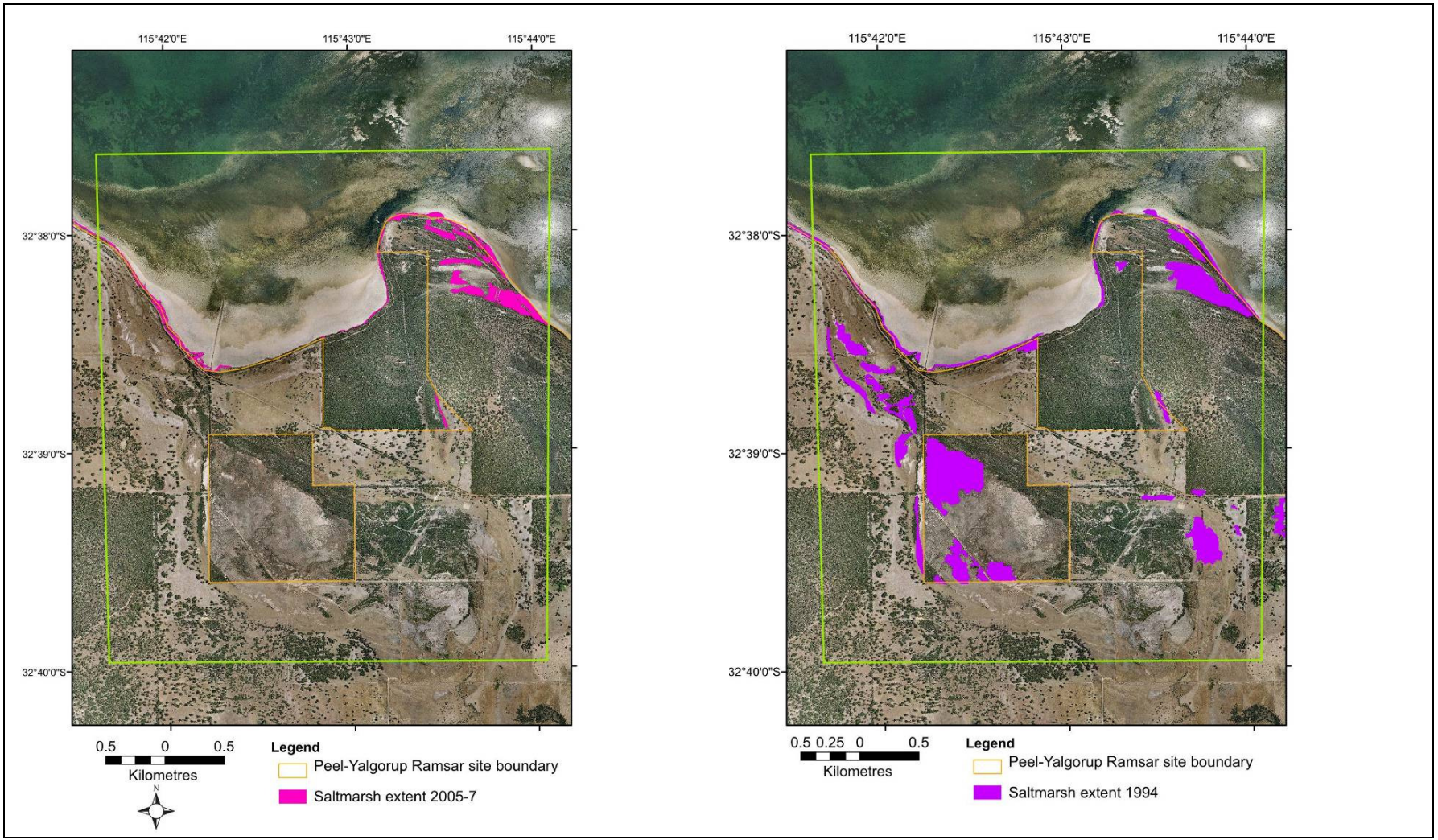
Extent of littoral and fringing vegetation at Yalgorup Lakes (central portion) in 2005/6

