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CLLMM Survivorship Monitoring (2014 Plantings)

Project Report

To the Department of Environment, Water and Natural Resources, Government of South Australia

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EXECUTIVE SUMMARY

The Coorong, Lower Lakes and Murray Mouth (CLLMM) region is one of Australia's highest profile wetland systems, internationally recognised under the Ramsar Convention. The region provides diverse ecological, cultural, social and economic value to surrounding regions and the state of South Australia. DEWNR's CLLMM Program is conducting a 5 year restoration project to protect and enhance the region, which includes extensive habitat restoration plantings undertaken by the Vegetation Program across the CLLMM region.

This project involved the collection, collation and provision of field data from 45 revegetation sites situated across the CLLMM region during spring 2014 and autumn 2015, to determine survivorship rates of 2014 plantings. A subset of survey sites was visited in spring 2013 (new planting sites), with a more extensive autumn 2015 (new and infill sites) monitoring event revisiting all spring sites, plus an additional set of sites.

The results of the study indicated:

- A good overall revegetation survivorship success rate of 67% at the time of monitoring in autumn 2015, achieved in dry, challenging conditions.
- A very wide range of survivorship rates at different individual sites, ranging from as low as 19.4% up to a peak of 89.3%. This variability reflects the breadth of site variables that can affect planting success, including soil type, topography, hydrology and exposure to sun and wind, however in an encouraging overall trend, more than ¾ of all sites demonstrated survivorship rates of over 60%.
- A wide range of site preparation and planting methods, which for some sites appeared to strongly influence plant survival and health.
- Again, there was observational evidence that weed control and the presence of a guard were among the strongest determinants of revegetation success, providing some justification for the efforts that have been made with guarding and ongoing site maintenance.

Some sites with high survivorship success and plant health had been prepared using intensive methods such as soil scalping and ripping, and planted in rows allowing for effective mechanised weed control. These activities are consciously undertaken to the detriment of a more natural structure, but were noted to achieve desirable survivorship results and substantially reduced competition with non-desirable species. It was also noted that weedy grasses and other invasive species persist across most sites, and suppression of this competition will be a major factor in longer term survivorship and subsequent restoration of more complex native habitat.

The report includes a summary of suggested site management actions, and a set of broader recommendations, including pest plant and animal management, guarding of plants, and possible directions for follow-up monitoring and analysis.

The results of this study give a comprehensive record of the survivorship of the 2014 plantings, including a detailed dataset and site photopoints, which can be referred to when conducting future assessments of revegetation success and planning for additional or infill plantings. There is also potential for this dataset to be used in more complex analysis along with other datasets such as soil survey results, site history and planting methods, in order to better identify the major determinants of revegetation success.

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1. INTRODUCTION

1.1. Objectives and background of the CLLMM program

The Coorong, Lower Lakes and Murray Mouth (CLLMM) region is an internationally significant wetland system, recognised under the Ramsar Convention, supporting a diverse range of habitats and species at the terminus of the Murray River in South Australia. The CLLMM region is highly diverse supporting freshwater, estuarine and marine ecosystems over its estimated 142,500 hectares, and is culturally significant to the local Ngarrindjeri Nation.

The Coorong, Lower Lakes and Murray Mouth region is a focal area for the Department of Environment, Water and Natural Resources (DEWNR), the lead agency responsible for the environmental management of the Ramsar site. Management and active restoration works in the region are coordinated and primarily delivered by DEWNR's Coorong, Lower Lakes and Murray Mouth (CLLMM) Program.

The five-year CLLMM Bioremediation and Revegetation Project is funded by the Australian Government's Murray Futures Program. An initial focus was emergency works in response to long-term drought conditions, but with the return of water to the Lower Lakes system in 2010 (around the time the Long Term plan for the CLLMM site was released (DEH 2010)), the emphasis shifted to habitat restoration and building ecosystem resilience. The magnitude of the CLLMM Program has resulted in restoration works that provide significant habitat benefits for the fauna and flora of the CLLMM region.

In 2014, revegetation plantings by the CLLMM Restoration Program resulted in over 850,000 tube-stock seedlings being planted across 56 sites including the Hindmarsh Island multi-site, and covered approximately 280 Ha.

1.2. Project scope

In September 2014, Barron Environmental was engaged to carry out the CLLMM Vegetation Survivorship Monitoring (2014 plantings) project. The project involved establishing and conducting transect-based vegetation survival monitoring at a subset of the 2014 planting sites during spring 2014 (new sites only) and autumn 2015 (new and infill sites). This monitoring enables the density of surviving plants from the 2014 plantings to be determined and is an important part of tracking effectiveness of actions (at both site specific and program-wide scales) and ultimately improving the future delivery of similar activities in the region.

Barron Environmental partnered with NGT Consulting for delivery of the project. NGT Consulting delivered the CLLMM monitoring project for the 2013 plantings, completed in June 2014.

1.3. Project objectives

The project was split into two major components: fieldwork, followed by data entry and production of project reports.

The key objectives of the fieldwork component included:

- Undertaking field-based survivorship monitoring at identified sites in spring and autumn.
- Estimating the survivorship of the planting at each revegetation site.
- Providing a basic photographic record of sites.
- Providing an independent check against reported works completed.

The key objectives of the data entry and project report component included:

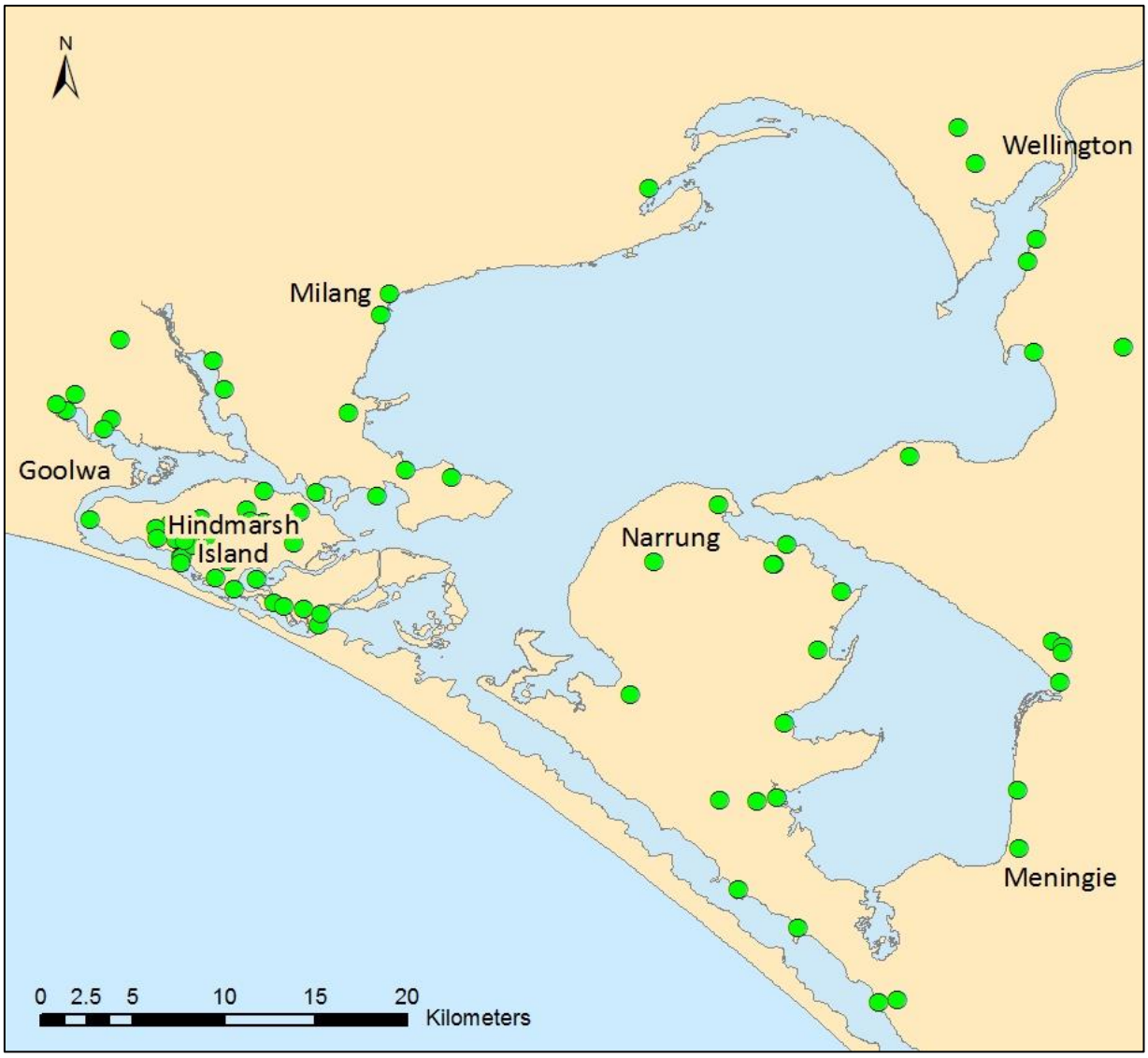
- Entering all field data from the spring and autumn monitoring into a Microsoft Access database.
- Producing a short interim report following the spring monitoring.
- Producing a final report of the spring and autumn monitoring including a discussion of the results.

2. METHODOLOGY

2.1. Monitoring sites

The monitoring sites were situated within the CLLMM region, including sites around the edge of Lake Alexandrina, Lake Albert, the Finniss River, Currency Creek, Goolwa Channel, Hindmarsh Island, Mundoo Island and south along the Coorong lagoon. In total, 45 sites were visited and assessed throughout the project, including the Hindmarsh Island multi-site (refer to Figure 1).

Figure 1 - Map of the CLLMM region showing autumn 2015 monitoring locations



Sites were firstly surveyed in spring 2014 (450 transects across 17 individual sites - refer to Table 1) around three months after planting, to assess survivorship due to planting technique and grazing. These sites were then assessed (along with a set of other sites not monitored in spring) in autumn 2015 (1405 transects across 45 individual sites - refer to Table 2) to assess survivorship after the plants experienced their first summer season.

Table 1 – Spring 2014 monitoring sites (new planting sites)

Site no.	Site name
1	Alexandrina Dairies Hwy
2	Camp Coorong
3	Connelly
4	Fiebig Hwy
5	Henshell 2014
6	Jockwar Lake Edge
7	Meningie Cemetery
8	Mundoo Ewe Island
9	Mundoo Massive

Site no.	Site name
10	Mundoo South
11	Noonameena
12	Poltalloch Swamp
13	Schultz
14	Treloar Lucky
15	Watkins 2014
16	Wellington Lodge Swamp Sth
17	Wilkinson

Table 2 - Autumn 2015 monitoring sites (new and infill sites). Sites only surveyed in autumn are shown with an asterisk (*).

Site no.	Site name
1	Alexandrina Dairies Hwy
2	Blake Community 2014 *
3	Browns Beach *
4	Camp Coorong
5	Clayton Bay Foreshore *
6	Connelly
7	Council Triangle *
8	Dodds Landing *
9	Fiebig Hwy
10	Fiebig Reserve *
11	Grey & Mundoo *
12	Griffin *
13	Henshell 2014
14	Hindmarsh Island 2014 (multiple sites) *
15	Hongs Bluff *
16	Jacob 2014 *
17	Jockwar Lake Edge
18	Jockwar Reserve 2014 *
19	Kindaruar Farm Gahnia *
20	Lifestyles *
21	Long Point Ngarrindjeri *
22	Low Point Wellington Lodge 2014 *

Site no.	Site name
23	McClure Highway Gahnia *
24	Meningie Cemetery
25	Milang Commonage *
26	Mundoo Ewe Island
27	Mundoo Massive
28	Mundoo South
29	Narrung Wetland 2014 *
30	Noonameena
31	Pobbybonk/Snake Reserve *
32	Poltalloch Swamp
33	Schultz
34	Shadows West *
35	Shaw *
36	Stratland Gahnia *
37	Treloar Lucky
38	Treloar 2014 *
39	Treloar Gahnia *
40	Waghorn *
41	Watkins 2014
42	Wellington Dairies *
43	Wellington Lodge Swamp South
44	Wilkinson
45	Yalkuri Gahnia *

2.2. Field survey methodology

The sampling component of the surveys consisted of a number of 50m transects, with the number of transects on each restoration site determined by, and proportional to, the size of the site. Hence for the autumn surveys, the number of transects on individual sites ranged from 2 transects on multiple smaller sites, up to 122 transects at the Treloar Lucky site on the Narrung Peninsula, with 9 sites having more than 50 transects. Additionally, 150 transects were distributed across multiple sites on Hindmarsh Island, although not all sites and transects were surveyed due to issues described in Section 4.1.11.

To ensure the robustness of the method and prevent site selection bias for transects, the starting coordinates for each site were determined by DEWNR from randomly generated points in ArcGIS.

Plantings were implemented in distinct zones signifying differences in landform and soil types (e.g. Inundated, Lake/Lagoon Edge, Rising Ground). Transect direction was determined on-site, and where possible were run only within the zone in which a transect was started (Figure 2).

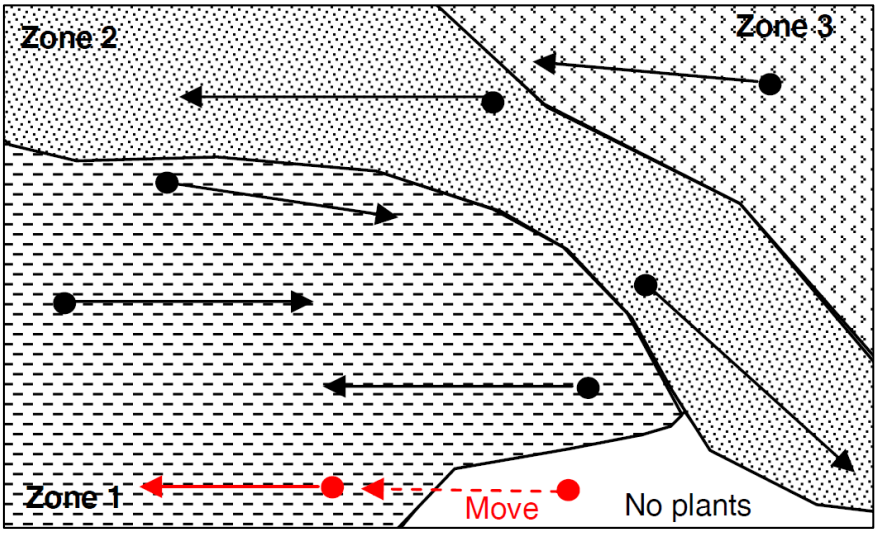


Figure 2 - Transect direction

Each transect consisted of a 50m line, starting at the supplied coordinates. The transect was then walked, counting all individual plants one metre to the left of the transect. At the end of the 50m transect line, the direction was reversed, and plants on the other side were counted while walking back to the starting point (Figure 3).

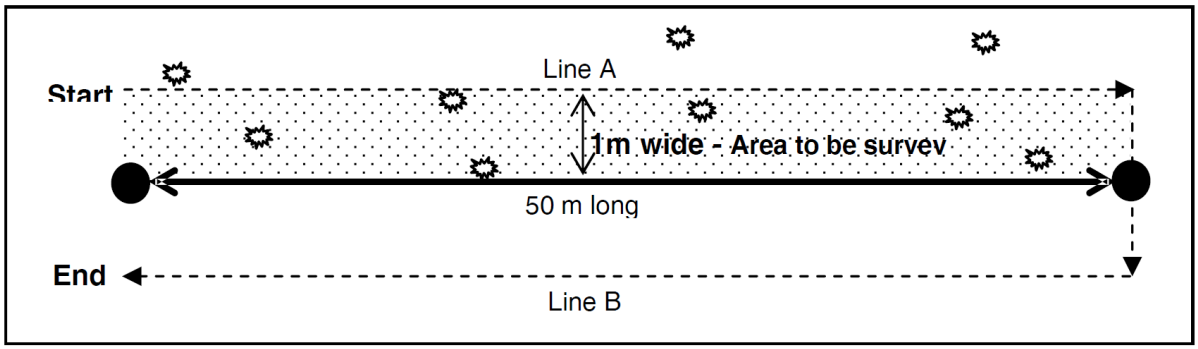


Figure 3 - Transect area

Each plant – either dead or alive – was identified to species level. Where species identification of a dead plant was not possible, it was counted as "Dead (unknown species)".

2.3. Site photographs

At each site, at least one photo was taken at locations which reflected overall site condition. Easting and northing was recorded for each photo, along with bearing and approximate height.

2.4. Survivorship scoring

Each plant counted was identified to species level and recorded as either dead or alive. Where possible, dead plants were identified to species level, and where this was not possible they were recorded as "Dead (unknown species)".

2.5. Observational notes

Observations were taken at each site, recording overall plant health, conditions of tree guards, impacts from pest plants and animals, stock incursions, and site condition notes including site preparation and any signs of follow-up maintenance such as spraying of weeds or fence repair. Where areas were found to be unplanted, this was also recorded and where possible transects were moved to a nearby planted location.

2.6. Data management

All transect data was entered into a Microsoft Access database supplied by DEWNR and delivered as an electronic file.

3. RESULTS AND DISCUSSION

3.1. Overall survivorship for the 2014 plantings

Across the 45 sites that were sampled in Autumn 2015, a total of 41,748 plants were counted and assessed, with an average of 67% of all plants recorded as being alive after their first summer since planting in 2014, see Table 3.

Table 3 - Autumn 2015 survivorship by site, with site survival percentages grouped into 5 colour-coded categories: brown (0-20%), orange (20-40%), yellow (40-60%), light green (60-80%) and dark green (80-100%).

Site name	Total Plants	Alive	Dead	Survival (%)
Alexandrina Dairies Hwy	4233	3043	1190	71.9
Blake Community 2014	496	363	133	73.2
Browns Beach	166	124	42	74.7
Camp Coorong	853	560	293	65.7
Clayton Bay Foreshore	265	202	63	76.2
Connelly	423	339	84	80.1
Council Triangle	336	217	119	64.6
Dodd's Landing	1216	236	980	19.4
Fiebig Hwy	350	190	160	54.3
Fiebig Reserve	362	294	68	81.2
Grey & Mundoo	451	397	54	88.0
Griffin	176	138	38	78.4
Henshell 2014	534	390	144	73.0
Hindmarsh Island (multiple sites)	1511	1252	259	82.9
Hongs Bluff	2679	1970	709	73.5
Jacob 2014	946	577	369	61.0
Jockwar Lake Edge	1036	656	380	63.3
Jockwar Reserve 2014	49	34	15	69.4
Kindaruar Farm Gahnia	624	173	451	27.7
Lifestyles	644	483	161	75.0
Long Point Ngarrindjeri	1073	656	417	61.1
Low Point Wellington Lodge 2014	83	25	58	30.1
McClure Highway Gahnia	39	21	18	53.8
Meningie Cemetery	422	325	97	77.0
Milang Common	427	303	124	71.0
Mundoo Ewe Island	530	391	139	73.8
Mundoo Massive	2539	1966	573	77.4
Mundoo South	1267	762	505	60.1
Narrung Wetland 2014	572	368	204	64.3
Noonameena	1835	998	837	54.4
Pobbybonk/Snake Reserve	62	37	25	59.7
Poltalloch Swamp	355	245	110	69.0

Site name	Total Plants	Alive	Dead	Survival (%)
Schultz	774	618	156	79.8
Shadows West	118	50	68	42.4
Shaw	1424	885	539	62.1
Stratland_Gahnia	236	182	54	77.1
Treloar 2014	309	268	41	86.7
Treloar Lucky	5692	3301	2391	58.0
Treloar Gahnia	597	523	74	87.6
Waghorn	104	71	33	68.3
Watkins	3457	2493	964	72.1
Wellington Dairies	1516	1218	298	80.3
Wellington Lodge Swamp South	384	283	101	73.7
Wilkinson	290	222	68	76.6
Yalkuri Gahnia	293	133	160	45.4
Total	**41748**	**27982**	**13766**	**67.0**

In Table 4, these 45 sites are grouped according to five broad (colour-coded) percentage categories of survivorship success (based on Durbridge 2012). It can be seen that the majority (78%) of all sites have achieved survivorship rates of over 60%, while 7% of sites had survivorship rates below 40%.

Table 4 - Summary of autumn sites by survivorship percentage category (as applied in Durbridge 2012)

Survivorship category		# sites	% sites
0-20%	Very Poor	1	2.2
20-40%	Poor	2	4.4
40-60%	Average	7	15.5
60-80%	Good	28	62.2
80-100%	Excellent	7	15.6
Total		**45**	**100**

For the 17 sites that were visited in both Spring 2014 and Autumn 2015, there is an opportunity to compare the change in survivorship rates after the 2014/15 summer season, see Table 5.

Table 5 - Change between spring and autumn survivorship for sites monitored in both rounds. NOTE: the colour-coding of "percentage change" categories has been reversed to reflect a desirable minimal change (green) through to a larger, undesirable change (brown).

Site name	Spring survival (%)	Autumn survival (%)	% change
Alexandrina Dairies Highway	87.2	71.9	-15.3
Camp Coorong	89.3	65.7	-23.6
Connelly	90.6	80.1	-10.5
Fiebig Hwy	93.6	54.3	-39.3
Henshell 2014	77.3	73.0	-4.3
Jockwar Lake Edge	94.2	63.3	-30.9
Meningie Cemetery	91.7	77.0	-14.7
Mundoo Ewe Island	82.9	73.8	-9.1
Mundoo Massive	90.0	77.4	-12.6
Mundoo South	78.2	60.1	-18.1
Noonameena	75.0	54.4	-20.6
Poltalloch Swamp	88.4	69.0	-19.4
Schultz	91.1	79.8	-11.3
Treloar Lucky	84.8	58.0	-26.8
Watkins	93.7	72.1	-21.6
Wellington Lodge Swamp South	94.1	73.7	-20.4
Wilkinson	87.0	76.6	-10.4
Average	**87.6**	**69.6**	**-18.0**

More detailed comparative analysis by percentage category is presented in Table 6. While all 17 sites showed survivorship rates of over 60% in spring 2014, by autumn 2015 the combined number of sites with survivorship rates over 60% had dropped by 3, to 14. However, no sites had declined to less than 40%.

Table 6 - summary of sites visited in both spring 2014 and autumn 2015, according to survivorship percentage category

Survivorship category		# sites Spring 2014	# sites Autumn 2015
0-20%	Very Poor	0	0
20-40%	Poor	0	0
40-60%	Average	0	3
60-80%	Good	3	13
80-100%	Excellent	14	1
Total		**17**	**17**

Table 7 presents the change in survivorship percentage for the 17 sites monitored in both spring and autumn. Significantly, no sites experienced a drop in survivorship of more than 40% between the two monitoring seasons.

Table 7 - Summary of survivorship percentage change measured between spring and autumn sites

Survivorship percentage change		# sites	% sites
80-100%	Very Poor	0	0%
60-80%	Poor	0	0%
40-60%	Average	0	0%
20-40%	Good	7	41%
0-20%	Excellent	10	59%
Total		**17**	100%

3.2. Survivorship of each species identified

The results of revegetation survivorship according to species provides a useful overview of the composition of the Vegetation Program 2014 revegetation works – see Table 8, and the full species list in Appendix C. However, this comes with some limitations.