Extent of littoral and fringing vegetation at Yalgorup Lakes (southern portion) in 2005/6

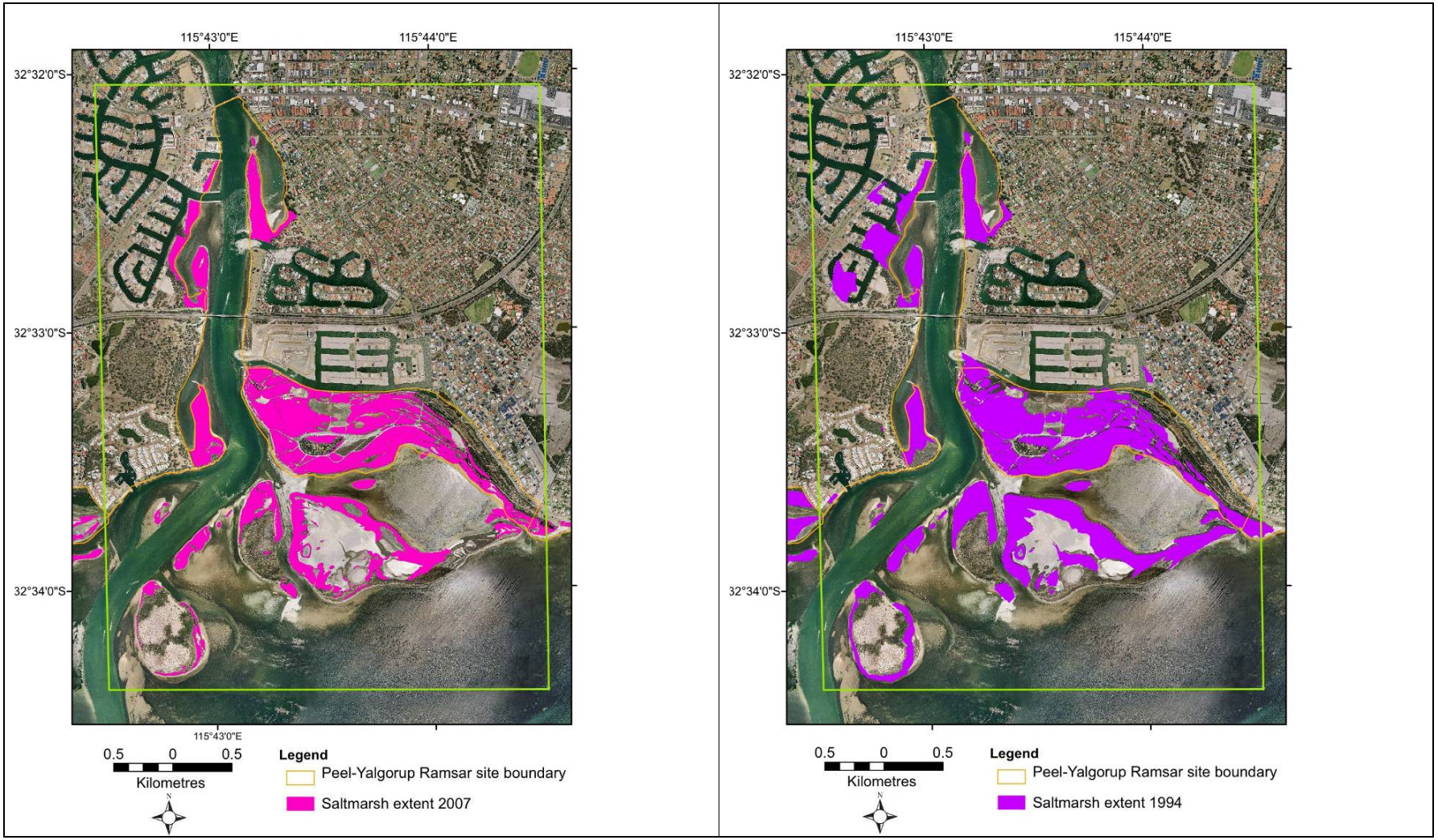
Appendix B: Saltmarsh extent 2005-7 and 1994 by reporting region



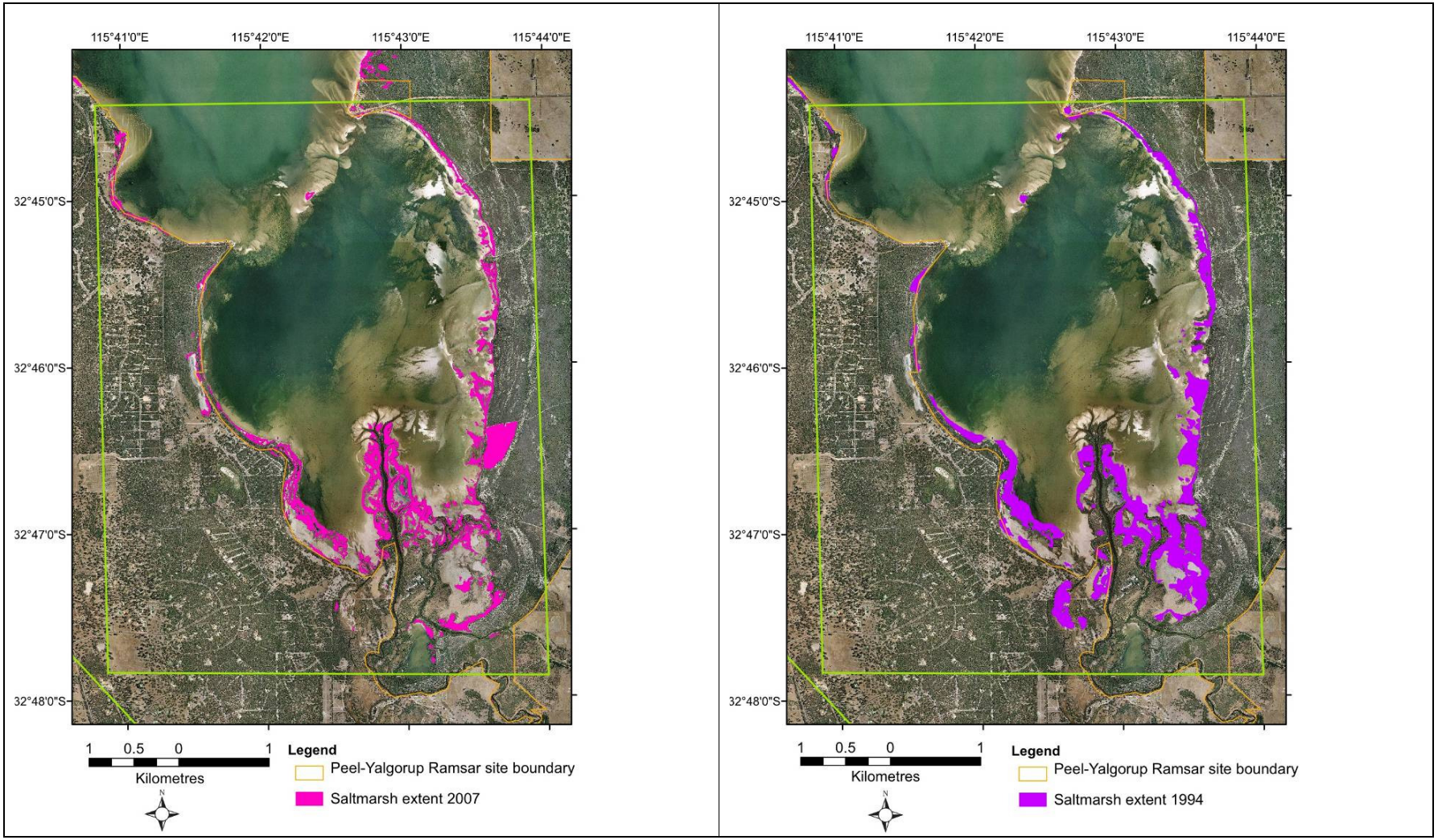
Saltmarsh extent in Austin Bay (Peel Inlet) from current mapping (right) and 1994 (left).