It should be noted that some genus were difficult to identify to the species level in the field, including *Vittadinea* sp., *Allocasuarina* sp. (smaller-leaved species) and many of the grasses. Some *Eucalyptus* species were also difficult due to the high variability of juvenile foliage.

Additionally, nearly half (48%) of dead plants were unable to be accurately identified to species level, due to loss of the whole plant, or loss of foliage making identification difficult or impossible in the field.

This substantially limits the value of more detailed analysis of this data, by creating a significant bias (of missing data) that it is reasonably assumed would impact upon the survivorship statistics for the majority of individual species listed here.

Table 8 - Autumn survivorship by species (species with >100 plants counted – see Appendix C for full list)

Species	Plants	Alive	Dead	Survival (%)
Acacia calamifolia	110	93	17	84.5
Acacia cupularis	356	307	49	86.2
Acacia dodonaeifolia	166	160	6	96.4
Acacia leiophylla	140	98	42	70.0
Acacia longifolia ssp. *sophorae*	285	216	69	75.8
Acacia paradoxa	215	178	37	82.8
Acacia pycnantha	602	400	202	66.4
Acacia spinescens	110	96	14	87.3
Adriana quadripartita	102	65	37	63.7
Allocasuarina sp.	266	245	21	92.1
Allocasuarina verticillata	1850	1498	352	81.0
Atriplex paludosa ssp.	1137	1103	34	97.0
Atriplex semibaccata	950	913	37	96.1
Atriplex suberecta	256	238	18	93.0
Austrostipa sp.	328	277	51	84.5
Billardiera cymosa	366	359	7	98.1
Bursaria spinosa ssp.	689	533	156	77.4
Callitris gracilis	230	202	28	87.8
Carpobrotus rossii	273	240	33	87.9
Clematis microphylla	325	311	14	95.7
Cyperus gymnocaulos	187	126	61	67.4
Dianella brevicaulis	272	236	36	86.8
Dianella sp.	283	238	45	84.1

Species	Plants	Alive	Dead	Survival (%)
Disphyma crassifolium ssp.	471	455	16	96.6
Dodonaea viscosa ssp.	515	466	49	90.5
Duma florulenta	240	214	26	89.2
Einadia nutans ssp.	192	189	3	98.4
Enchylaena tomentosa var.	661	645	16	97.6
Eucalyptus diversifolia	380	284	96	74.7
Eucalyptus fasciculosa	220	210	10	95.5
Eucalyptus incrassata	213	186	27	87.3
Eucalyptus porosa	175	157	18	89.7
Ficinia nodosa	3029	2014	1015	66.5
Gahnia filum	4832	3204	1628	66.3
Hakea mitchellii	218	207	11	95.0
Juncus kraussii	1177	688	489	58.5
Kennedia prostrata	147	126	21	85.7
Kunzea pomifera	166	107	59	64.5
Leptospermum myrsinoides	465	373	92	80.2
Maireana brevifolia	681	657	24	96.5
Maireana oppositifolia	832	800	32	96.2
Melaleuca halmaturorum	1235	985	250	79.8
Melaleuca lanceolata	730	541	189	74.1
Melaleuca uncinata	168	156	12	92.9
Muehlenbeckia gunnii	121	116	5	95.9
Myoporum insulare	607	573	34	94.4
Olearia axillaris	1405	1238	167	88.1
Pelargonium australe	238	226	12	95.0
Poa labillardieri ssp. *labillardieri*	747	558	189	74.7
Poa poiformis	220	72	148	32.7
Poa sp.	572	408	164	71.3
Puccinellia stricta	819	574	245	70.1
Rhagodia candolleana ssp.	436	418	18	95.9
Rytidosperma caespitosum	268	163	105	60.8
Rytidosperma sp.	465	321	144	69.0
Tetragonia implexicoma	326	310	16	95.1
Threlkeldia diffusa	139	136	3	97.8
Xanthorrhoea caespitosa	169	131	38	77.5
Another species	195	187	8	95.9
Dead (unknown species)	6615	0	6615	0.0
Total (including unlisted species)	**41748**	**28037**	**13711**	**67.0**

3.3. Overall survivorship in each zone

A total of 12 distinct planting zones were recorded across all sites. The survivorship results according to planting zone present an interesting overview of the field sampling – see Table 9. The most commonly planted zones monitored were Saline Edge (3), Sandhill (8), Other Inland (9) and Rising Ground (4), making up nearly 90% of all plants recorded.

In terms of survival rates, three stand-out zones had greater than 80% survival: Inundated (0), Cliff (6) and Cliff Top (7). It should be noted that the sample size for each of these zones was very small, and collectively they made up less than 1% of all plants surveyed. Apart from the Coastal (10) zone, all other zones fell in the good 60-80% survivorship category.

The zones with the lowest survivorship (around 60%) were Coastal (10), Lake/Lagoon Edge (1) and Other Inland (9), and collectively made up 29% of all plants counted. Of these three zones, Other Inland was by far the most numerous in terms of plants counted (20% of all plants), and its relatively low survivorship had a significant effect on overall survivorship.

Table 9 - Autumn survivorship by planting zone

Zone	Zone description	Plants	Alive	Dead	Proportion of total plants per zone (%)	Survival (%)
0	Inundated	161	144	17	0.4	89.4
1	Lake/Lagoon Edge	1408	869	539	3.4	61.7
2	Saline Swamp	168	116	52	0.4	69.0
3	Saline Edge	12922	8796	4126	31.0	68.1
4	Rising Ground	6037	4257	1780	14.5	70.5
5	Slope/Embankment	625	486	139	1.5	77.8
6	Cliff	19	17	2	0.0	89.5
7	Cliff Top	208	169	39	0.5	81.3
8	Sandhill	9497	6563	2934	22.7	69.1
9	Other Inland	8366	5169	3197	20.0	61.8
10	Coastal	2294	1362	932	5.5	59.4
13	Blowout	43	34	9	0.1	79.1
Total		**41748**	**27982**	**13766**	**100**	**67.0**

4. DISCUSSION

4.1.1 Overall survivorship

At the time of monitoring in Autumn 2015, overall survivorship of the 2014 plantings was good, especially considering the low prevailing rainfall (discussed in section 4.1.5). Survivorship levels had dropped moderately from 86.5% to 67.0% between the spring 2014 and autumn 2015 monitoring periods, with over three-quarters of all sites recording autumn survivorship rates of over 60%. The first summer after establishment provides challenges for seedlings due to the higher temperatures and limited moisture. As can be seen in the results, most sites did not suffer high rates of plant mortality.

The three sites that did suffer the highest mortality rates (a change of 25-40%) over the summer were Dodd's Landing, Kindaruar Farm Gahnia and Yalkuri Gahnia.

Given the circumstances, these overall survivorship rates are markedly consistent with previous survivorship monitoring results, both by Tuck and Bachmann (2014) and those published by the Goolwa to Wellington LAP in relation to 2010 and 2011 plantings in the CLLMM region (Durbridge, 2012).

4.1.2 Survivorship at zone level

Most of the zones that were widely planted (more than 5% of overall plants counted) were in the middle of the 60-80% survivorship category. Notable exceptions were Coastal (10) at 59% and Other Inland (9) at 62%.

Interestingly, given the dry conditions over the summer of 2014/15, some of the zones that could have been expected to be dry and challenging such as Cliff Top, Sandhill and Blowout were not adversely affected in comparison to other zones. They were in fact all higher than the average across all zones.

While the Cliff Top and Blowout zone results are subject to variation from small sample sizes, the Sandhill result could be seen as an unusually good result given the prevailing conditions, and that the Sandhill areas tend to have water-repellent sandy surface soil and greater wind exposure. However, site preparation and species selection was good in many cases, and if planting was timed well, the 'self-mulching' ability of the sandy surface may have helped to retain enough moisture to aid seedling survival. So perhaps these beneficial attributes overcame the negative ones on these sites.

4.1.3 Survivorship at species level

While some species such as *Poa poiformis* showed poor survivorship, many of these were small sample sizes that could be affected by a single patch of dead plants. It should be noted that a large proportion (48%) of all dead plants were unable to be positively identified. As such, the survivorship data for the majority of individual species are likely to be considerable

over-estimates and this particular element of analysis is therefore unfortunately limited in value in this instance.

Despite this limitation, it should be noted that the most reliably identifiable species were ones that have tougher, more fibrous foliage such as sedges, and *Juncus kraussii* (59%) and *Ficinia nodosa* (67%) were among the species with a lower survivorship percentage, as they were in the autumn 2014 monitoring.

Gahnia filum (66%) was a widely-planted species that had good survivorship in many locations, but had noticeably poorer results on bare, saline edges where low soil moisture and higher surface temperatures would be challenging over the summer months.

Trees and shrubs such as *Eucalyptus* sp. or *Acacia* sp. are very difficult to identify once they have lost their leaves, and while it was suspected that many Eucalypts had perished on rises, the lack of identification means that this is not necessarily reflected in the statistics for those species. *Acacia pycnantha* was below average at 66% despite it being difficult to identify once it has lost its foliage, so its actual survival rate may be significantly lower than that. At the other end of the scale, all *Atriplex* species recorded over 90% survival, but this will be skewed by the lack of identifiable dead plants as the soft foliage is quickly lost as the plant dies.

4.1.4 Notable sites

Sites with high survivorship rates

The Grey & Mundoo, Treloar Gahnia and Treloar 2014 sites were notable for their high success rates.

Grey & Mundoo was a Hindmarsh Island site with infill plantings and it proved difficult to survey, but the areas surveyed showed excellent plant health and planting method – albeit with the usual cover of *Ehrharta sp.* and other weedy pasture grasses typical of the Island. Guards were intact and there was little evidence of grazing.

While Treloar Gahnia was a single-species site, it still displayed higher survival than the other *Gahnia filum*-only sites, of which 3 of 5 had survivorship rates of less than 60%. The site showed signs of recent weed control and adequate site preparation.

Treloar 2014 was a small site that spanned Saline Edge and Rising Ground planting zones, and showed evidence of good weed control.

Figure 4 - The three highest survivorship sites in autumn 2014

TOP – Grey & Mundoo: 88% survivorship

MID – Treloar Gahnia: 88% survivorship

BELOW – Treloar 2014: 87% survivorship

Sites with low survivorship rates

Sites with notably poor survivorship of less than 50% included Dodd's Landing, Kindaruar Farm Gahnia, Yalkuri Gahnia, Low Point Wellington Lodge and Shadows West. All other sites had more than 50% survivorship. It should be noted that the Low Point Wellington Lodge and Shadows West sites had very small sample sizes.

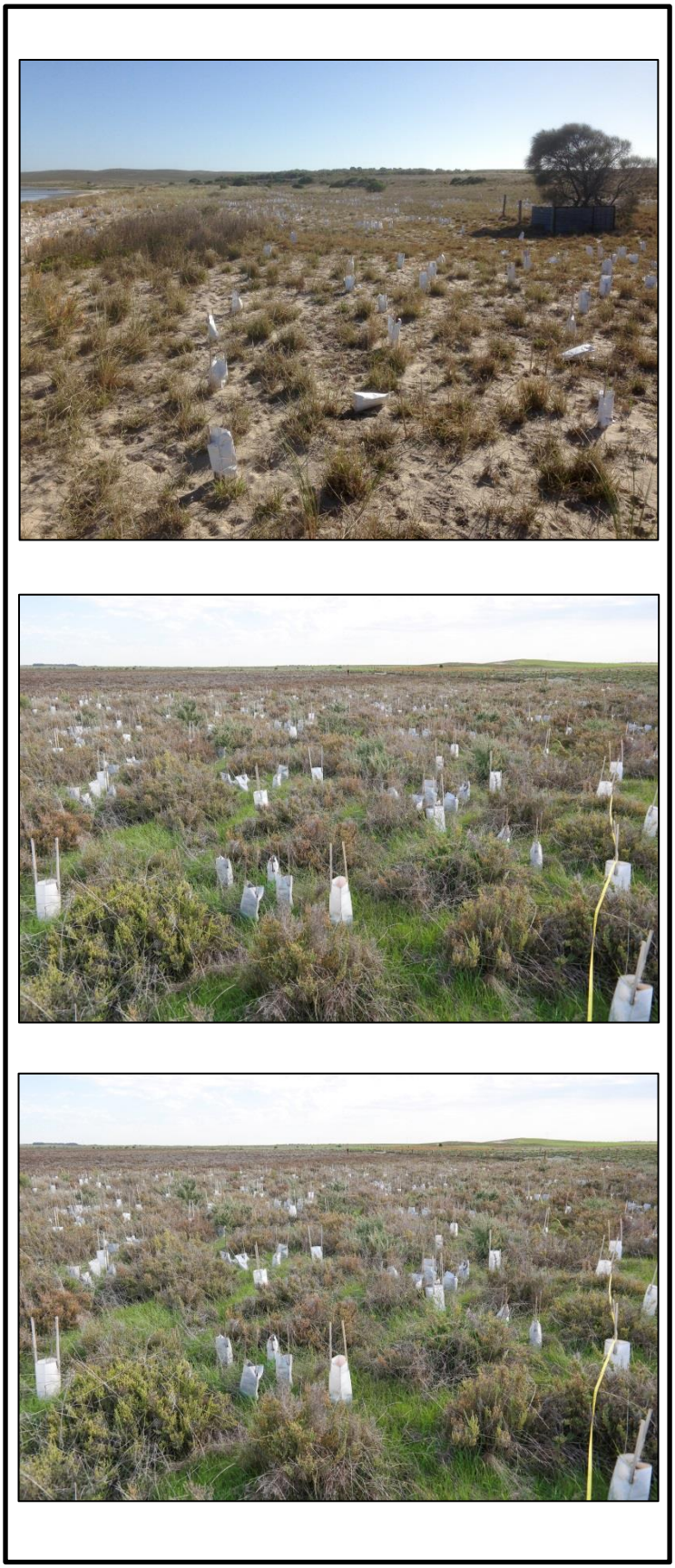


Figure 5 - Three sites with the lowest survivorship levels in autumn 2014 (excl. Low Point Wellington Lodge & Shadows West)

TOP – Dodd's Landing: 19% survivorship

MID – Kindaruar Farm Gahnia: 28% survivorship

BELOW – Yalkuri Gahnia: 45% survivorship

In looking for possible reasons for failure at these sites, it can be first noted that two of the three sites are single-species plantings with just *Gahnia filum* planted in areas zoned *Saline Edge (3).* This can be challenging ground to plant, and in sustained hot, dry conditions the lack of vegetation can accelerate moisture loss and increase soil temperature compared to areas with more ground cover.

However, survivorship across Saline Edge-zoned transects on all sites was 68% - well above the survivorship at these sites. In addition, *Gahnia filum* had a much higher survival rate across all sites of 66% – although this may be artificially high due to the likelihood that some dead plants could not be identified. For these sites, it is likely that site-specific factors such as preparation and planting method had a major influence.

The remaining site – Dodd's Landing – had multiple issues that may have contributed to the low survivorship of 19%. Planting may have occurred late in the season, giving seedlings less time to establish before conditions became dryer. Planting method was poor in places, and potting mix and rootballs were exposed in some instances. Kangaroo and rabbit grazing was also a factor, and weed control was also poor, resulting in challenging conditions all-round for seedlings.

It appears therefore that local factors at these three sites, including soil characteristics and inundation regime, are most likely to have influenced revegetation survivorship success.

4.1.5 Low rainfall

Low rainfall after July 2014 has contributed to drier site conditions than in the previous year and is likely to be affecting seedling survival at many sites. Rainfall measured at nearby locations (refer to Table 10) was significantly below the long term average – particularly in February and March where end of summer rains did not appear as they did in the previous year.

Dry conditions were particularly severe on sandy hills and other areas that retain little moisture, and may have offset improvements made in planting technique and higher rates of guarding.

The lower rainfall could have had some positive impact on areas susceptible to inundation under heavy rain. Signs of non-tidal inundation were not observed in either spring or autumn sampling, reducing a significant factor in plant deaths in 2013.

Table 10 - Monthly total rainfall (mm) across CLLMM planting region
April 2014 to March 2015

		2014									2015		
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Meningie	2014-15	35.8	56.4	111.8	85.6	25.2	23.4	6.6	18.0	19.8	43.6	0.6	8.0
	Mean 1961-90	41.6	50.5	55.9	65.9	62.3	40.7	39.3	28.3	26.8	23.6	16.8	24.0
Narrung	2014-15	24.6	-	94.4	-	16.0	23.6	7.8	-	-	35.2	0.2	5.0
	Mean 1961-90	32.5	45.7	47.7	57.1	53.1	34.2	33.7	23.2	20.4	18.8	16.2	18.0
Finniss	2014-15	26.0	55.8	67.6	75.6	31.0	23.6	4.8	15.0	23.8	22.0	1.8	9.2
	Mean 1961-90	43.1	52.2	54.3	56.2	66.9	47.0	42.8	26.1	22.7	22.6	21.1	24.4

Higher than mean
Lower than mean

4.1.6 Tree guards

Observations

From observations in the field, it appeared that the incidence of unguarded plants decreased from the previous year, with nearly all plants protected by guards in a range of forms, including milk cartons, plastic film guards, corflute, plastic mesh and flexible plastic sleeves. There were notably more sites using sturdier corflute guards than in the previous year of planting. The high usage of guards has helped to keep weedy grasses and grazing animals away from the plants in most instances and may be a factor in the relatively consistent survivorship result.

Unguarded plants have been observed to have lower survivorship rates and plant health, particularly at sites where thick pasture grasses are present. These grasses often smother planted seedlings, significantly reducing their chances of survival.

Most sites use paper guards which are working effectively in most instances but were often knocked over, missing or degraded at sites with high wind exposure or intense browsing and grazing, such as Long Point and Camp Coorong, see Figure 7 and Figure 8.

Figure 6 – A surviving guard protecting a Rhagodia from grazing

Figure 7 – Unguarded plants at Camp Coorong – a below-average survivorship site with heavy grazing

Figure 8 – Snails on degraded milk carton guards at the Jacob site

On Hindmarsh Island, most plants were guarded with plastic film guards, as in the previous year. While these can be susceptible to being blown away by wind in exposed sites, they have been installed with good technique and the guards were working well to provide some weed, weather and browsing protection, see Figure 9.

Figure 9 - Hindmarsh Island (Grey & Mundoo) site: plastic film guards are working well

Guard removal

Some sites may benefit from earlier guard removal for some species, as guards were observed to be restricting their growth. This was seen in particular at the Shaw, Fiebig Reserve, Henschell 2014 and Lifestyles sites.

It was also noted that at some sites where plant growth rates are high and guards are intact, some plants are growing out of the top of the guards and becoming top-heavy (Figure 10). When guards at exposed sites are removed or blow away, the plants are likely to buckle in the wind and fall on their side. This could be partially mitigated by removing guards when plants reach the top of the guard, but would be difficult to time correctly.

Figure 10 - A top-heavy plant at Alexandrina Dairies

4.1.7 Weed management

Many sites contain high loads of weedy grasses such as *Erharta villosa*, *Ehrharta calycina*, *Cynodon dactylon*, *Paspalum* sp., and *Cenchrus clandestinus* and these are competing with planted seedlings for moisture, nutrients and space. Other common and problematic weedy species across sites include *Oenothera stricta*, *Lycium ferocissimum*, *Solanum nigrum*, *Citrullus lanatus* and *Euphorbia terracina*.

Woody weeds such as *Lycium ferocissimum* and *Acacia saligna* have clearly been controlled across most sites, but a few mature individuals remain and work will need to be done to treat emergent seedlings across multiple sites (see Table 12).

It was evident that some good follow-up weed control to combat both pasture grasses and woody weeds is being conducted at several sites, including Shaw, Watkins and Treloar Gahnia, using a variety of methods including cutting at the base, drill and fill and foliar spraying.

The effectiveness of these methods will depend on the method used and the timing, as well as the ability to follow up in subsequent seasons. In the case of Treloar Gahnia, the effectiveness of spraying directly after slashing – with no regrowth to increase uptake of chemical – will become evident later in the year.

It is acknowledged that most revegetation projects need to plant in a set timeframe, which then limits the amount of site preparation that can be performed. In some of the sites, a more comprehensive weed control program over a few successive years could have eliminated many weeds and exhausted seed banks, allowing a relatively weed-free start and a greater chance at revegetation success.

Figure 12 – Treloar Gahnia: a high-survivorship site where there is evidence of active weed management

Figure 11 – Lifestyles: a site where weed control is good between rows but Perennial Veldt grass is invading guards

Despite this, control has made inroads into these issues at many sites, and any follow-up weed work that can be done to maintain the sites in future years will likely be rewarded with greater long term success in those plantings.

4.1.8 Planting method

Sites that appeared to have been scalped and then planted in ripped rows displayed the highest growth levels. Schultz, Lifestyles and Fiebig Reserve were among sites that had plants growing out of the top of the guards and some prostrate plants that measured more than a metre across. This was consistent with the previous year's monitoring, and can be partially attributed to the removal of most of the weed seedbank in the topsoil, and active weed control that is aided by the layout of the site in lanes that allow boom-spraying. This row-based layout – while advantageous during plant establishment and early maintenance stages – may result in an inferior habitat structure when compared to more scattered plantings.

Figure 13 – Vigorous growth at the Schultz site

4.1.9 Comparison with the previous year's monitoring

While it can be difficult to make comparisons across planting years and sites due to the huge range of environmental variables at play, some useful observations can still be made.

Firstly, the relative success of the revegetation plantings in the face of difficult climatic conditions – with two thirds of all plants still alive at the time of monitoring – is a positive result, and could point to improvements in planting method and maintenance. It was noted

that the rate of guarding was higher in 2014, and that there was less of an inundation influence due to a dryer planting season.

The percentage of sites in each of the survivorship percentage categories (Table 4) are very consistent for sites below 60%. However, in the 2013 plantings there was a significantly higher percentage of sites with excellent survivorship of 80% or more, with 30% of all sites compared to 17% in the 2014 plantings (see Table 11).

Table 11 - Summary of autumn sites by survivorship percentage category (2013 and 2014 plantings)

Survivorship category		2013 plantings		2014 plantings	
		# sites	% sites	# sites	% sites
0-20%	Very Poor	2	2.9	1	2.2
20-40%	Poor	3	4.4	2	4.3
40-60%	Average	11	15.9	7	15.2
60-80%	Good	32	46.4	28	60.9
80-100%	Excellent	21	30.4	8	17.4
Total		**69**	**100**	**46**	**100**

The difficult summer period resulted in a similar die-off on both years in terms of total survivorship percentage, with 2013 at 18.6% and 2014 at 19.5%. It should be noted that this figure only addresses plant deaths; the overall health of plants is not formally measured. While 2014 plantings may be more likely to be stressed by the lack of moisture, this is not visible in the overall survivorship score.

4.1.10 Issues locating sites and waypoints

Site access

All sites were easily accessible using the maps provided, and instructions were clear for accessing locked gates or considerations such as appropriate visiting times and clean-down procedures. Any remaining questions were well answered by landholders or by DEWNR staff.

Most landholders were contactable immediately prior to visiting sites, and while some were difficult to contact, it was possible given a few days. As in previous monitoring, landholders or custodians were generally very supportive of both the revegetation and the monitoring, and were accommodating when contact needed to be made.

Mapping discrepancies

The maps and directions supplied by DEWNR were prepared well and were critical to locating sites and transects efficiently.

Site maps were accurate most of the time, but in multiple instances the polygons that transects had been placed into didn't match the planting areas on the ground. This was usually a case of certain areas not being planted, and transects were moved into nearby areas, or skipped if not practicable.

It would have been advantageous for sites to be ground-truthed prior to the generation of random waypoints to confirm actual planting areas – particularly in community sites.

Site names on maps

On Hindmarsh Island, maps didn't list site names, and this could not be derived from the survivorship database as the site name was listed as "Hindmarsh Island". These site names were derived from discussions with Richard Owen from the Hindmarsh Island Landcare Group, and by using the document *Hindmarsh Island – Multiple Sites Action Plan* supplied by DEWNR.

4.1.11 Other survey limitations

Mixed-age and infill plantings

The number one limitation of the survey method was in dealing with mixed age plantings. In some sites, the areas planted in 2014 also contained significant numbers of older plants. In this case, obviously mature age (est. > 3y) were not counted, but where the age was not easily determined and transects could not be relocated, these areas were skipped.

As was the case in the previous year's monitoring, this issue was particularly evident at the Hindmarsh Island community planting sites, with most sites subject to infill plantings across the past few years. Of course, this has definite benefits in terms of revegetation success as it allows replacement of dead plants and density to be increased where needed, but it makes the task of monitoring plants from a particular planting period very difficult.

While the site maps showed the planned planting area, the actual area planted in infill sites was seldom provided to DEWNR, making transect selection difficult. However, Richard Owen from the Hindmarsh Island Landcare Group was particularly useful in both determining the few areas that could be surveyed accurately for 2014 plantings, and those sites which were too difficult.

Patchy plantings

In 'patchy' sites that have non-contiguous sections of vegetation, it can be difficult to find sufficiently-sized areas to run a 50m transect. This problem was run into at Milang Common, and the existing methodology was difficult to apply and not considered appropriate for the small, patchy nature of the site. Again, ground-truthing before the generation of waypoints may have helped.

Sites with few transects

For smaller sites with fewer transects, the survivorship rates of the few transects completed may not accurately reflect the overall condition of the plantings. A “bad transect” with low survival may markedly decrease the survivorship score for a site, while the rest of the site may have higher survival rates. This is a minor (but unavoidable) drawback of the process of randomly assigning transect locations.

Difficulty finding dead plants

With the decrease in unguarded (but staked) plants from the previous year’s monitoring, there were fewer issues in finding dead plants, but this issue was still present on occasion. It could be remedied by guarding all plants, and the fact that less unguarded plants were found may indicate an improvement in this component of the planting method.

5. RECOMMENDATIONS

5.1. General management recommendations

Based on the results of the survivorship monitoring, key recommendations proposed for consideration include:

1. Ensure that follow up weed control is maintained across sites, such as slashing of weedy grasses and removal or chemical treatment of problematic weeds. Effective implementation of this will involve regular checks on sites and reporting any emergent weed outbreaks for management, along with continuing control measures for existing weeds.

2. Control measures should be implemented immediately on spreading weeds such as *Emex australis* and *Gazania* sp. Refer to Section 5.2 for a list of significant management issues.

3. Continue to use guards around plants wherever possible in future plantings to reduce grazing and competition from weedy grasses. Use of guards appeared to be higher than in the previous year of monitoring (2013/14). A stronger guard (i.e. corflute) may be of value at sites that are subject to factors that degrade 'milk carton' guards, such as high moisture, high levels of grazing or the presence of large numbers of kangaroos, but involves a significantly higher cost.

4. Remove guards at some sites, where plants are growing out of the top of the guards. This can restrict growth in some instances, resulting in misshapen and unhealthy plants.

5. Continue to work with nearby landholders to report and manage the impacts of pest animals such as hares and rabbits to minimise impacts on plantings. These species have significant impacts on site condition through diggings, and affect plant survivorship through grazing pressure.

6. For sites with markedly low survivorship rates, factors such as site preparation, planting method and inundation levels should be reviewed and recorded. This may result in some insight into the factors that may have contributed to plant death and help prevent similar problems occurring in future plantings.

7. Some sites with high survival rates were anecdotally noted to have markedly different site preparation and planting methods. These should be reviewed and analysed in order to determine any correlation between survivorship and combinations of site history, soil type, topography, hydrology, site preparation, species selection, planting method, and post-planting maintenance. Sites prepared using soil scraping and planted in rows appeared to have the strongest plant health and high survivorship; however, these

preparation methods may have ecological drawbacks. Without access to information about site preparation and planting method any comparison between methods remains subjective.

8. Implement an abbreviated version of the survivorship survey at 3 to 5 years after planting. This would help to indicate the longer-term success of the plantings and aid in planning adjacent and infill plantings to help continue the transition of sites to a species composition reflecting remnant native vegetation.

9. Where sites are subject to infill plantings, it is recommended that a different guard or a painted stake is used. Marking or painting the top of stakes could be done in bulk quite quickly before being used in planting, and using a particular colour for a given planting period would offer an easy way of identifying plants from other periods. This would add considerable value at sites such as those found on Hindmarsh Island, where uncertainty in mixed-age plantings made surveying difficult or impossible.

10. In reference to 9. above: If different guards or painted stakes are not practicable, a different method for monitoring infill sites needs to be designed. This may involve a more ad-hoc method that is not tied to the 50m transect, as it can be difficult to find such a long stretch of plants in some sites. Whatever the method chosen, it will remain dependent on finding the locations of the correct plantings from those who have planned and planted the sites. It should be noted that using a different survey method will limit the ability to compare restoration success between sites and across years.

11. Where justified, ground-truth planting areas or zones post-planting but prior to creating waypoints for monitoring.

5.2. Site specific management recommendations

Autumn site specific management recommendations are included in Table 12. Recommendations resulting from the spring surveys were not revisited during autumn monitoring due to time constraints, but are also included for reference in Table 13, as some actions may still be relevant.

Table 12 - Autumn 2015 monitoring - management recommendations

Site name	Location (E/N)	Issue/recommendation
Alexandrina Dairies Highway	Across site	*Acacia saligna* control needs to be followed-up as some are re-shooting. Previously-treated saplings are also reshooting.
Blake Community	306317/6076803	Fruiting *Solanum nigrum*.
Fiebig Reserve	Site entrance from road	*Emex australis* noted at entrance. Recommend chemical treatment, removal of seed and signage.

Henschel	339754/6061035	Mature *Lycium ferocissimum*. There were also numerous juvenile plants. Ongoing control required.
Hindmarsh Island - Farrow	Across site	Some African Boxthorn are regenerating. Advise chemical treatment.
Hindmarsh Island – Hartill	Across site	Ongoing *Lycium ferocissimum* control required (seedlings).
Hindmarsh Island – Pomeroy	Across site	Ongoing *Lycium ferocissimum* control required.
Hongs Bluff	330466/6065494	*Chondrilla juncea* present. Not much seen on site so may be worth controlling.
Jockwar Lake Edge	Site	Possible off-target damage from baiting. A dead hawk was seen, and neighbours reported several dead hawks which may have been off-target deaths from rabbit/fox baiting.
Long Point	335015/6057615 and 335238/6057729	Mature *Solanum linnaeanum* individuals. May be worth controlling as no others were seen.
	Across site	Small numbers of juvenile *Lycium ferocissimum*.
Lifestyles	Across site	Some fruiting *Cucumis myriocarpus* seen.
Mundoo Massive	Eastern end of site	*Gazania* sp. is present and spreading on the eastern end of this site and should be controlled – high priority.
Treloar Lucky	336459/6052404	Much recent weed control observed, but some juvenile *Lycium ferocissimum* and *Xanthium spinosum* still remain. Advise ongoing chemical treatment.

Table 13 - Spring 2014 monitoring - management recommendations

Site name	Location (E/N)	Issue/recommendation
Alexandrina Dairies Highway	Across site	Juvenile *Asparagus asparagoides* individuals common across site. Advise follow-up removal/spot spraying.
	Northern end of site	*Pennisetum clandestinum and Ehrharta spp.* grasses are recovering at the northern end of the site and will need treatment soon. Blue lupins common.
	Across site	*Acacia saligna* and other woody weeds shooting after initial treatment. Advise follow up treatment.
Camp Coorong		*Asparagus asparagoides* seen in the adjacent carpark.
Noonameena	0343008/6041598	*Lycium ferocissimum* individual.
	0342865/6042049	*Asparagus asparagoides* individual.
Watkins	East end of site	One *Disa bracteata* individual found and reported to GWLAP in 2014.

6. REFERENCES

DEH (2010) *Securing the Future: Long Term Plan for the Coorong, Lower Lakes and Murray Mouth*. Department for Environment and Heritage: Adelaide, South Australia.

Durbridge, R. (2012) *Vegetation Survivorship Monitoring of the Community Revegetation Project Summary Final Report – June 30th 2012.* Goolwa to Wellington Local Action Planning Association.

Tuck, J. and Bachmann, M. (2014) *CLLMM Vegetation Survivorship Monitoring (2013 Plantings).* Report to the Department of Environment, Water and Natural Resources, Government of South Australia. NGT Consulting, Mount Gambier, South Australia.

7. APPENDIX A. SITE DATASHEET

Form 1: Vegetation Survivorship Monitoring Site Summary

Plan ID:	Site Name:

Transects (WaypointID) completed:

Photo points taken:

Camera Ref #	Easting	Northing	Bearing	Height

Anecdotal Observation:

e.g. evidence of pest animals, general health/vigour of plants and pest plant impacts.

8. APPENDIX B. TRANSECT DATASHEET

Form 2: Vegetation Survivorship Monitoring Transect Datasheet

WaypointID:

Transect Direction (compass bearing)

Observers:

Date:

Time:

Survey:

Line A or B	Species	Alive	Dead

Line A or B	Species	Alive	Dead

9. APPENDIX C. FULL SURVIVORSHIP RESULTS BY SPECIES

Species	Plants	Alive	Dead	Survival (%)
Acacia acinacea	10	10	0	100
Acacia brachybotrya	16	15	1	93.8
Acacia calamifolia	110	93	17	84.5
Acacia cupularis	356	307	49	86.2
Acacia dodonaeifolia	166	160	6	96.4
Acacia hakeoides	9	8	1	88.9
Acacia leiophylla	140	98	42	70.0
Acacia ligulata	15	15	0	100
Acacia longifolia ssp. *sophorae*	285	216	69	75.8
Acacia microcarpa	9	8	1	88.9
Acacia myrtifolia	90	58	32	64.4
Acacia paradoxa	215	178	37	82.8
Acacia provincialis	11	11	0	100
Acacia pycnantha	602	400	202	66.4
Acacia spinescens	110	96	14	87.3
Acaena novae-zelandiae	69	51	18	73.9
Adriana quadripartita	102	65	37	63.7
Allocasuarina muelleriana ssp.	24	23	1	95.8
Allocasuarina paludosa	22	20	2	90.9
Allocasuarina pusilla	18	8	10	44.4
Allocasuarina sp.	266	245	21	92.1
Allocasuarina verticillata	1850	1498	352	81.0
Arthropodium fimbriatum	6	6	0	100
Arthropodium strictum	10	5	5	50.0
Atriplex acutibractea ssp.	2	2	0	100
Atriplex paludosa ssp.	1137	1103	34	97.0
Atriplex rhagodioides	32	32	0	100
Atriplex semibaccata	950	913	37	96.1
Atriplex suberecta	256	238	18	93.0
Austrostipa elegantissima	75	68	7	90.7
Austrostipa flavescens	95	86	9	90.5
Austrostipa mollis	1	1	0	100
Austrostipa sp.	328	277	51	84.5
Banksia marginata	27	22	5	81.5
Banksia ornata	69	49	20	71.0
Billardiera cymosa	366	359	7	98.1
Bursaria spinosa ssp.	689	533	156	77.4
Callistemon rugulosus	59	53	6	89.8
Callitris gracilis	230	202	28	87.8

Species	Plants	Alive	Dead	Survival (%)
Calytrix tetragona	2	2	0	100
Carex appressa	30	19	11	63.3
Carpobrotus rossii	273	240	33	87.9
Clematis microphylla	325	311	14	95.7
Correa reflexa	3	3	0	100
Cyperus gymnocaulos	187	126	61	67.4
Daviesia benthamii ssp.	9	8	1	88.9
Daviesia pectinata	1	0	1	0.0
Dianella brevicaulis	272	236	36	86.8
Dianella revoluta	99	90	9	90.9
Dianella sp.	283	238	45	84.1
Disphyma crassifolium ssp.	471	455	16	96.6
Dodonaea baueri	32	28	4	87.5
Dodonaea viscosa ssp.	515	466	49	90.5
Dodonaea viscosa ssp. *angustissima*	1	1	0	100
Duma florulenta	240	214	26	89.2
Duma horrida ssp. *horrida*	17	17	0	100
Einadia nutans ssp.	192	189	3	98.4
Enchylaena tomentosa ssp.	661	645	16	97.6
Eucalyptus baxteri	83	47	36	56.6
Eucalyptus camaldulensis ssp.	18	18	0	100
Eucalyptus diversifolia	380	284	96	74.7
Eucalyptus fasciculosa	220	210	10	95.5
Eucalyptus incrassata	213	186	27	87.3
Eucalyptus leucoxylon	24	21	3	87.5
Eucalyptus odorata	64	60	4	93.8
Eucalyptus porosa	175	157	18	89.7
Eucalyptus socialis ssp.	9	8	1	88.9
Eucalyptus sp.	38	5	33	13.2
Eutaxia microphylla	22	17	5	77.3
Ficinia nodosa	3029	2014	1015	66.5
Gahnia filum	4832	3204	1628	66.3
Goodenia ovata	27	26	1	96.3
Hakea mitchellii	218	207	11	95.0
Hakea rostrata	3	2	1	66.7
Hakea sp.	26	22	4	84.6
Hakea vittata	42	40	2	95.2
Hibbertia sericea	2	2	0	100
Hibbertia sp.	30	11	19	36.7
Juncus kraussii	1177	688	489	58.5
Juncus pallidus	19	2	17	10.5
Juncus pauciflorus	19	14	5	73.7
Kennedia prostrata	147	126	21	85.7

Species	Plants	Alive	Dead	Survival (%)
Kunzea pomifera	166	107	59	64.5
Lasiopetalum baueri	22	17	5	77.3
Lawrencia squamata	8	8	0	100
Leptospermum continentale	9	8	1	88.9
Leptospermum coriaceum	1	1	0	100
Leptospermum myrsinoides	465	373	92	80.2
Leucophyta brownii	54	48	6	88.9
Leucopogon parviflorus	24	9	15	37.5
Linum marginale	16	15	1	93.8
Lomandra juncea	1	1	0	100
Lomandra leucocephala	8	8	0	100
Lomandra sp.	11	11	0	100
Lotus australis	14	14	0	100
Maireana brevifolia	681	657	24	96.5
Maireana oppositifolia	832	800	32	96.2
Melaleuca acuminata ssp. *acuminata*	73	60	13	82.2
Melaleuca brevifolia	35	30	5	85.7
Melaleuca decussata	8	7	1	87.5
Melaleuca halmaturorum	1235	985	250	79.8
Melaleuca lanceolata	730	541	189	74.1
Melaleuca uncinata	168	156	12	92.9
Muehlenbeckia adpressa	6	6	0	100
Muehlenbeckia gunnii	121	116	5	95.9
Myoporum insulare	607	573	34	94.4
Myoporum parvifolium	1	1	0	100
Nitraria billardierei	36	35	1	97.2
Olearia axillaris	1405	1238	167	88.1
Olearia ramulosa	96	92	4	95.8
Pelargonium australe	238	226	12	95.0
Pimelea humilis	17	16	1	94.1
Pittosporum angustifolium	23	23	0	100
Platylobium obtusangulum	2	1	1	50.0
Poa labillardieri var. labillardieri	747	558	189	74.7
Poa poiformis	220	72	148	32.7
Poa sp.	572	408	164	71.3
Puccinellia stricta	819	574	245	70.1
Pultenaea densifolia	6	6	0	100
Rhagodia candolleana ssp.	436	418	18	95.9
Rhagodia crassifolia	3	3	0	100
Rytidosperma caespitosum	268	163	105	60.8
Rytidosperma sp.	465	321	144	69.0
Senecio odoratus	2	2	0	100
Senecio phelleus	6	5	1	83.3

Species	Plants	Alive	Dead	Survival (%)
Senecio picridioides	1	1	0	100
Senecio pinnatifolius	46	29	17	63.0
Senecio sp.	4	2	2	50.0
Senna artemisioides ssp.	27	25	2	92.6
Solanum aviculare	19	8	11	42.1
Solanum laciniatum	37	36	1	97.3
Tetragonia implexicoma	326	310	16	95.1
Themeda triandra	39	36	3	92.3
Thomasia petalocalyx	8	6	2	75.0
Threlkeldia diffusa	139	136	3	97.8
Vittadinia cuneata ssp.	43	24	19	55.8
Vittadinia megacephala	7	4	3	57.1
Vittadinia scabra	1	1	0	100
Vittadinia sp.	95	84	11	88.4
Xanthorrhoea caespitosa	169	131	38	77.5
Xanthorrhoea semiplana ssp.	63	58	5	92.1
Another species	195	187	8	95.9
Dead (unknown species)	6615	0	6615	0.0
Total 133 identified to species level	**41748**	**28037**	**13711**	**67.0**

10. APPENDIX D. INDIVIDUAL SITE SUMMARIES

10.1. Notes for referring to this section

Site maps

Where a site map includes multiple sites, a listing of waypoints is included with the site notes for reference.

Detailed site survivorship data

Plant counts by site are available in the tables in Section 3. In some cases, a site justifies further details to be included in this report due to poor survivorship or large changes between the spring and autumn counts; this is included with the site notes. This way, the most relevant data is highlighted.

Full survivorship count data for each site, including dead and alive by polygon, zone, transect, and species, is available in the database **survival_rel.accdb**.

10.1.1 Alexandrina Dairies Hwy - PlanID 356

10.1.1.1 Site maps


Legend
Zones_2014
0. Inundated
1. Lake / Lagoon edge
2. Saline Swamp
3. Saline Edge
4. Rising Ground
5. Slope/Embankment
6. Cliff
7. Cliff Top
8. Sandhill
9. Other Inland
10. Coastal
13. Blow-out
Alexandrina Dairies Hwy
Fiebig Hwy
N
0 30 60 120 180 240
Meters

10.1.1.2 Site photo

10.1.1.3 Survivorship results

Alexandrina Dairies Hwy	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	3007	442	3043	1190
Survival	**87.2 %**		**71.9 %**	

Plant health and survivorship was variable across the site, but all plants were commonly competing with emerging weeds, including high loads of *Ehrharta villosa* that were often in the guards. Despite this, survivorship was above average with a moderate drop of 15% since spring. Over 60% of plantings were in the Sandhill zone (8) which recorded 71% survivorship, while, Saline Edge (3) plantings were at 60%.

Survivorship seemed better on the upper (northern) parts of the site. Some grazing of seedlings was noted – particularly of *Allocasuarina verticillata* in the south. *Euphorbia terracina* was widespread, along with *Cynodon dactylon* and *Ehrharta calycina* grasses. *Chondrilla juncea* was a problem on the sandy soils, and chemical control may be needed as it is widely established.

10.1.2 Blake Community 2014 - PlanID 376

10.1.2.1 Site map

10.1.2.2 Site photo

10.1.2.3 Survivorship results

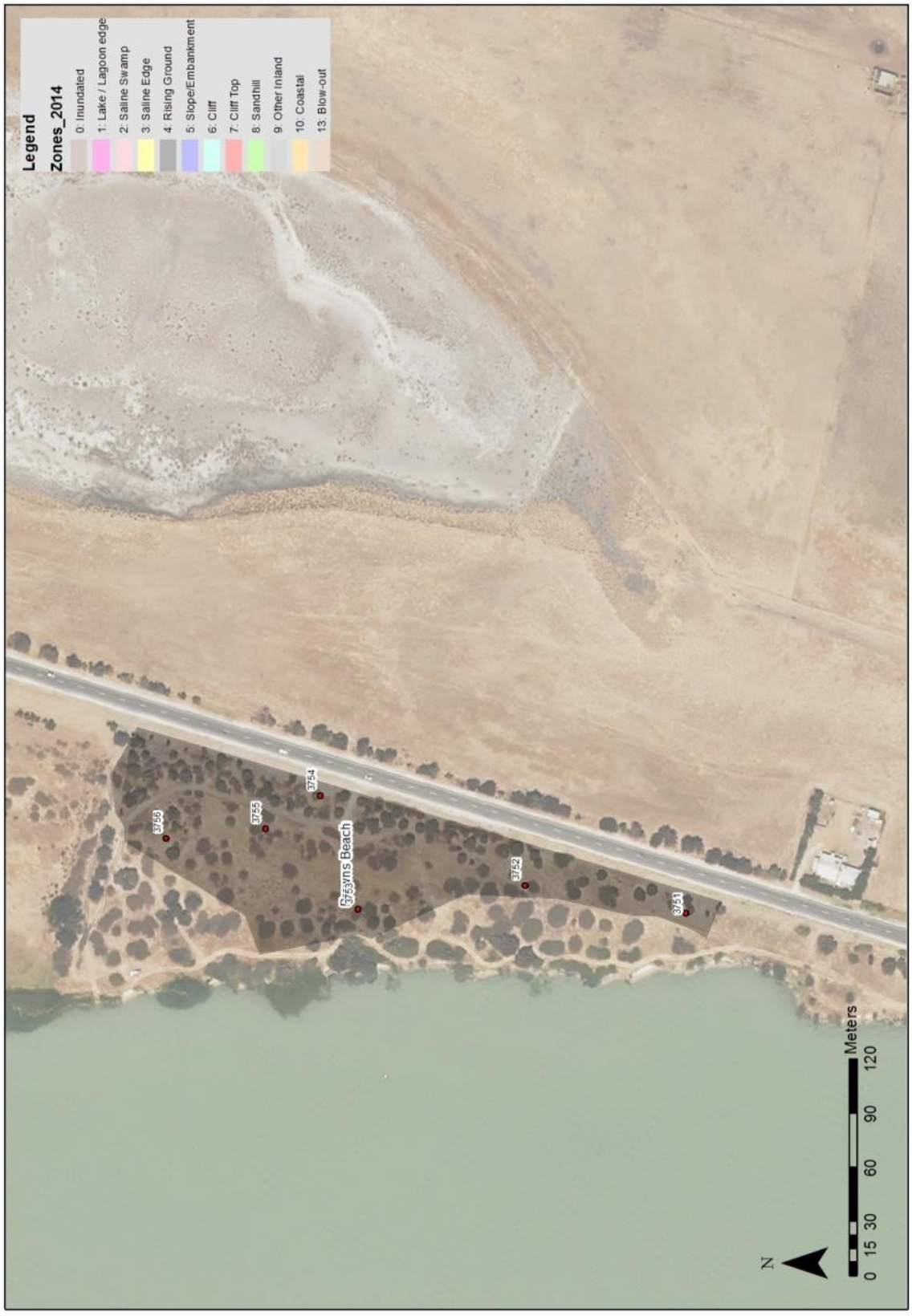
Blake Community 2014	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		363	133
Survival	**-**		**73.2 %**	

The site was characterised by patchy infill planting among older (2013) revegetation. Plant vigour appeared average to good in patches. Only one zone was planted – Sandhill (8) – but species diversity was quite high with nearly 40 species counted. The site was very exposed with guards blown from stakes in places.