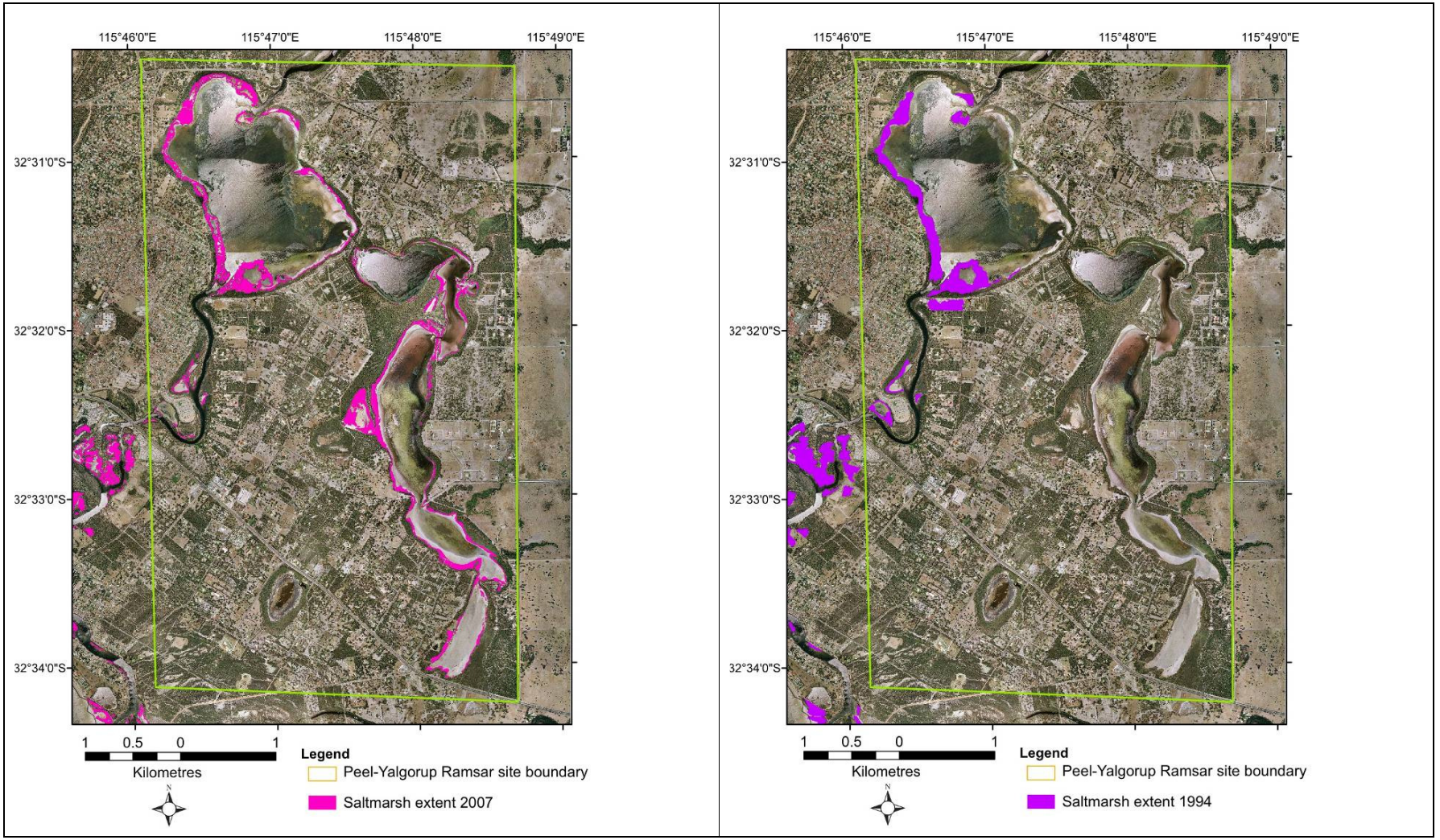
Saltmarsh extent in Roberts Bay (Peel Inlet) from current mapping (right) and 1994 (left).