Gomphocarpus cancellatus is invading the site and should be controlled, otherwise no significant pest plant or animal impacts were noted. *Solanum nigrum* is common but not expected to cause long term competition.

10.1.3 Browns Beach - PlanID 377

10.1.3.1 Site map



10.1.3.2 Site photo

10.1.3.3 Survivorship results

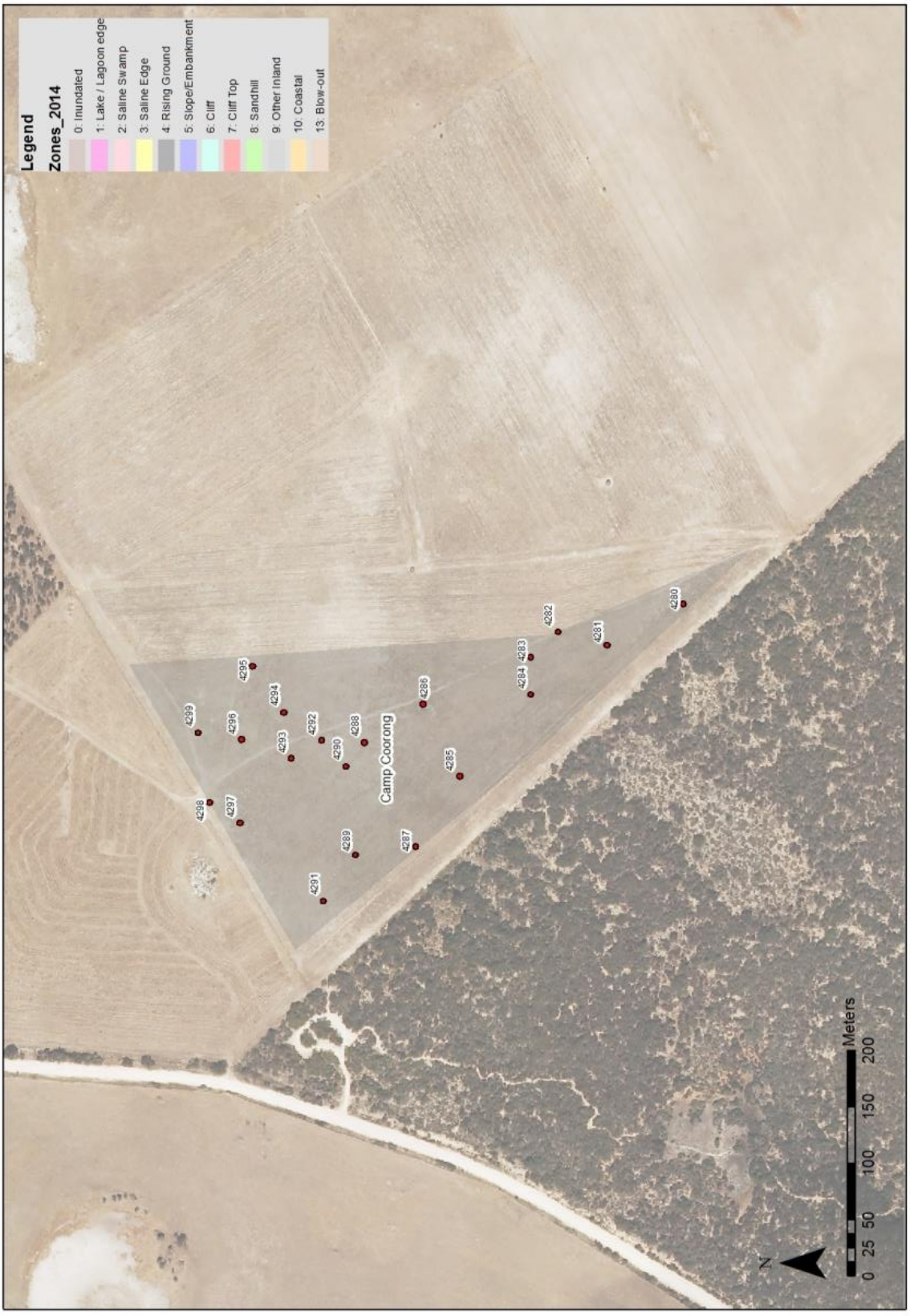
Browns Beach	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		124	42
Survival	**-**		**74.7 %**	

One zone – Rising Ground (4) – was planted, and only 9 species were recorded. Survivorship and vigour was generally good at 75%. All of the dead plants counted were *Rytidosperma* sp. and it is possible that a few of these were dormant rather than dead.

Some transects were skipped as only the southern end of the polygon appeared to be planted in 2014. Mapping was not quite accurate for the 2014 plantings, with the site extending 100m further south in a narrow strip.

10.1.4 Camp Coorong - PlanID 407

10.1.4.1 Site map



10.1.4.2 Site photo

10.1.4.3 Survivorship results

Camp Coorong	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	366	44	560	293
Survival	**89.3 %**		**65.7 %**	

One zone (Other Inland – 9) was planted at the site. Plant health and vigour was variable, with some plants showing exceptional growth while others – particularly those which had been grazed, were struggling. A notably weedy site, with many weed species present. There were high loads of *Oenothera stricta*, along with *Solanum nigrum*, *Cirsium vulgare*, *Euphorbia terracina* and *Marrubium vulgare*.

Heavy grazing of seedlings was noted across the site, and was particularly severe on *Allocasuarina verticillata*, with many grazed down to the ground. Other species which appeared to be heavily grazed included *Acacia cupularis* and *Rhagodia candolleana*. Many guards had been lost to the wind or grazing animals, or hadn't been installed in the first place, as can be seen in the photopoint image above.

10.1.5 Clayton Bay Foreshore - PlanID 378

10.1.5.1 Site map

10.1.5.2 Site photo

10.1.5.3 Survivorship results

Clayton Bay Foreshore	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		202	63
Survival	**-**		**76.2 %**	

The site was mostly hilly and covered zones Rising Ground (4), Cliff (6) and Cliff Top (7), with Rising Ground making up most of the plantings. Survivorship was good overall and plants were generally healthy but competing with weed cover. There were lots of infill plantings, which made discerning the new plantings difficult and some transects had to be skipped to retain accuracy.

Flexible plastic guards were used and some rabbit diggings were noted, but this seemed to have little impact on plants. The site was noted to be quite weedy, with broadleafs and tall pasture grasses over the rocky slopes.

10.1.6 Connelly - PlanID 379

10.1.6.1 Site map

10.1.6.2 Site photo

10.1.6.3 Survivorship results

Connelly	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	Not surveyed		339	84
Survival	-		**80.1 %**	

Survivorship was good and at 80% was well above average for the only zone planted – Other Inland (9) – which recorded 62% across all sites. Plants were generally healthy and growing well and there were no significant pest plant or animal issues.

Some *Oxalis pes-caprae* was noted, and pasture grasses were dominant across the site but these were mostly low and not smothering seedlings or guards.

There was minor grazing and the landholders mentioned that there were rabbits burrowing around buildings.

10.1.7 Council Triangle - PlanID 380

10.1.7.1 Site map

10.1.7.2 Site photo

10.1.7.3 Survivorship results

Council Triangle	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	Not surveyed		217	119
Survival	-		**64.6 %**	

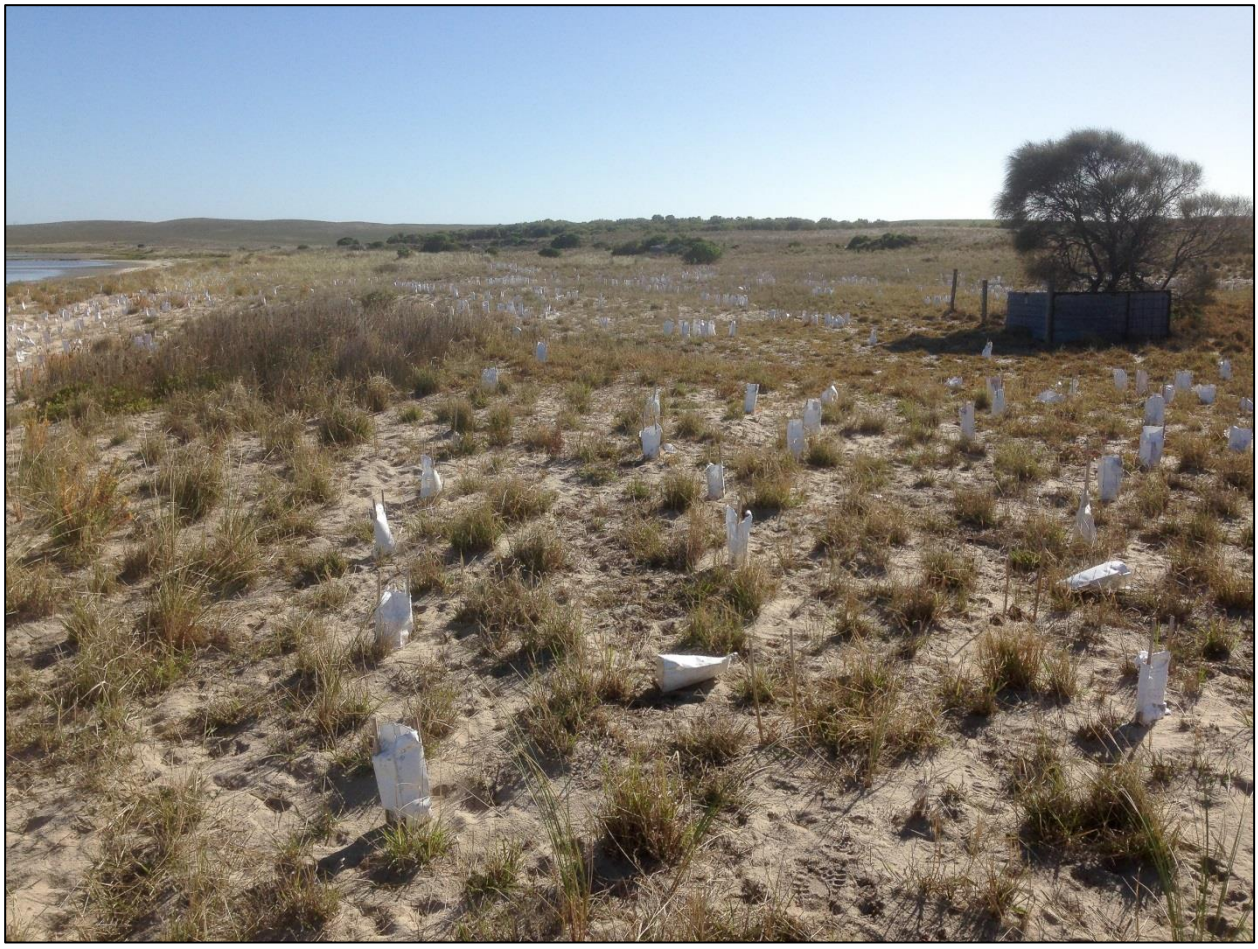
Survivorship was slightly below average at 65%. Most plantings were in the Sandhill (8) zone which at 60% was lower than the average across all sites of 69%.

2014 infill was difficult to differentiate from 2013 plants due to widespread rapid guard disintegration and patchy grazing pressure. Extensive *Acacia saligna* and *Xanthium spinosum* follow-up control was evident, but there may have been some off-target damage to seedlings – this is acknowledged as difficult to avoid due to weed density and proximity.

10.1.8 Dodd's Landing - PlanID 408

10.1.8.1 Site map

10.1.8.2 Site photo



10.1.8.3 Survivorship results

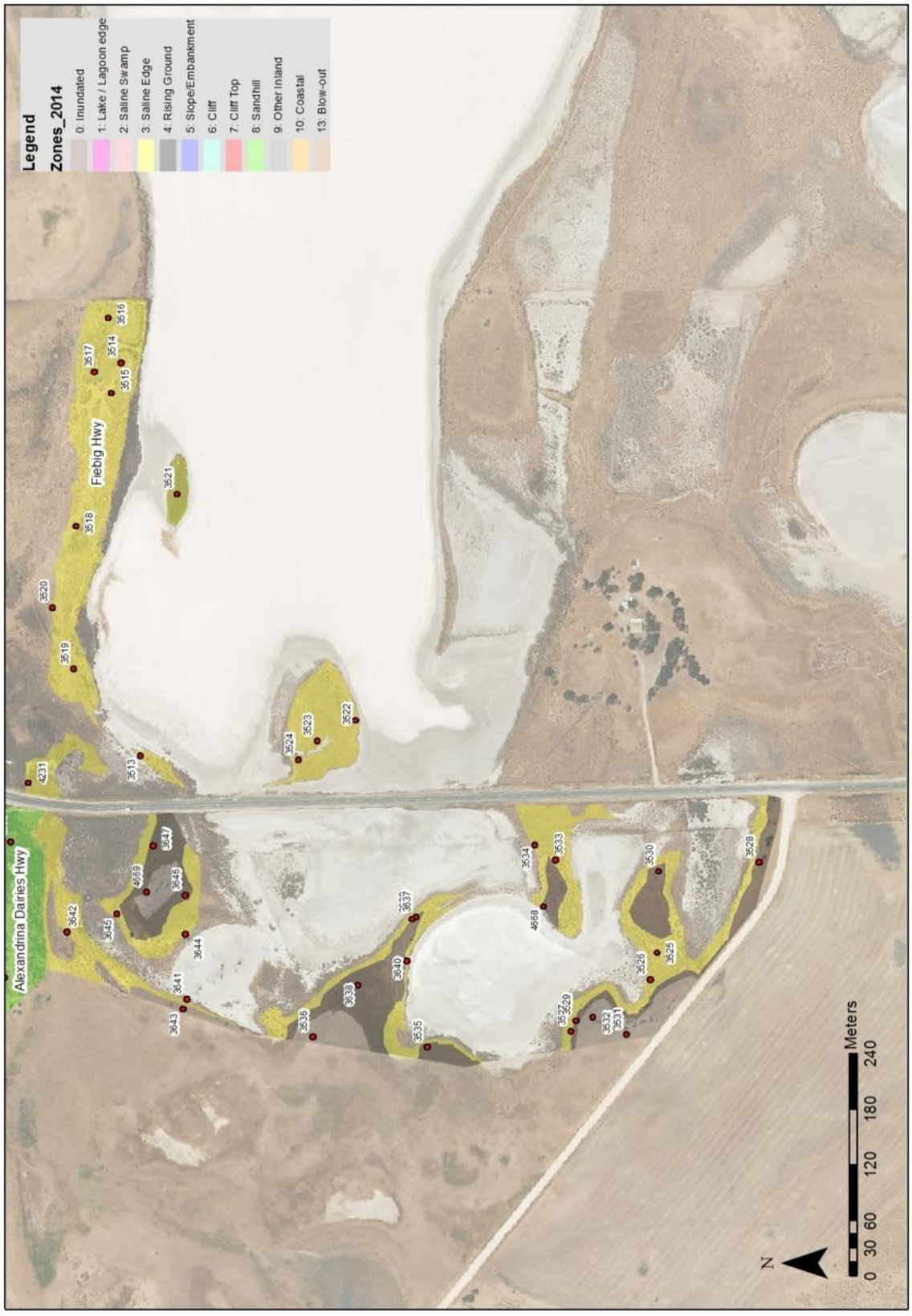
Dodd's Landing	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		236	980
Survival	**-**		**19.4 %**	

One zone was planted (Other Inland – 9). With the exception of the northern corner and north-east boundary of the site, there were very poor results at just 19% survival. Most species were struggling, and there was almost total die off of *Melaleuca* sp., *Acacia* sp., and *Ficinia nodosa*. Seedlings may have been disadvantaged from being planted late in the season and there was also some evidence of poor planting method with potting mix and rootballs exposed.

Rabbits and foxes were present and some evidence of kangaroo damage to guards, with a large mob of kangaroos seen on site. Weed control was generally poor, but with the low survivorship results in mind, these weeds are helping to maintain ground cover on the sandy site and could help to reduce erosion.

10.1.9 Fiebig Highway - PlanID 355

10.1.9.1 Site map



10.1.9.2 Site photo

10.1.9.3 Survivorship results

Fiebig Highway	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	190	13	190	160
Survival	**93.6 %**		**54.3 %**	

Most plants were reasonably healthy, but survivorship was generally poor. It can be seen from the table above that there was a large drop-off in survivorship between the spring and autumn counts – nearly 40% lower. Most dead plants could not be identified, but the survival of the sedges *Ficinia nodosa* and *Juncus kraussii* was notably poor.

The planting area was mostly lake edge with Samphire ground cover and pasture grasses, and all plantings were in the Saline Edge zone (3). Some patches of *Ficinia nodosa* were dead where they had been inundated after being planted on lower ground. Similarly, many *Melaleuca halmaturorum* seedlings were dead where they had been planted on rises. One fox was spotted on the site, and no grazing or significant weed issues were noted.

10.1.10 Fiebig Reserve - PlanID 382

10.1.10.1 Site map

10.1.10.2 Site photo

10.1.10.3 Survivorship results

Fiebig Reserve	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	Not surveyed		294	68
Survival	-		**81.2 %**	

The site comprised all Saline Edge (3) plantings, and displayed excellent plant health and growth from plantings in ripped rows. The planting area was mostly covered in pasture grasses with some *Atriplex* sp. and older *Melaleuca halmaturorum*.

Four transects were in older revegetation with lots of die-off, including areas of unguarded stakes with no sign of planted seedlings. The two transects that were in new revegetation were typical of the patch and gave a decent reflection of survivorship. A patch of *Emex australis* was noted at the entrance to the site and is detailed in Section 5.2.

10.1.11 Grey & Mundoo - PlanID 381

10.1.11.1 Site maps


Legend
Zones_2014
0: Inundated
1: Lake / Lagoon edge
2: Saline Swamp
3: Saline Edge
4: Rising Ground
5: Slope/Embankment
6: Cliff
7: Cliff Top
8: Sandhill
9: Other Inland
10: Coastal
13: Blow-out
Grey & Mundoo
Hindmarsh Island 2014
4115
4116
4117
4118
4119
4120
4121
4122
4425
4426
4427
4428
4429
4430
4431
4432
4433
4034
4036
4037
N
0 35 70 140 210 280
Meters


Legend
Zones_2014
0: Inundated
1: Lake / Lagoon edge
2: Saline Swamp
3: Saline Edge
4: Rising Ground
5: Slope/Embankment
6: Cliff
7: Cliff Top
8: Sandhill
9: Other Inland
10: Coastal
13: Blow-out
Hindmarsh Island 2014
Grey & Mundoo
N
0 25 50 100 150 200
Meters

10.1.11.2 Site photo

10.1.11.3 Survivorship results

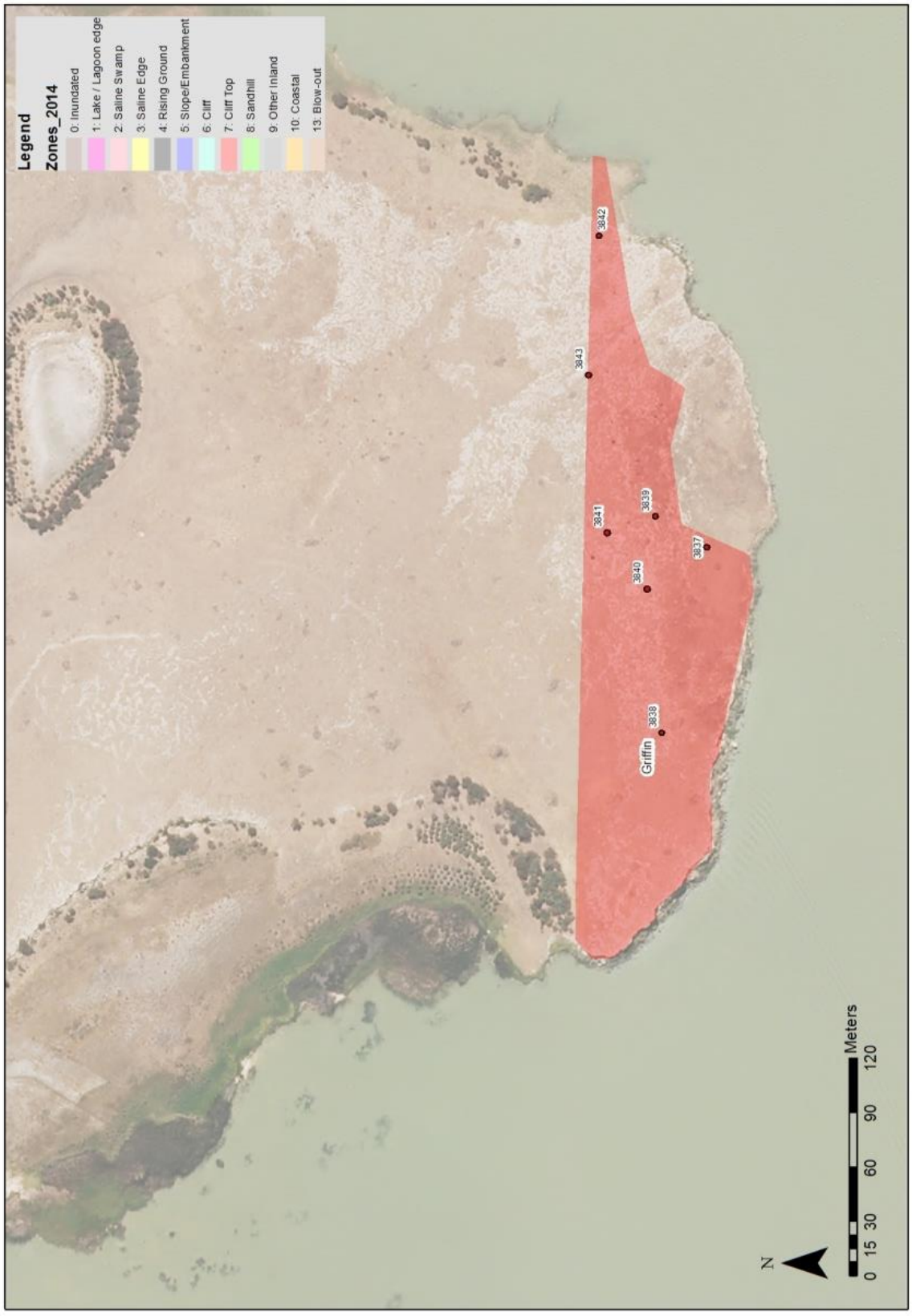
Grey & Mundoo	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	Not surveyed		397	54
Survival	-		**88.0 %**	

This was an infill site and some areas could not be surveyed due to difficulty discerning between plantings, but those areas surveyed showed excellent survivorship and vigour. Most of the northern areas were planted with *Melaleuca halmaturorum* which were looking healthy, as were other species around the site. Zones surveyed were Saline Edge (3) with a smaller amount of Inundated (0).

There were some areas of tall *Ehrharta villosa*, which are of management concern but common across the island. No other major weed or grazing issues were noted.

10.1.12 Griffin - PlanID 385

10.1.12.1 Site map



10.1.12.2 Site photo

10.1.12.3 Survivorship results

Griffin	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		138	38
Survival	**-**		**78.4 %**	

All plants surveyed were in the Cliff zone (7), and Survivorship was very good at 78% considering the shallow soils and exposed location.

Planting was at a lower density due to infill of past work and sheet limestone, but general vigour and survival appeared good. Control of *Lycium ferocissimum* across the site was observed. Two hares were observed but grazing pressure appeared low.

10.1.13 Henshell 2014 - PlanID 386

10.1.13.1 Site map

10.1.13.2 Site photo

10.1.13.3 Survivorship results

Henshell 2014	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	197	58	390	144
Survival	**77.3 %**		**73.0 %**	

Mostly good survivorship across the site, but it was noted that Rising Ground (4) zone plantings struggled with 55% survivorship – compared to 81% for Saline Swamp (2) and 85% for Saline Edge (3). There was very little drop off in survival from spring to autumn, and plants were mostly healthy, with good growth as typical of sites planted in ripped rows.

A mature *Lycium ferocissimum* was seen with a scattering of smaller individuals also present. Pasture grasses were widespread but no other significant weed issues were noted. There was no evidence of grazing pressure on the plants. Guards are in need of removal around many plants, as they are restricting growth.

10.1.14 Hindmarsh Island – Farrow - PlanID 381

10.1.14.1 Site map

Site contained transects 3803, 3804, 3805 and 3806

10.1.14.2 Site photo

10.1.14.3 Survivorship results

Survivorship and plant health was generally good. Planted species diversity was impressive. Site was largely ok in terms of weeds, but some *Lycium ferocissimum* that had been treated were seen to be regenerating.

10.1.15 Hindmarsh Island – Ferrymans Reserve - PlanID 381

10.1.15.1 Site map

10.1.15.2 Site photo

10.1.15.3 Survivorship results

Plants appeared healthy with good growth and very high survivorship. As with many of the sites on Hindmarsh Island, multiple generations of plants and infill plantings made it difficult to discern between 2014 plantings and those from other periods, but assistance was given by Hindmarsh Island Landcare members who were familiar with the site.

Scabiosa sp. and *Acacia cyclops* were seen at the site and are actively controlled by the Landcare group's members, and at least one *Acacia longifolia* var. *sophorae* was found. Some other valuable native plants are regenerating, including *Pimelea* sp.

10.1.16 Hindmarsh Island – Gilbert – PlanID 381

10.1.16.1 Site map

10.1.16.2 Site photo

10.1.16.3 Survivorship results

Plants were generally healthy and guards were intact. There was little evidence of grazing across the site, although a hare was spotted during the survey. No major weed issues were noted.

10.1.17 Hindmarsh Island – Hartill - PlanID 381

10.1.17.1 Site map

Site contained transects 3847, 3848, 3849, 3850 and 3851

10.1.17.2 Site photo

10.1.17.3 Survivorship results

Plants generally showed good vigour but survival was noticeably poorer in heavier limestone areas. Weed competition and grazing pressure was fairly low but ongoing *Lycium ferocissimum* control will be required as seedlings were seen across the site.

10.1.18 Hindmarsh Island – Irwin – PlanID 381

10.1.18.1 Site map

Site contained transects 3867, 3868, 3869, 3870, 3871, 3872, 3873, 3874, 3875 and 3876

10.1.18.2 Site photo

10.1.18.3 Survivorship results

Allocasuarina verticillata was the only planted species and it was generally surviving well – although there were some deaths which appeared to increase further up the slope where soil moisture may be lower.

The north-eastern part of the site was unplanted, and the original mapping showed a wider corridor along the northern part of the site, when a significant part of that was grazing land on the southern side of a fence. Tall *Ehrharta villosa* was present across the sandy site.

10.1.19 Hindmarsh Island – Lane - PlanID 381

10.1.19.1 Site map

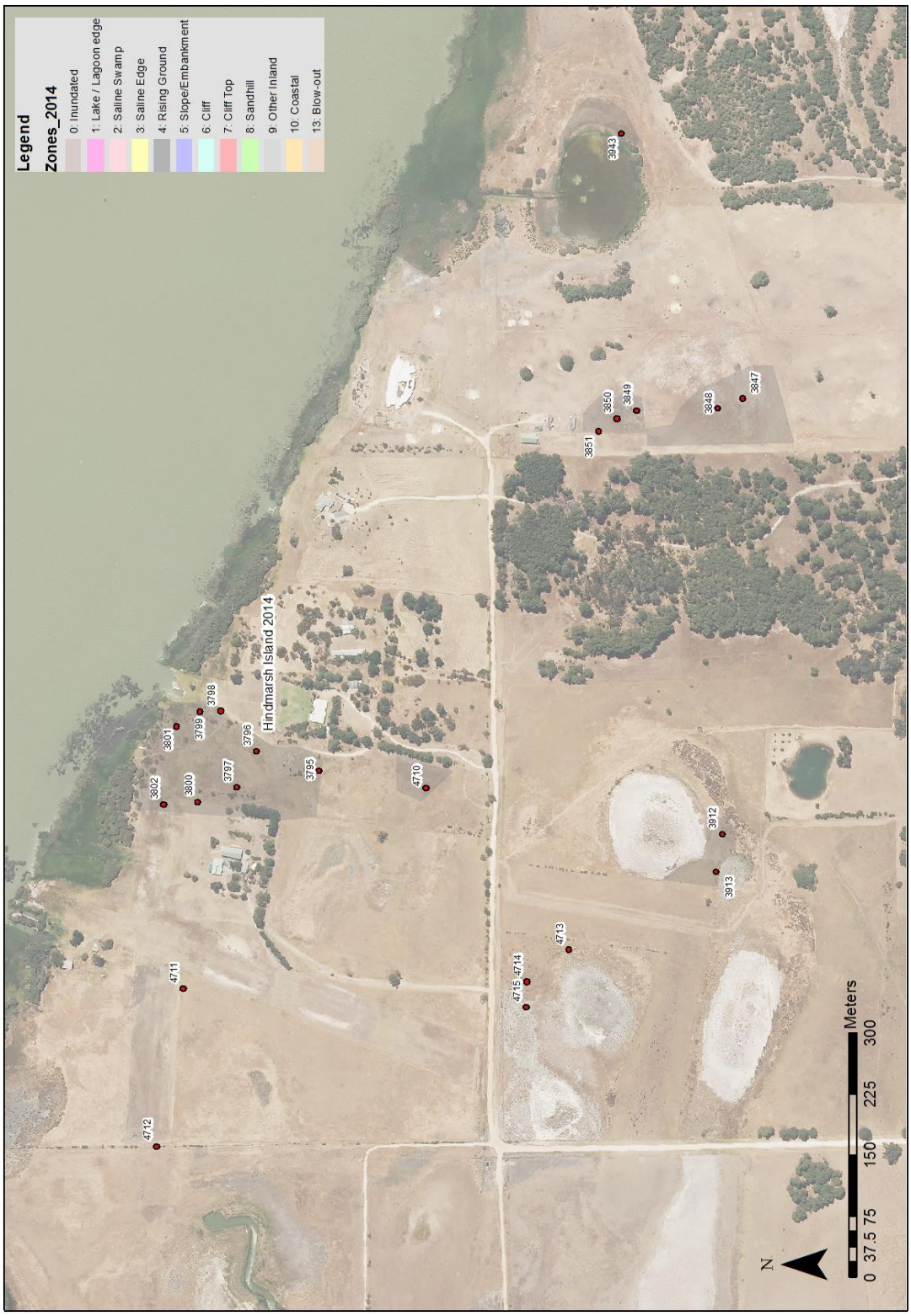
10.1.19.2 Site photo

10.1.19.3 Survivorship results

All plants were in the Other Inland (9) zone, with little existing native vegetation. The site showed generally good vigour, with some competition from weedy grasses, but not smothering plants. Grazing pressure was fairly low and guards were intact and in good condition.

10.1.20 Hindmarsh Island – Minnis – PlanID 381

10.1.20.1 Site map



10.1.20.2 Site photo

10.1.20.3 Survivorship results

Plants were generally healthy with good growth, and species diversity was good. Weed competition and grazing pressure were moderate.

10.1.21 Hindmarsh Island – Pennington - PlanID 381

10.1.21.1 Site photo

10.1.21.2 Survivorship results

Plants showed good survivorship and vigour. There were no significant weed issues and grazing pressure appeared low. Guards were largely intact.

Several transects were not surveyed due to the site being smaller than on the plan.

10.1.22 Hindmarsh Island – Pomeroy - PlanID 381

10.1.22.1 Site map

Site contained transects 4018, 4019, 4020, 4021, 4022, 4023, 4024, 4025, 4026 and 4027

10.1.22.2 Site photo

10.1.22.3 Survivorship results

Rabbits and white-snails present but low grazing pressure observed. Generally good vigour observed but thick exotic grass cover persists throughout the site, especially *Ehrharta calycina*, which is providing strong competition. Ongoing *Lycium ferocissimum* control is required.

10.1.23 Hindmarsh Island – Reynolds-Sturt Farm – PlanID 399

10.1.23.1 Site map

10.1.23.2 Site photo

10.1.23.3 Survivorship results

All plants surveyed were in the Other Inland (9) zone, and survivorship was very high. Thick exotic grass cover persists throughout the site, especially *Ehrharta calycina*, which is providing strong competition. Otherwise there is good vigour and low grazing pressure.

Four transects were dropped due to either being outside the planting area or too difficult to accurately differentiate from earlier plantings.

10.1.24 Hindmarsh Island – Roadsides – PlanID 381

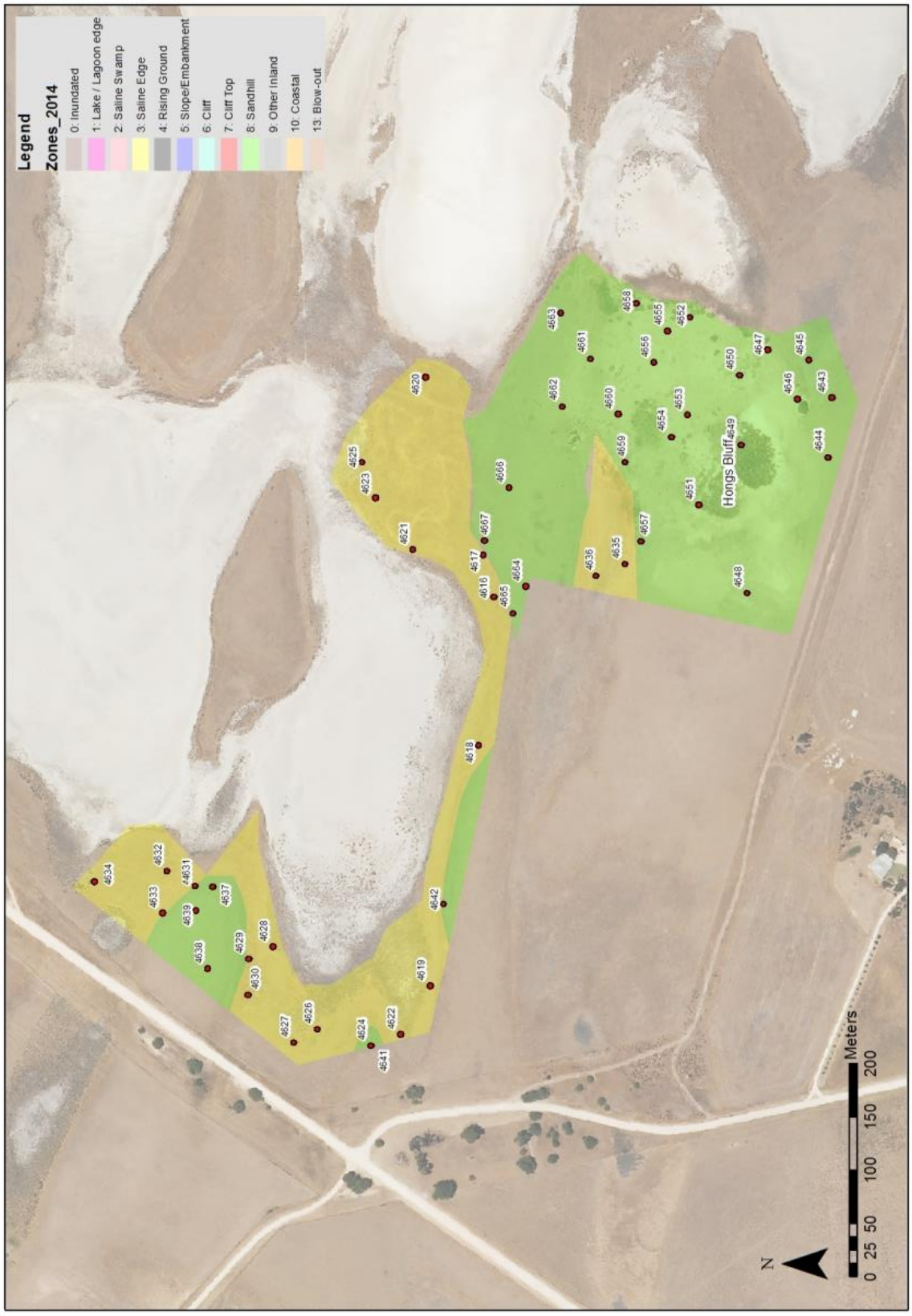
10.1.24.1 Site photo

10.1.24.2 Survivorship results

Plants were healthy, and no significant weed or grazing issues were noted. Most pasture grasses in the planting area were low and guards were largely clear of weedy species. All guards were intact and appeared to be working well.

10.1.25 Hongs Bluff - PlanID 417

10.1.25.1 Site map



10.1.25.2 Site photo

10.1.25.3 Survivorship results

Site surveyed in spring 2013 and autumn 2014.

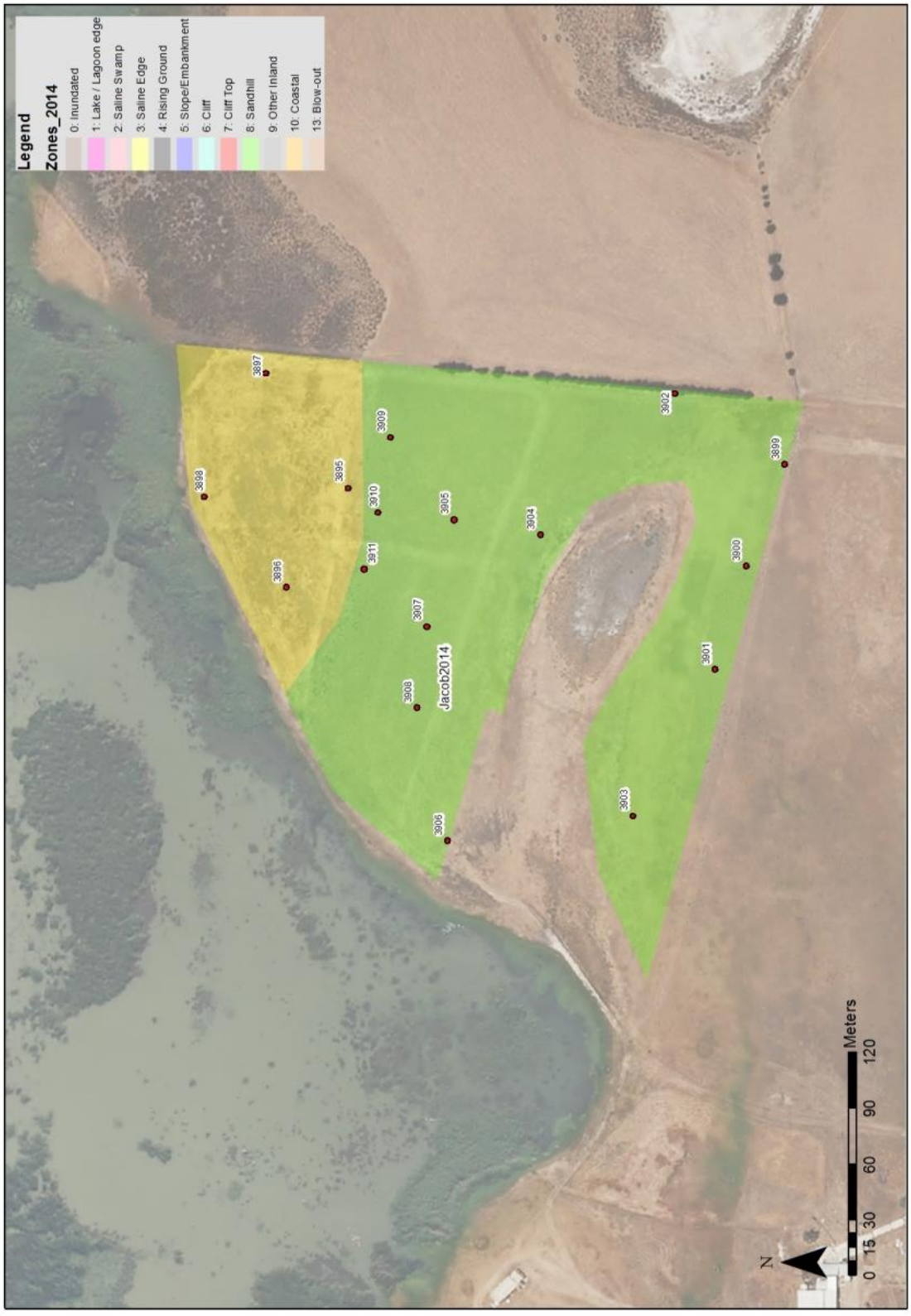
Hongs Bluff	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		1970	709
Survival	**-**		**73.5 %**	

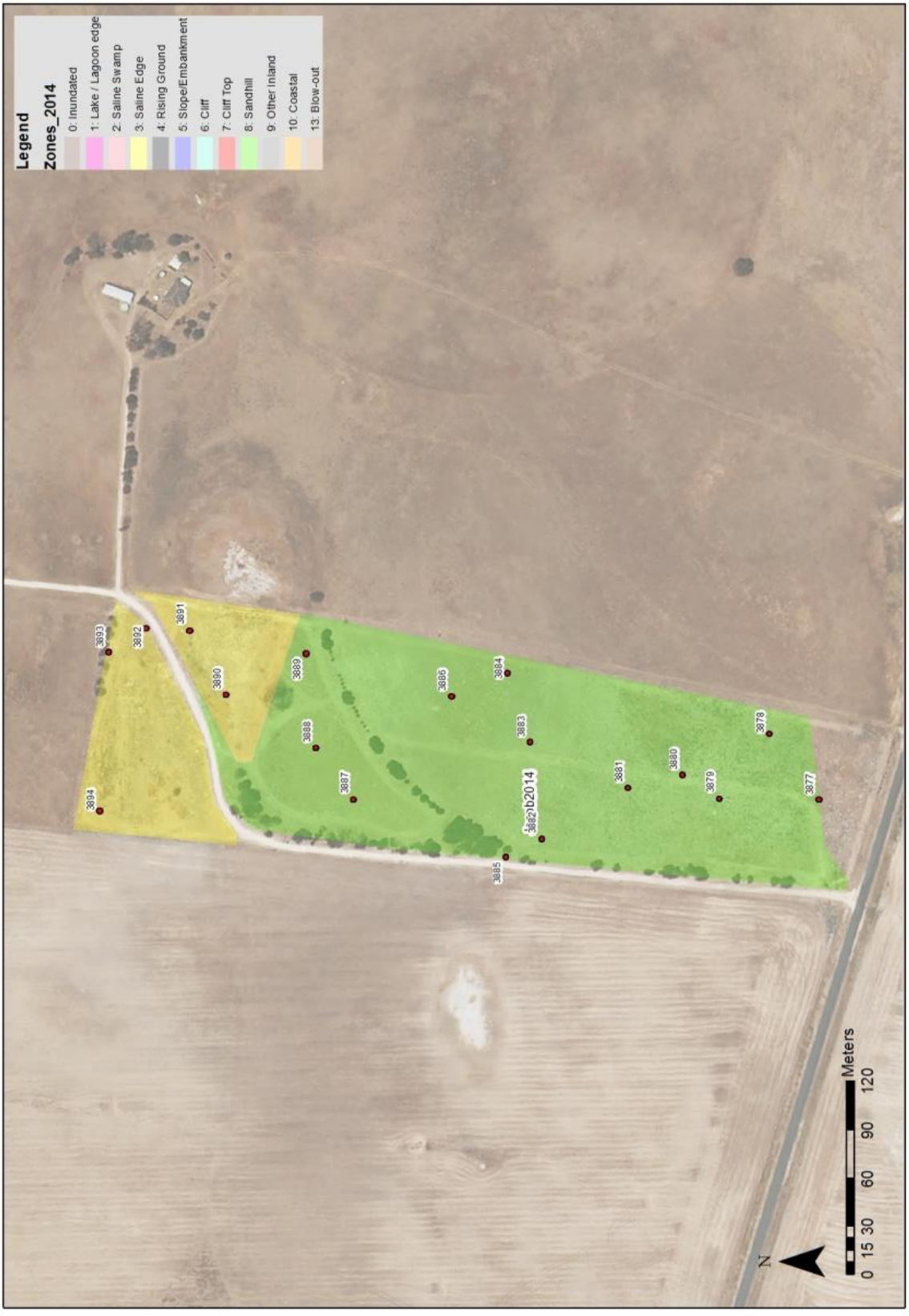
Zones surveyed were Saline Edge (3) and Sandhill (8). Plants were generally surviving well and the health of plants was a little better in Saline Edge (79%) than they were on Sandhills (59%). Shrubs and herbs were planted in much denser groups than seen at other sites, which made counting laborious but will provide some advantage in allowing for some plant die-off.

Some *Citrullus lanatus* and *Cirsium vulgare* were seen between patches. *Ehrharta villosa* was patchy across the site, but weed loads were fairly low in general. Quite a few guards were missing, possibly due to strong winds, and many of the remaining ones were in poor condition.

10.1.26 Jacob - PlanID 388

10.1.26.1 Site map




Legend
Zones_2014
0: Inundated
1: Lake / Lagoon edge
2: Saline Swamp
3: Saline Edge
4: Rising Ground
5: Slope/Embankment
6: Cliff
7: Cliff Top
8: Sandhill
9: Other Inland
10: Coastal
13: Blow-out
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3878
3877
N
0 15 30 60 90 120
Meters

10.1.26.2 Site photo

10.1.26.3 Survivorship results

Site surveyed in spring 2013 and autumn 2014.

Jacob	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		577	369
Survival	**-**		**61.0 %**	

Survivorship was fair at 61%, with consistent results between the two zones surveyed – Saline Edge (3) and Sandhill (8).

The northern and southern patches were markedly different in condition and results. In the southern patch (mostly infill), the area was quite weedy but sparse with earlier weed control efforts resulting in some bare soil. It was noted that older plantings had established well and were in excellent condition, while the 2014 plantings were struggling in areas, particularly *Atriplex* sp. at the northern end of the southern patch.

Snails (mostly *Theba pisana*) were present in large numbers and may have been eating the guards – some of which appeared tattered.

In the northern patch, plant health was generally excellent and has likely been influenced by more extensive site preparation and maintenance methods. Weed loads were very low in 2014 plantings, but older plantings harbour high loads of weeds that pose a threat. Some transects were located in these older plantings and were moved, or skipped where moving wasn't practicable.

10.1.27 Jockwar Lake Edge - PlanID 361

10.1.27.1 Site map

10.1.27.2 Site photo

10.1.27.3 Survivorship results

Jockwar Lake Edge	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	666	41	656	380
Survival	**94.2 %**		**63.3 %**	

Most of the plants counted were in the Rising Ground (4) zone. Survivorship was fair at 63%, but with variable vigour depending on species. *Gahnia filum* had poor survival, and other sedges were also particularly poor.