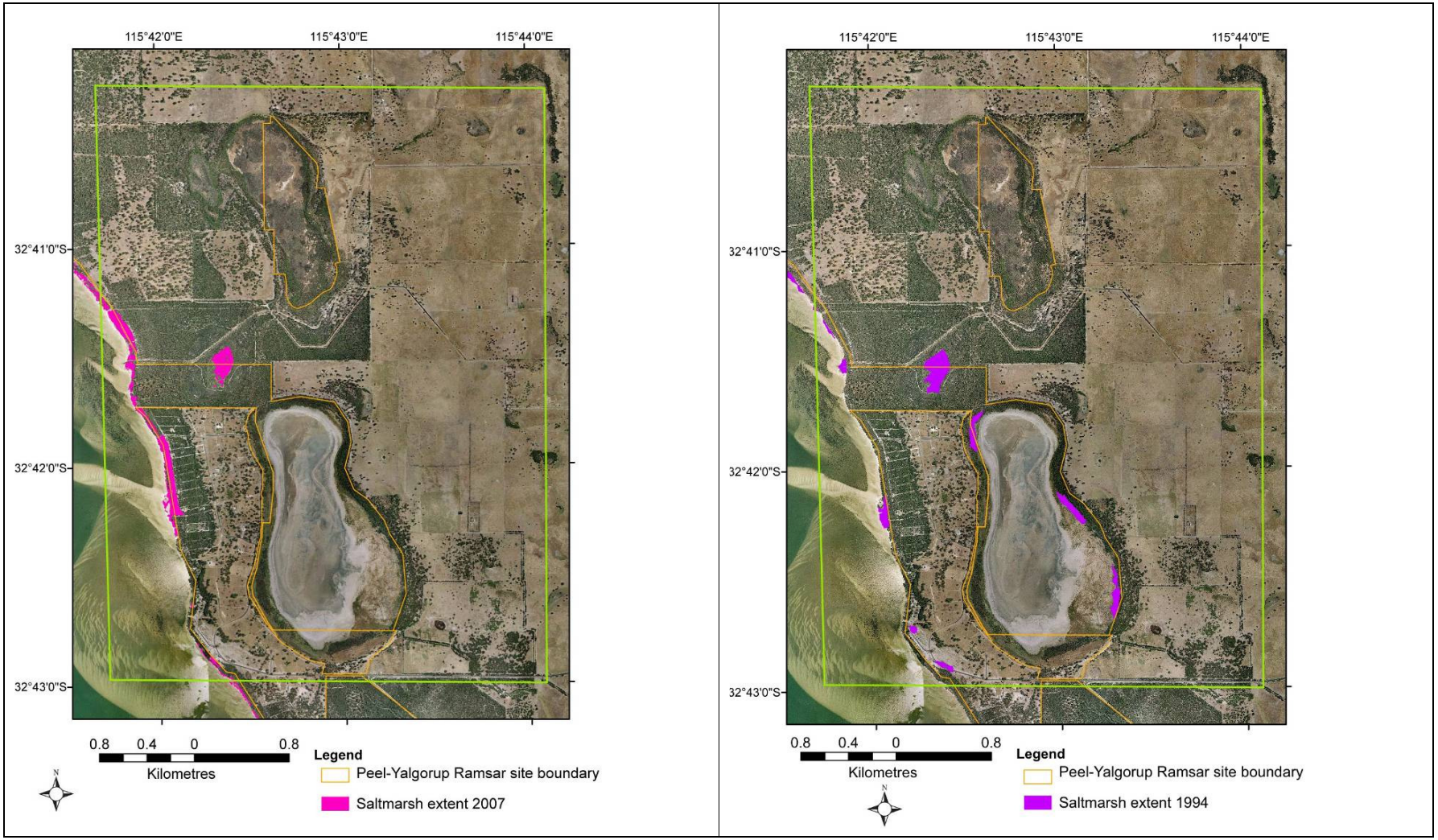
Saltmarsh extent in Creery Wetlands (Peel Inlet) from current mapping (right) and 1994 (left).



Saltmarsh extent in the Harvey Delta (Harvey Estuary) from current mapping (right) and 1994 (left).



Saltmarsh extent at Lake Goegrup from current mapping (right) and 1994 (left).



Saltmarsh extent at Lakes McLarty and Mealup from current mapping (right) and 1994 (left).