Duma florulenta regeneration was prolific in places and can be expected to overwhelm the site in the near future.

High grazing pressure from rabbits and hares was still evident despite recent baiting. Foxes were also present. A dead hawk was seen, and the neighbours reported several dead hawks which may have been off-target deaths from rabbit/fox baiting.

10.1.28 Jockwar Reserve 2014 – PlanID 361

10.1.28.1 Site map

10.1.28.2 Site photo

10.1.28.3 Survivorship results

Jockwar Reserve 2014	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		34	15
Survival	**-**		**69.4 %**	

A small site of only three transects, with transects in zones Rising Ground (4) and Other Inland (9). Survivorship was patchy although good overall, and plant health was noted to be low.

It appeared that the site may have been planted late in a difficult year, giving plants little time to get started before the dryer spring and summer periods. No significant weed or grazing issues were noted.

10.1.29 Kindaruar Farm Gahnia - PlanID 421

10.1.29.1 Site map

10.1.29.2 Site photo

10.1.29.3 Survivorship results

Kindaruar Farm Gahnia	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		173	451
Survival	**-**		**27.7 %**	

A single-species (*Gahnia filum*) site with very poor survivorship at 28%. This was among the lowest of all surveyed sites. All surveyed plants were in the Saline Edge (3) zone. Site preparation did not seem to have had much effect, and most plants were growing amongst pasture grasses.

Of the plants from previous years, some *Atriplex* sp., *Duma florulenta* and *Myoporum insulare* were growing well. No major weed or grazing issues were noted, and one fox was seen during the survey.

10.1.30 Lifestyles - PlanID 390

10.1.30.1 Site map

10.1.30.2 Site photo

10.1.30.3 Survivorship results

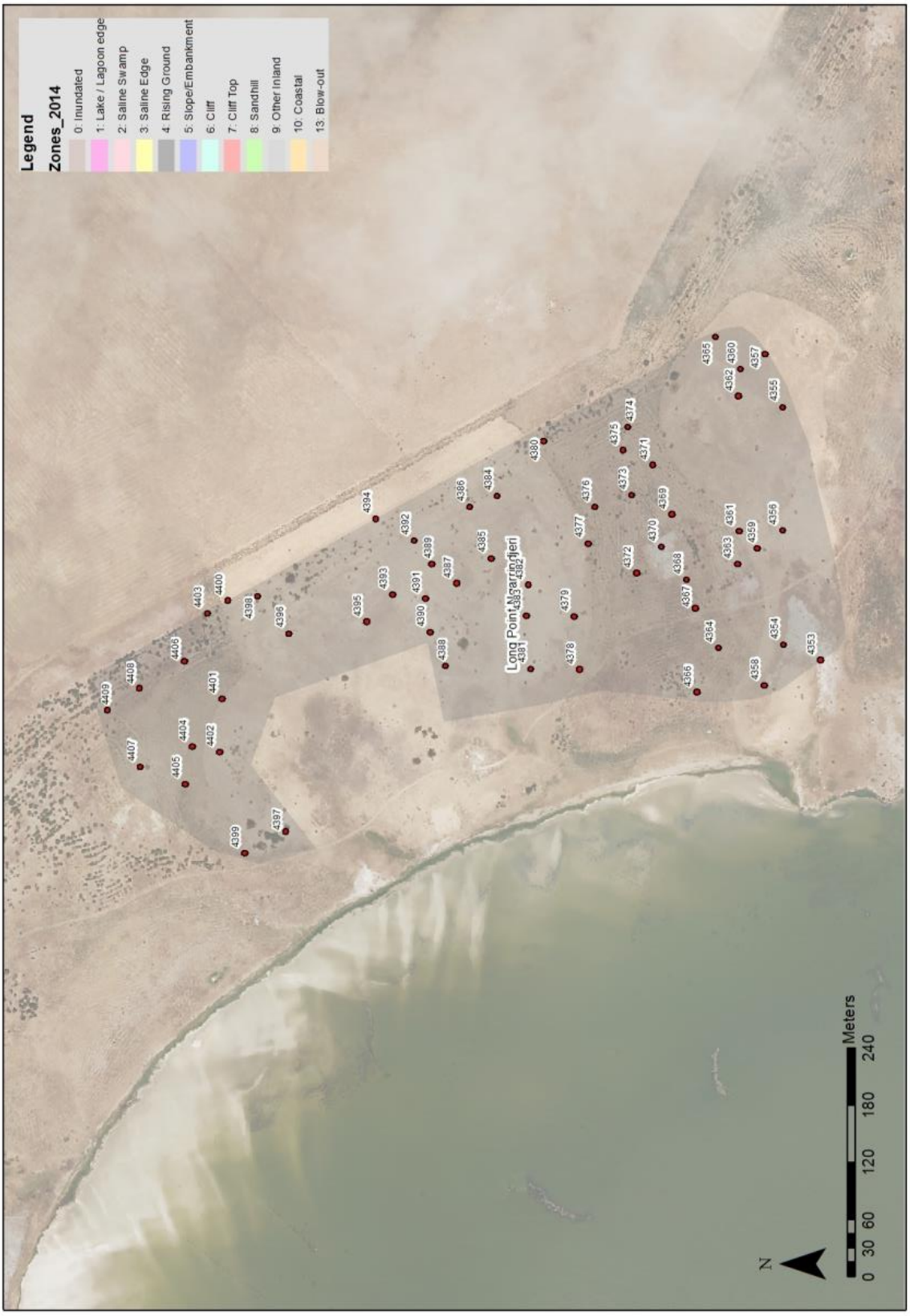
Lifestyles	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		483	161
Survival	**-**		**75.0 %**	

Three zones were surveyed – Saline Edge (3), Rising Ground (4) and Sandhill (8). Survivorship was very good at 75%, and plants were mostly very healthy, with many seedlings growing out of (and restricted by) guards.

Site maintenance appeared to be quite high and has been aided by planting in ripped rows. Despite this, dense *Ehrharta villosa* and *Ehrharta calycina* grasses were present in some of the guards, and in some cases had smothered the seedlings. *Oenothera stricta* was also scattered across the site, and occasional *Cucumis myriocarpus* plants were seen. Grazing pressure was moderate, but certain species had clearly been grazed, including *Allocasuarina verticillata* and *Melaleuca halmaturorum*.

10.1.31 Long Point Ngarrindjeri - PlanID 409

10.1.31.1 Site map



10.1.31.2 Site photo

10.1.31.3 Survivorship results

Long Point	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		656	417
Survival	**-**		**61.1 %**	

All plants surveyed were in the Other Inland (9) zone. Survivorship was below average at 61%, although consistent with the survival rate across all Other Inland zone plantings. General site condition and plant vigour was poor. Large parts of the site were unplanted – particularly in the south – and while some of these transects were relocated into planted patches, the sufficient density of transects within the planted patches meant that some transects were not surveyed. *Acacia* sp., *Bursaria spinosa* and *Solanum aviculare* were among the species with poor survival.

Weed loads were high, with this *Ehrharta villosa* and *Euphorbia terracina* across the site, and some *Solanum linnaeanum* and *Lycium ferocissimum* individuals. Lots of rabbit activity was seen but no active burrows were recorded.

10.1.32 Low Point Wellington Lodge - PlanID 370

10.1.32.1 Site map

10.1.32.2 Site photo

10.1.32.3 Survivorship results

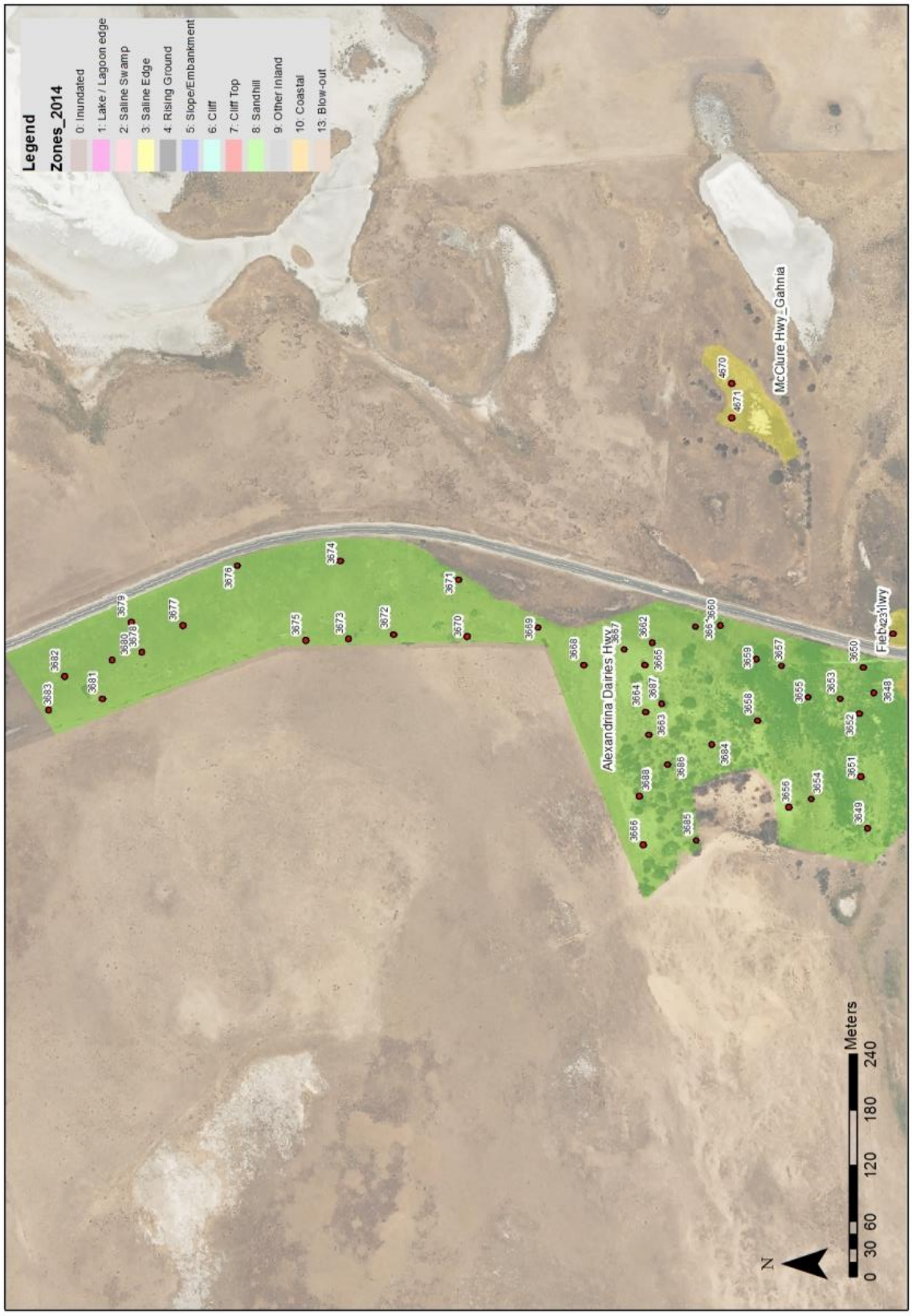
Low Point Wellington Lodge	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		25	58
Survival	**-**		**30.1 %**	

All plants were in the Rising Ground (4) zone. Only two transects were surveyed, but there was generally very poor survivorship and plant vigour, possibly due to late planting. *Ficinia nodosa* seedlings were the most numerous and were mostly dead.

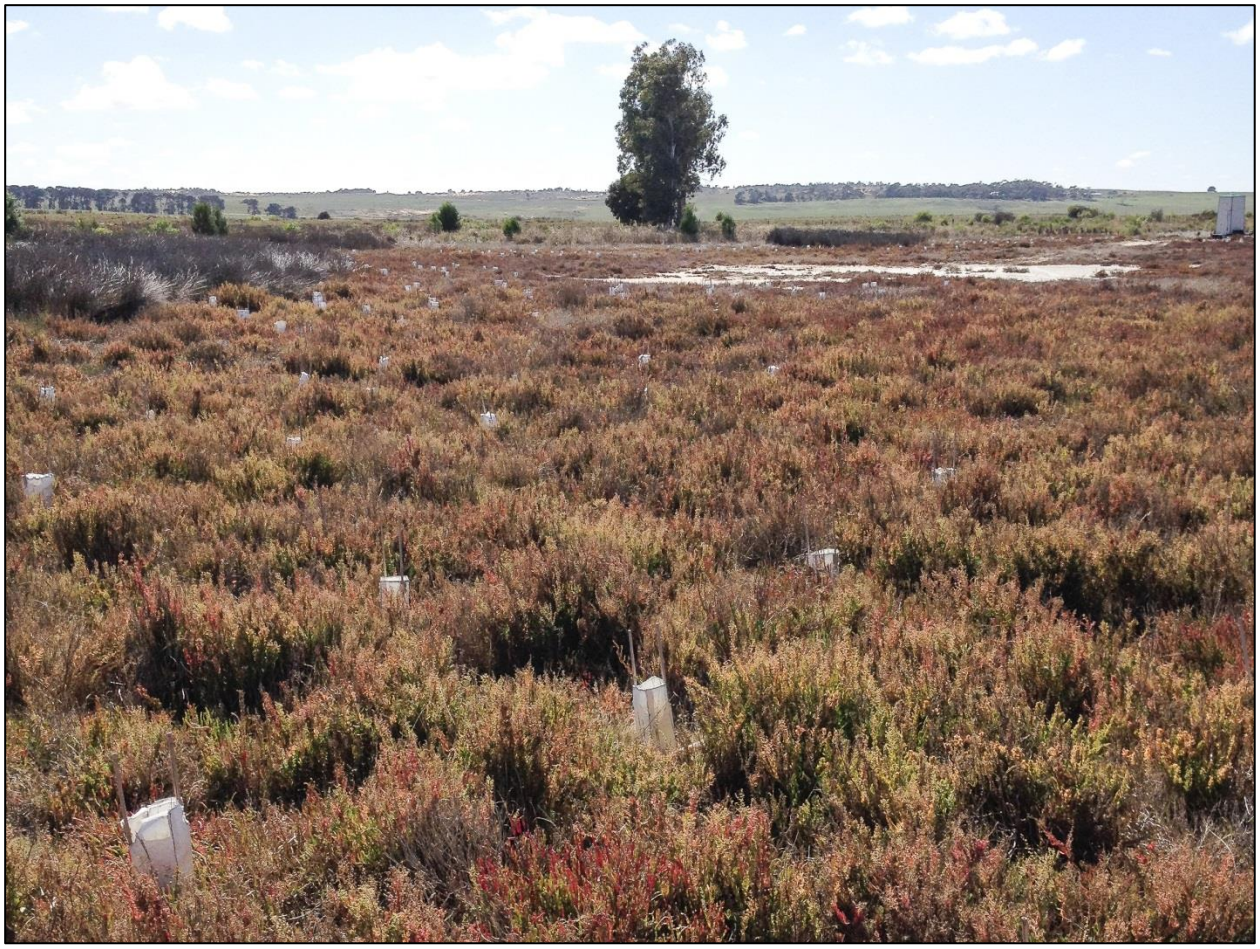
Rabbits were present but most tree guards were intact, and there appears to be limited grazing pressure on the planted seedlings.

10.1.33 McClure Highway Gahnia - PlanID 420

10.1.33.1 Site map



10.1.33.2 Site photo



10.1.33.3 Survivorship results

McClure Highway Gahnia	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		21	18
Survival	**-**		**53.8 %**	

A small site of only two transects which were located in the Saline Edge (3) zone. All plants counted were *Gahnia filum*, and survivorship was fairly poor at 54%.

Seedlings were planted in a relatively weed-free environment amongst Samphire, and appeared healthy with no significant weed issues noted. Plantings from previous years are growing well.

10.1.34 Meningie Cemetery - PlanID 340

10.1.34.1 Site map

10.1.34.2 Site photo

10.1.34.3 Survivorship results

Meningie Cemetery	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	232	21	325	97
Survival	**91.7 %**		**77.0 %**	

All plants counted were in the Other Inland (9) zone. The site was patchy in terms of survival, but the overall survivorship was good and plants were generally healthy. Some areas were unplanted, and transects had to be moved. In particular, some were inside a fence close to the grave sites and were not prepared or planted.

It was noted that corflute guards were used and this may be helping to minimise grazing. The site was very weedy with high loads and diverse species (typified by the site photo above), and in some places tall *Ehrharta villosa* dominated. One fox was seen while on site.

10.1.35 Milang Common - PlanID 406

10.1.35.1 Site map

10.1.35.2 Site photo

10.1.35.3 Survivorship results

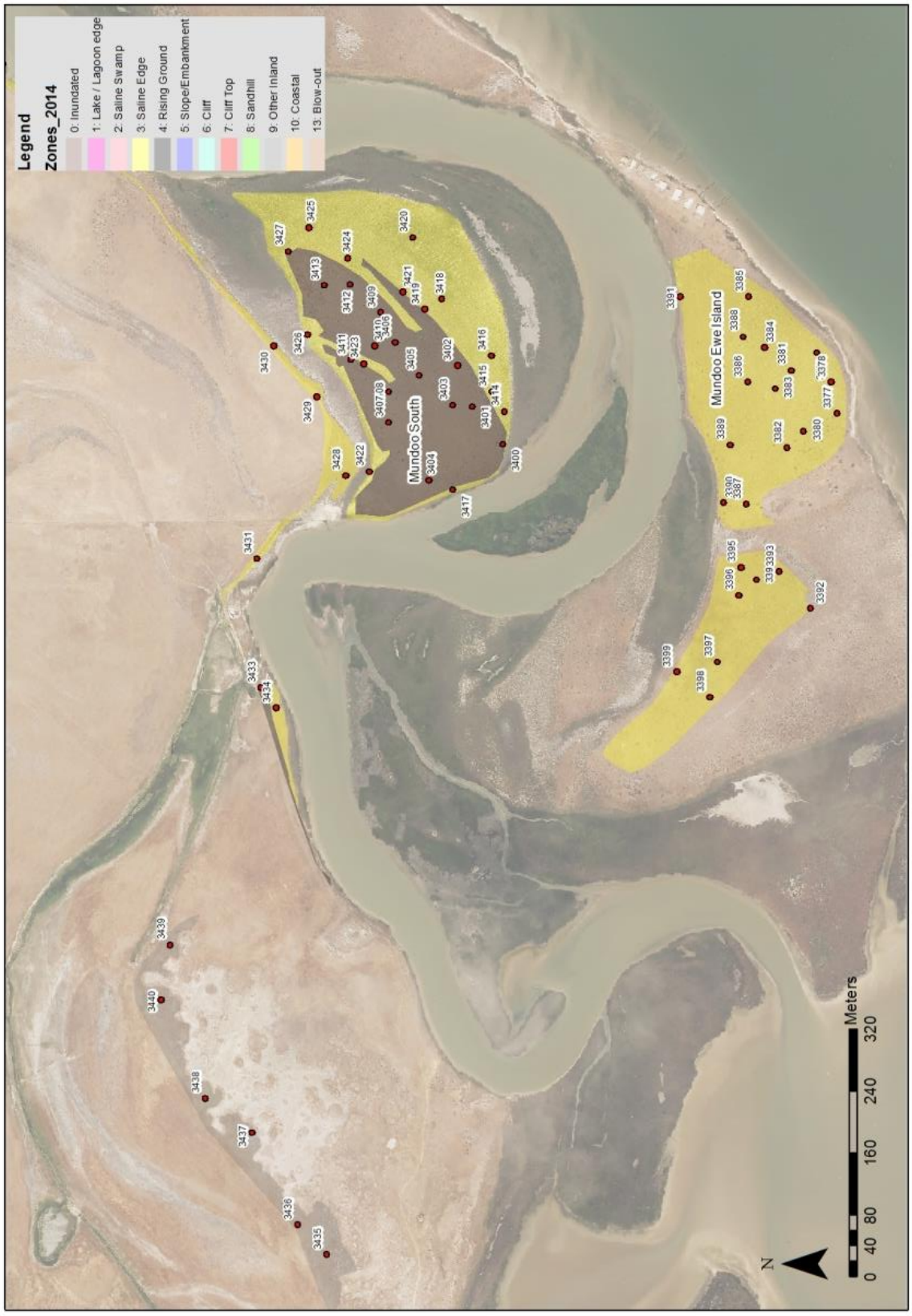
Milang Common	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	Not surveyed		303	124
Survival	**-**		**71.0 %**	

All plants counted were in in the Other Inland (9) zone, and the species mix had a high proportion of grasses such as *Austrostipa* sp., *Poa* sp. and *Rytidosperma* sp. Survivorship was generally good, although *Ficinia nodosa* seedlings were mostly dead. General plant vigour was very good.

Some apparent re-guarding of smaller 2013 plants may skew results and some species were detected that weren't on the species list. The assessment methodology was difficult to apply and not considered appropriate for the small, patchy nature of the site.

10.1.36 Mundoo Ewe Island - PlanID 343

10.1.36.1 Site map




Legend
Zones_2014
0: Inundated
1: Lake / Lagoon edge
2: Saline Swamp
3: Saline Edge
4: Rising Ground
5: Slope/Embankment
6: Cliff
7: Cliff Top
8: Sandhill
9: Other Inland
10: Coastal
13: Blow-out
Mundoo Ewe Island
3375
3376
4266
4265
4263
4264
3432
3427
3425
3413
3412
3424
3420
3421
N
0 40 80 160 240 320
Meters

10.1.36.2 Site photo

10.1.36.3 Survivorship results

Mundoo Ewe Island	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	325	67	391	139
Survival	**82.9 %**		**73.8 %**	

All counted plants were in the Saline Edge (3) zone. Parts of the site became temporarily inundated by a storm-surge soon after assessment.

While survival was generally good at 74%, plant vigour was generally poor and *Atriplex* sp. and *Disphyma crassifolium* results may be skewed by widespread natural regeneration that was also possibly occurring inside guards. Hares were observed and snails were abundant on guards.

10.1.37 Mundoo Massive - PlanID 341

10.1.37.1 Site map


Legend
Zones_2014
0: Inundated
1: Lake / Lagoon edge
2: Saline Swamp
3: Saline Edge
4: Rising Ground
5: Slope/Embankment
6: Cliff
7: Cliff Top
8: Sandhill
9: Other Inland
10: Coastal
13: Blow-out
Indoo Massive
Meters
0 30 60 120 180 240
N

10.1.37.2 Site photo

10.1.37.3 Survivorship results

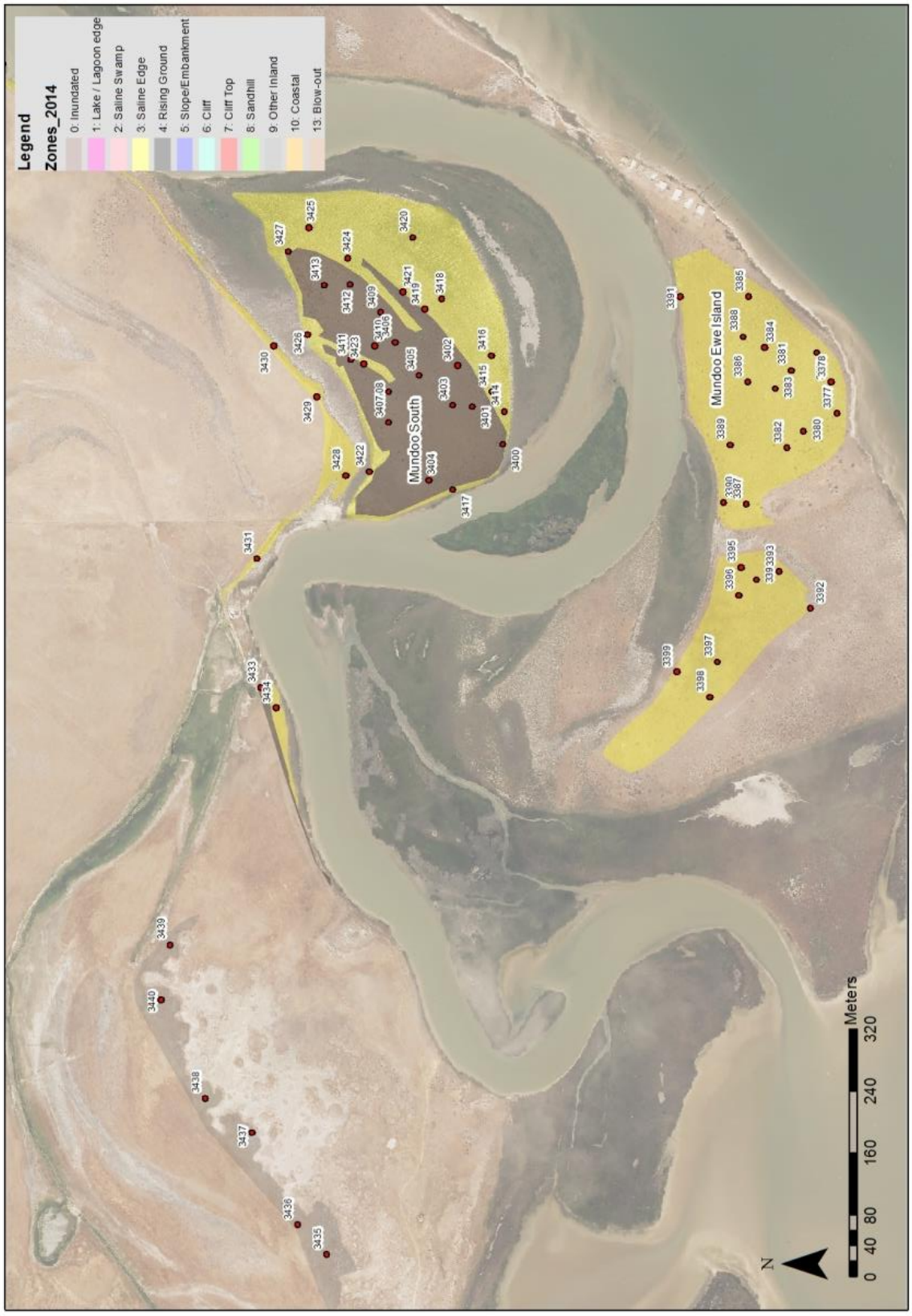
Mundoo Massive	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	1682	187	1966	573
Survival	**90.0 %**		**77.4 %**	

The counted plants were of a high diversity (nearly 50 species) and were spread across 4 zones: Saline Edge (3), Rising Ground (4), Coastal (10) and Blowout (13). Vigour and survival were very good and grazing pressure appeared low, despite the presence of hares.

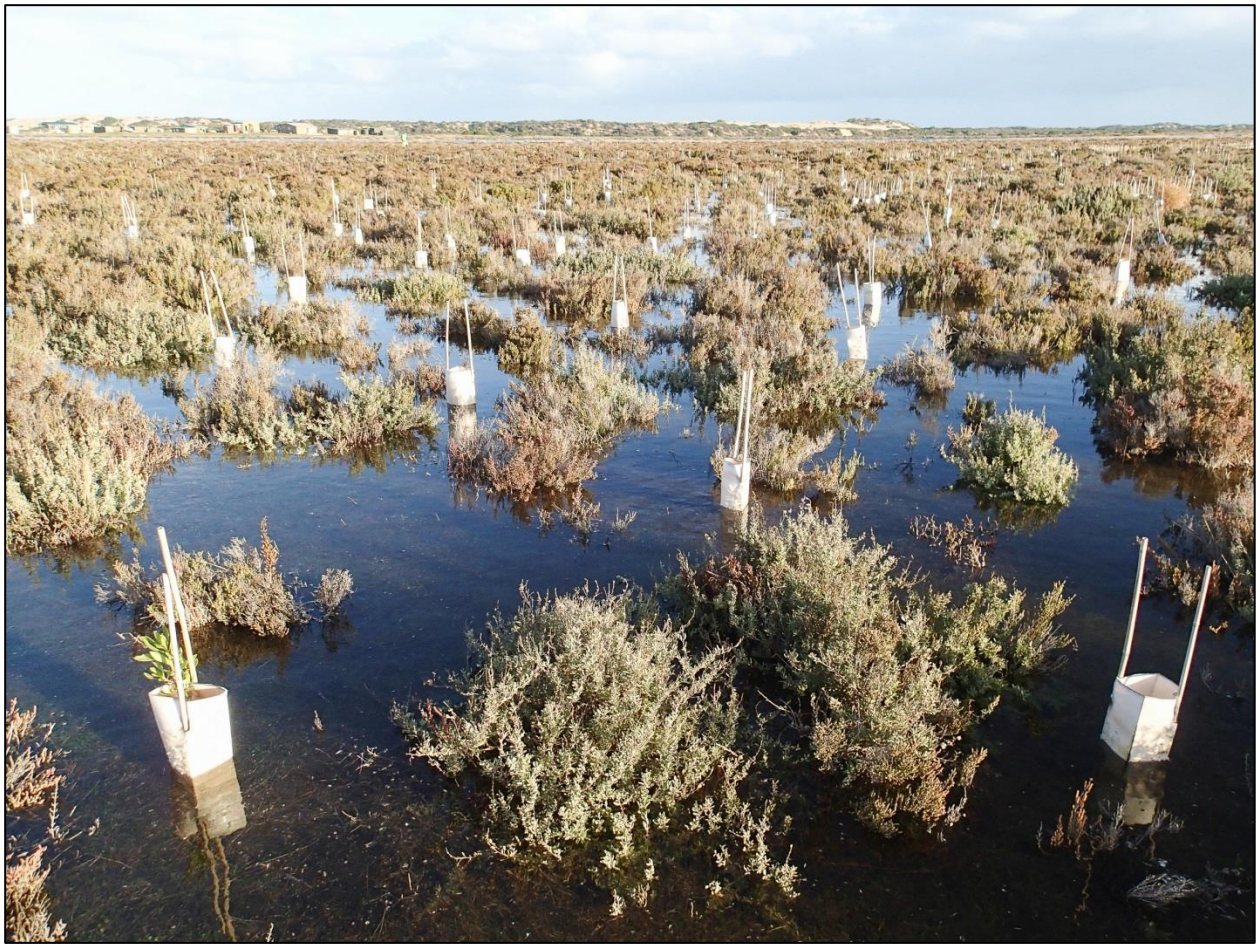
Some native ground cover was noted closer to the water's edge, including *Halosarcia sp.*, *Atriplex sp*. and *Enchylaena tomentosa*. Low exotic grasses persist across the site, but are not competing strongly with the plants. However Gazania is present and spreading on the eastern end of this site and should be controlled.

10.1.38 Mundoo South - PlanID 342

10.1.38.1 Site map



10.1.38.2 Site photo



10.1.38.3 Survivorship results

Mundoo South	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	483	135	762	505
Survival	**78.2 %**		**60.1 %**	

Three zones were planted: Saline Edge (3), Rising Ground (4) and Other Inland (9). Most of the site became inundated during the survey, with water reaching most of the way up treeguards.

Survivorship was fair, and surviving plants were generally healthy, with some patches of poor health. Among the species that were struggling were *Melaleuca halmaturorum*, *Ficinia nodosa* and *Juncus kraussii*.

Less than half of the *Melaleuca halmaturorum* seedlings counted had survived, with possibly more among the dead plants that couldn't be identified to species level. Many of the species are tolerant of periods of inundation, but some have been affected.

10.1.39 Narrung Wetland 2014 – PlanID 391

10.1.39.1 Site map

10.1.39.2 Site photo

10.1.39.3 Survivorship results

Narrung Wetland	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		368	204
Survival	**-**		**64.3 %**	

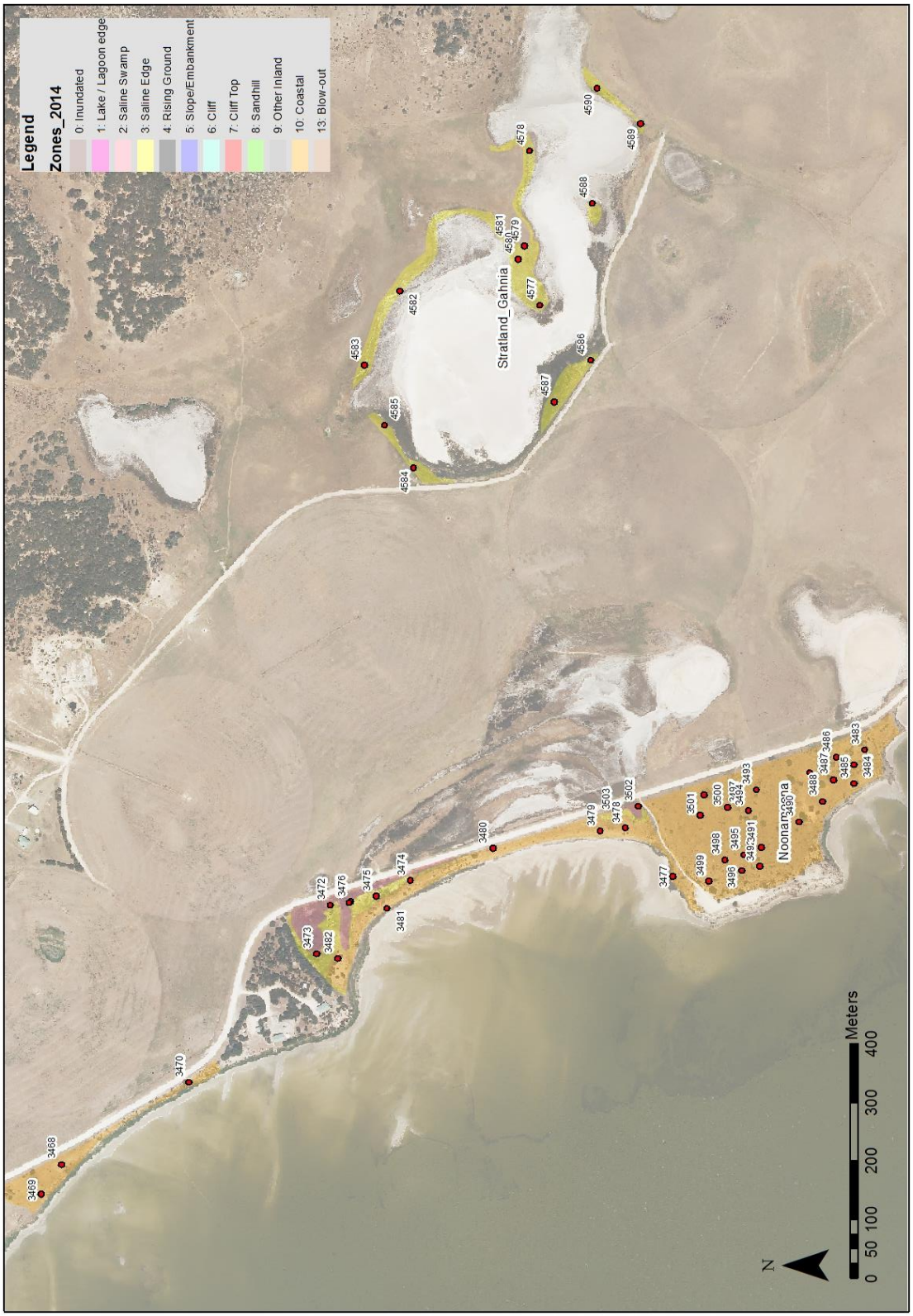
Most plants counted were in the Saline Edge (3) zone, with some Rising Ground (4) and Sandhill (8). Survivorship was fair at 64%, while plant vigour and species diversity was generally very good.

In some areas, it was difficult to discern 2014 plantings from those planted in 2013 due to mixed guard types, variable vigour/growth rates and possible re-guarding of 2013 plants with new guards.

Minor grazing pressure was noted and may have been caused by waterbirds in places.

10.1.40 Noonameena - PlanID 346

10.1.40.1 Site map



10.1.40.2 Site photo

10.1.40.3 Survivorship results

Noonameena	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	1275	426	998	837
Survival	**75.0 %**		**54.4 %**	

Nearly all of the plants counted were in the Coastal (10) zone, with smaller numbers in the Saline Swamp (2) and Saline Edge (3) zones. Survivorship was generally poor across the sandy, exposed site (54%).

It was noted that most Eucalypts that were planted on the sandier soils were dead. Weedy *Leptospermum laevigatum* had been sprayed but was starting to regenerate. Grazing pressure did not seem overly high but some rabbit diggings were seen.

10.1.41 Pobbybonk/Snake Reserve - PlanID 393

10.1.41.1 Site map

10.1.41.2 Site photo

10.1.41.3 Survivorship results

Pobbybonk/Snake Reserve	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		37	25
Survival	**-**		**59.7 %**	

Only one transect was counted at this site due to only one zone (Rising Ground – 4) being observed as planted in this location. A transect was selected that best reflected the zone, and survivorship was below average at 60% but not markedly so.

This was a dense infill planting with good plant vigour, with the exception of *Ficinia nodosa* and other sedges, which appeared to be struggling.

10.1.42 Poltalloch Swamp - PlanID 352

10.1.42.1 Site map

10.1.42.2 Site photo

10.1.42.3 Survivorship results

Poltalloch Swamp	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	274	36	245	110
Survival	**88.4 %**		**69.0 %**	

The surveyed areas contained two zones – Saline Edge (3) and Rising Ground (4). Survivorship was generally good at 69%, but had dropped approximately 20% from the spring season, and plant vigour was poor.

Some patches showed heavy grazing pressure, largely apparent from resident kangaroos. Weed control appeared good, so planting timing – possibly in conjunction with dry conditions and poor soil/salinity – may be a suppressing factor.

10.1.43 Schultz - PlanID 394

10.1.43.1 Site map

10.1.43.2 Site photo

10.1.43.3 Survivorship results

Schultz	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	530	52	618	156
Survival	**91.1 %**		**79.8 %**	

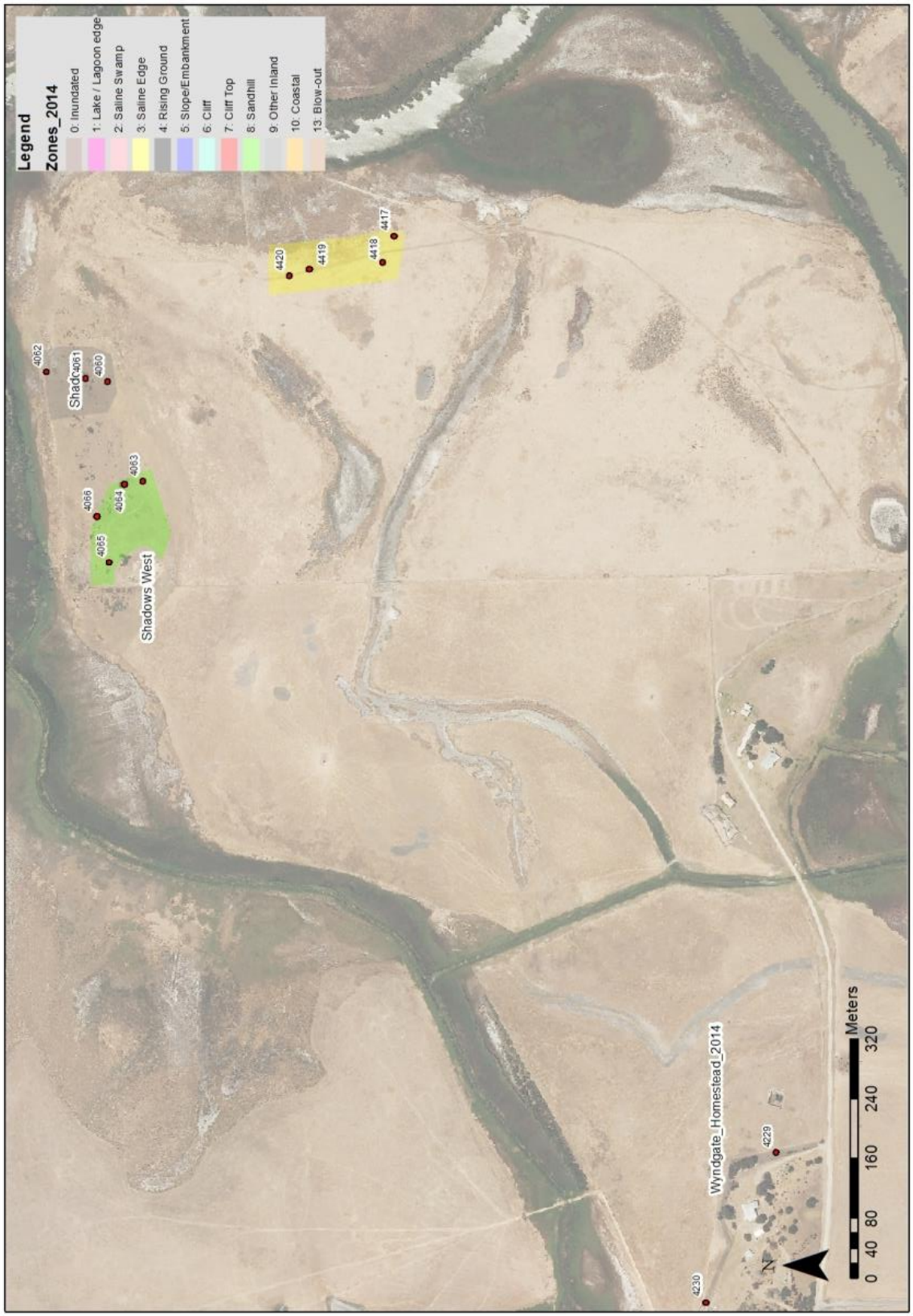
Two zones were surveyed – Saline Edge (3) and Other Inland (9), with a significantly lower survival in the Saline Edge zone. Despite this, survivorship was very good at just under 80%, with excellent plant growth and health as observed in other sites with ripped rows.

Grazing is not a big issue, but was noted on *Ficinia nodosa*. The site was notably free of major weed issues – especially in comparison to other sites – and this has been aided by the layout of the site, with rows leaving room for boom spraying.

10.1.44 Shadows West - PlanID 397

10.1.44.1 Site map


Legend
Zones_2014
0: Inundated
1: Lake / Lagoon edge
2: Saline Swamp
3: Saline Edge
4: Rising Ground
5: Slope/Embankment
6: Cliff
7: Cliff Top
8: Sandhill
9: Other Inland
10: Coastal
13: Blow-out
Hindmarsh Island 2014
Shadows West
4078
4076
4075
4074
4072
4071
4070
4067
4068
4069
4726
4727
4724
4722
4721
4728
4725
4723
N
0 37.5 75 150 225 300
Meters


Legend
Zones_2014
0: Inundated
1: Lake / Lagoon edge
2: Saline Swamp
3: Saline Edge
4: Rising Ground
5: Slope/Embankment
6: Cliff
7: Cliff Top
8: Sandhill
9: Other Inland
10: Coastal
13: Blow-out
4062
4061
4060
4066
4064
4063
4065
Shadows West
4420
4419
4418
4417
Wyndgate_Homestead_2014
4229
4230
N
0 40 80 160 240 320
Meters

10.1.44.2 Site photo

10.1.44.3 Survivorship results

Shadows West	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	Not surveyed		50	68
Survival	**-**		**42.4 %**	

Two zones were surveyed: Sandhill (8) and Other Inland (9). Survivorship was fairly low – particularly on the Sandhill zone (20%) – and displayed poor vigour. Most Eucalypts were dead and thick exotic grass cover persists throughout the site, especially Perennial Veldt. Grazing pressure appeared to be low.

Numerous transects were dropped due to either being outside planting area or too difficult to accurately differentiate from earlier plantings.

10.1.45 Shaw - PlanID 398

10.1.45.1 Site map


Legend
Zones_2014
0: Inundated
1: Lake / Lagoon edge
2: Saline Swamp
3: Saline Edge
4: Rising Ground
5: Slope/Embankment
6: Cliff
7: Cliff Top
8: Sandhill
9: Other Inland
10: Coastal
13: Blow-out
Shaw
Meters
0 35 70 140 210 280
N

10.1.45.2 Site photo

10.1.45.3 Survivorship results

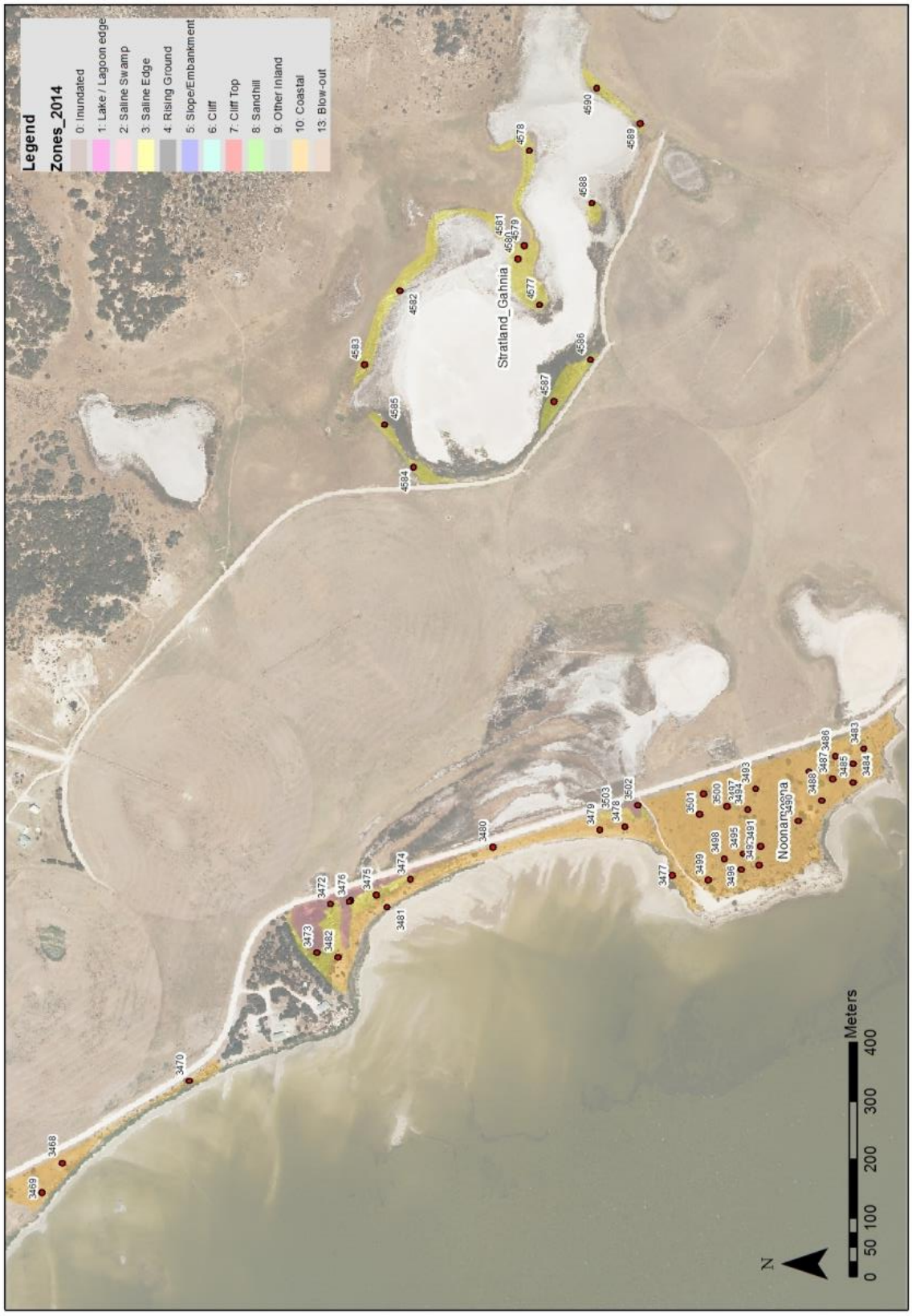
Shaw	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		885	539
Survival	**-**		**62.1 %**	

This was a diverse site, with over 60 species recorded across the zones Lake Lagoon Edge (1) and Slope/Embankment (5). Survivorship was fair at 62% but with poor plant vigour and high weed competition in places – often from weeds within guards.

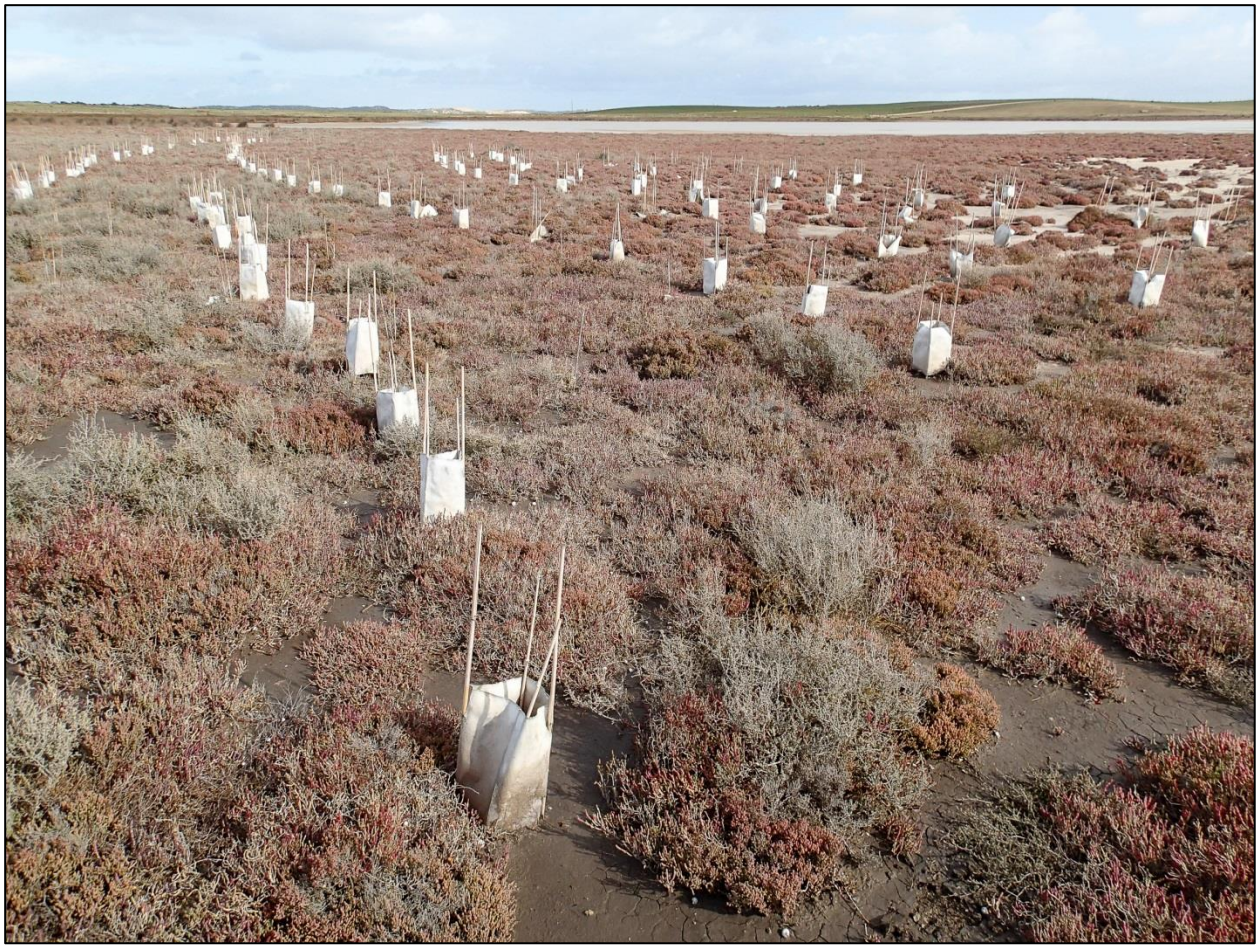
Patches of high grazing pressure were apparent, and may have been caused by hares. Excellent woody weed control for *Olea europaea* and *Rosa rubiginosa* was observed, and it was noted that some of the guards are in need of removal.

10.1.46 Stratland Gahnia - PlanID 415

10.1.46.1 Site map



10.1.46.2 Site photo



10.1.46.3 Survivorship results

Stratland Gahnia	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		182	54
Survival	**-**		**77.1 %**	

A Saline Edge (3) zoned site with one species - *Gahnia filum*. Survivorship was generally very good at 77% but many of the plants were of poor health and vigour, with this appearing to improve in the west of the site.

There were some unplanted areas – especially in the east of the site so a number of transects were not surveyed. No significant weed or grazing issues were noted.

10.1.47 Treloar Gahnia - PlanID 414

10.1.47.1 Site map

10.1.47.2 Site photo

10.1.47.3 Survivorship results

Treloar Gahnia	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		523	74
Survival	-		**87.6 %**	

Gahnia filum was the only species planted and it was all in the Saline Edge (3) zone. There was excellent survivorship across the site – although it is worth noting that only one species was planted. Most plants were not in the seasonally-inundated areas where – anecdotally – there seems to have been the most die-off of *Gahnia filum* at other sites.

The tree guards were becoming tattered but have probably done their job up to this point. Two hares were spotted on site.

Chemical treatment of *Thinopyrum ponticum* had been carried out in the previous days across the site and appeared to have good coverage, although the effectiveness of spraying directly after slashing – with no regrowth to increase uptake of chemical – is yet to be seen.

10.1.48 Treloar 2014 - PlanID 413

10.1.48.1 Site map

10.1.48.2 Site photo

10.1.48.3 Survivorship results

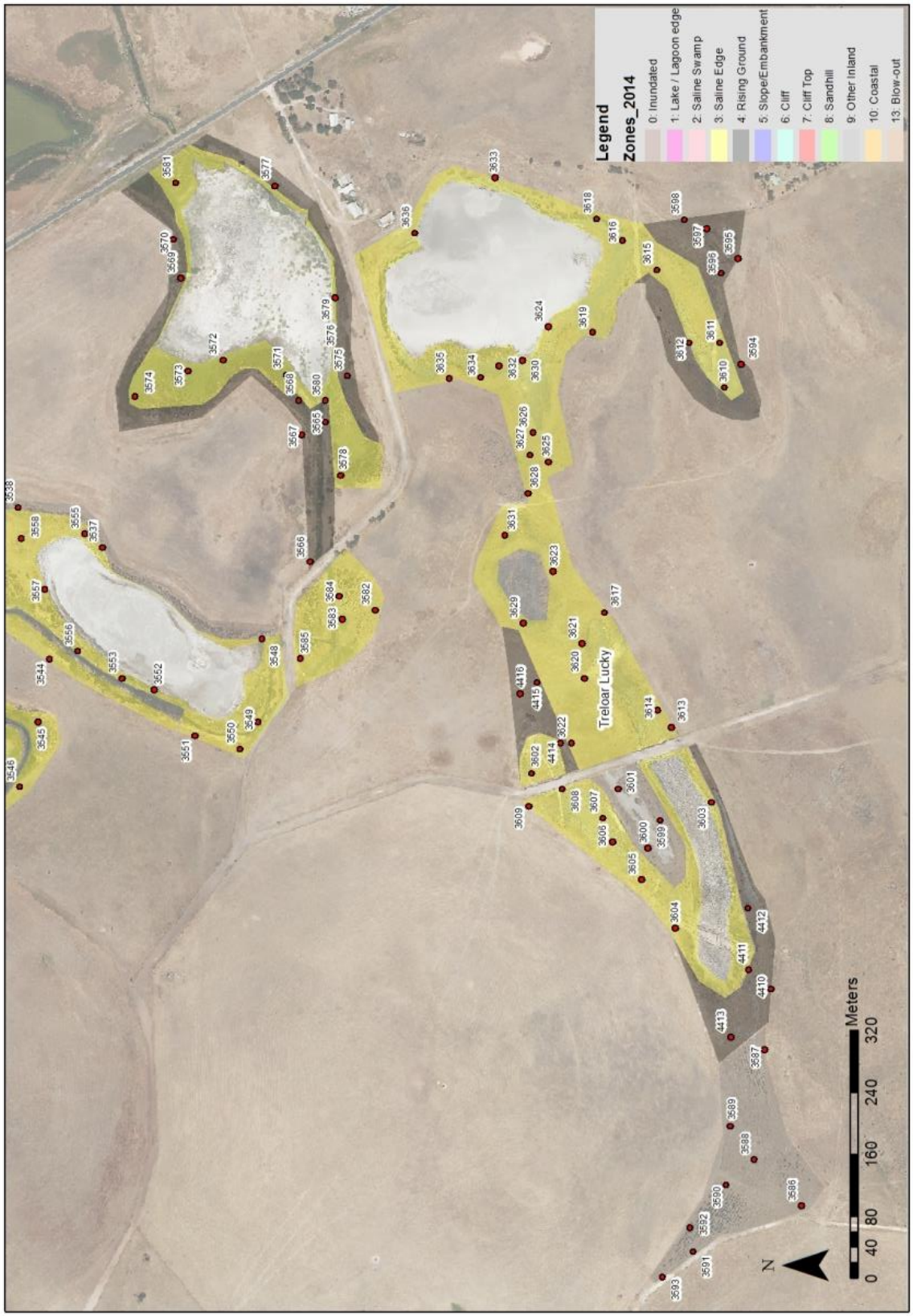
Treloar 2014	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		268	41
Survival	**-**		**86.7 %**	

A small site, with only 6 transects surveyed across the Saline Edge (3) and Rising Ground (4) zones. Survivorship was generally excellent at 86.7% with all species performing well and positive survivorship levels for *Atriplex* sp.

There was evidence of very recent weed control for African Boxthorn, *Thinopyrum ponticum* and *Xanthium spinosum*, which was excellent, but there were some juvenile weeds missed (as expected for large infestations) and ongoing follow-up is recommended.

10.1.49 Treloar Lucky - PlanID 357

10.1.49.1 Site map


Legend
Zones_2014
0: Inundated
1: Lake / Lagoon edge
2: Saline Swamp
3: Saline Edge
4: Rising Ground
5: Slope/Embankment
6: Cliff
7: Cliff Top
8: Sandhill
9: Other Inland
10: Coastal
13: Blow-out
Treloar Lucky
N
0 40 80 160 240 320
Meters

10.1.49.2 Site photo

10.1.49.3 Survivorship results

Treloar Lucky	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	3512	631	3301	2391
Survival	**84.8 %**		**58.0 %**	

A diverse site with nearly 50 species recorded across the zones Saline Edge (3), Rising Ground (4) and Other Inland (9). However, survivorship was generally poor at 58%, with plants also displaying poor vigour. Survival dropped by more than 25% over the summer period and it was particularly poor in lower-lying areas of the site, with most of the plants on mudflats dead – particularly *Gahnia filum*.

Grazing pressure was low, but there were large areas of dense couch/papsalum causing ongoing competition to seedlings. Control of woody weeds including *Lycium ferocissimum* was evident but many plants were still remaining, and other weedy species including *Xanthium pungens* are common.

10.1.50 Waghorn - PlanID 401

10.1.50.1 Site map

10.1.50.2 Site photo

10.1.50.3 Survivorship results

Waghorn	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	Not surveyed		71	33
Survival	**-**		**68.3 %**	

Only one zone was surveyed (Other Inland – 9) and survivorship was generally good at 68%. However, there were patches of poor survival which lowered site survivorship, and some die-off of *Melaleuca lanceolata*.

No significant pest plant or animal impacts were noted and vigour appeared good. Several transects were dropped due to being outside the planting area.

10.1.51 Watkins 2014 - PlanID 402

10.1.51.1 Site map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10.1.51.2 Site photo

10.1.51.3 Survivorship results

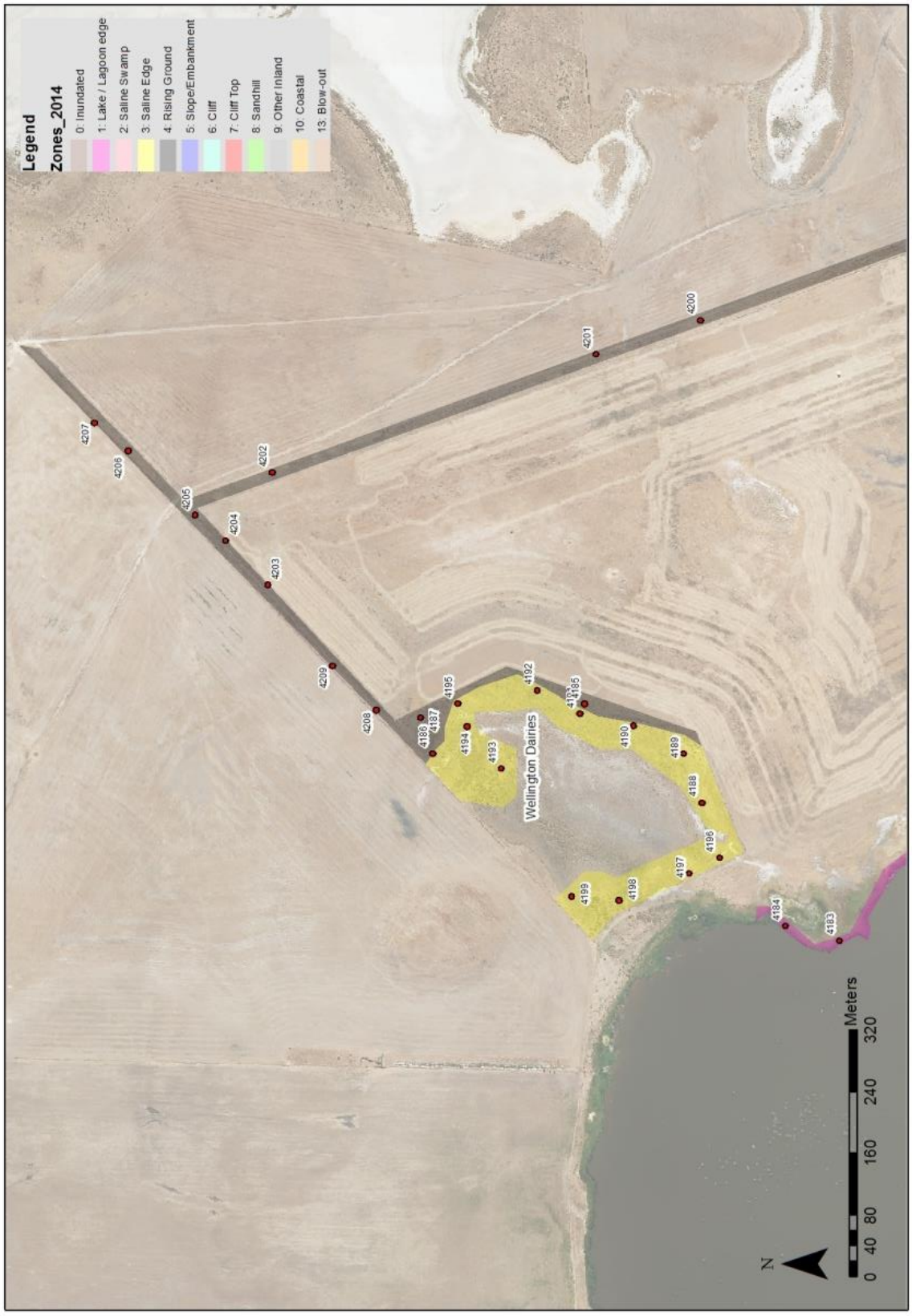
Watkins	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	1620	109	2493	964
Survival	**93.7 %**		**72.1 %**	

A large site with one planting zone (Sandhill – 8) and a diverse species list with around 50 plants recorded. While survivorship was slightly above average across all sites at 72%, this was around 20% lower than in spring and may be partially attributed to dry conditions on the sandy soils.

Plants were mostly planted in rows and the site was noted to be well-prepared and guarded with no significant pest plant or animal impacts. Extensive successful follow-up weed control was noted in rows and the site used sturdy corflute guards.

10.1.52 Wellington Dairies - PlanID 403

10.1.52.1 Site map




Legend
Zones_2014
0: Inundated
1: Lake / Lagoon edge
2: Saline Swamp
3: Saline Edge
4: Rising Ground
5: Slope/Embankment
6: Cliff
7: Cliff Top
8: Sandhill
9: Other Inland
10: Coastal
13: Blow-out
Wellington Dairies
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0 40 80 160 240 320
Meters


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Meters
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N

10.1.52.2 Site photo

10.1.52.3 Survivorship results

Wellington Dairies	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		1218	298
Survival	**-**		**80.3 %**	

Four planting zones were surveyed: Lake Lagoon Edge (1), Saline Edge (3), Rising Ground (4) and Sandhill (8). Survivorship was very good across the site, with good vigour in patches planted on better soils. Grazing pressure appeared to be low.

Young *Melaleuca halmaturorum* was difficult to differentiate from young *Melaleuca brevifolia* at times, so identification of this species may be unreliable. As with some of the other grass species in the survey, it was difficult to tell if *Puccinellia stricta* was dead or dormant.

The highway site was seemingly not planted in 2014 – it looked to be a 2013 planting.

10.1.53 Wellington Lodge Swamp South - PlanID 371

10.1.53.1 Site map

10.1.53.2 Site photo

10.1.53.3 Survivorship results

Wellington Lodge Swamp South	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	370	23	283	101
Survival	**94.1 %**		**73.7 %**	

Plants were surveyed in the zones Saline Edge (3) and Rising Ground (4). Vigour and survival appeared patchy, with some species, such as *Atriplex* sp., doing well, while others including *Gahnia filum* and *Juncus kraussii* were struggling with less than half surviving. Weed control appeared satisfactory.

Zone 4 was mapped but not planted as such and 5 Transects 4234, 4237, 4238, 4245 and 4246 were not counted due to incongruous zones, zone overlap or being outside the planted or fenced area.

10.1.54 Wilkinson - PlanID 404

10.1.54.1 Site map

10.1.54.2 Site photo

10.1.54.3 Survivorship results

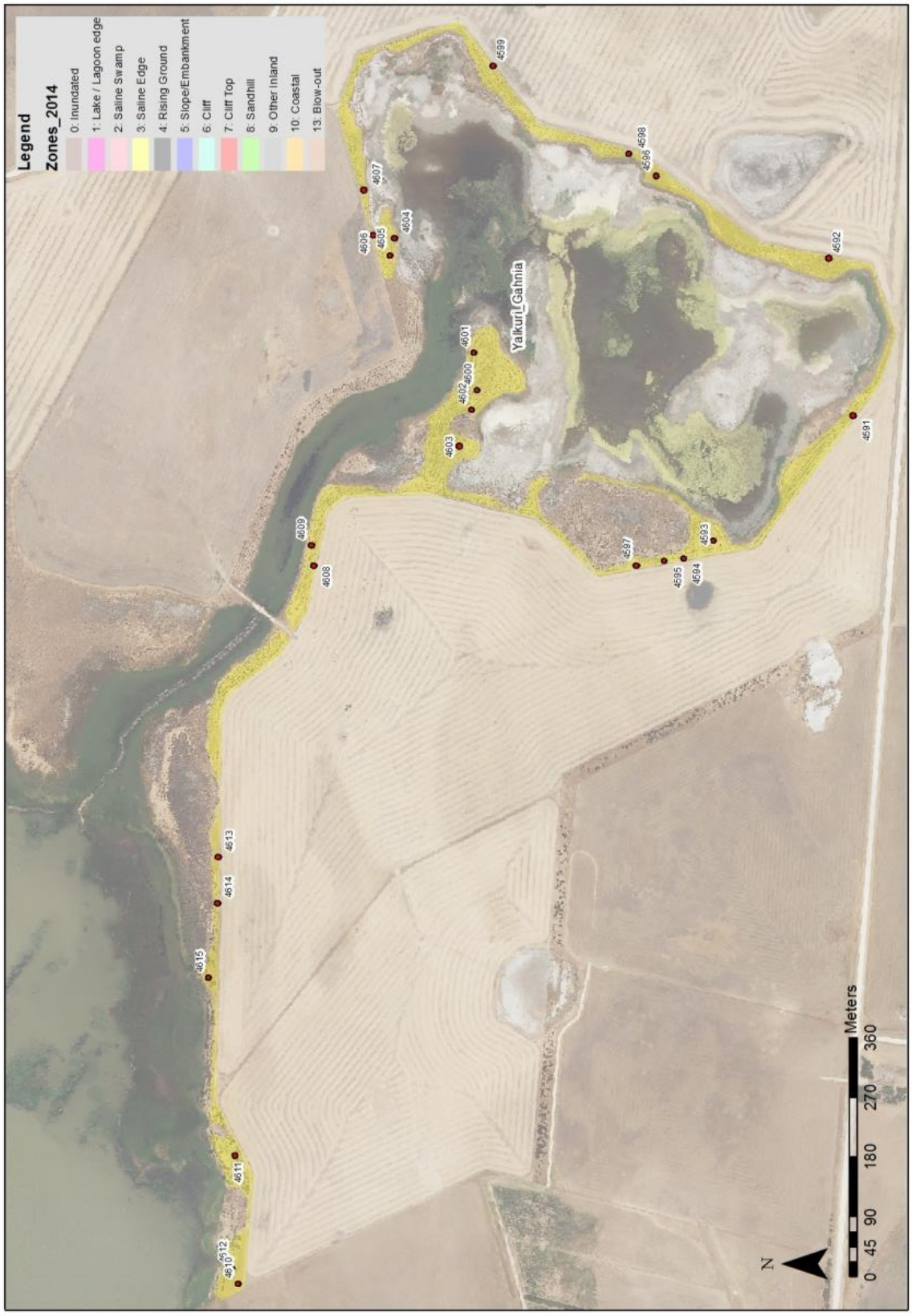
Wilkinson	Spring 2014		Autumn 2015	
	Alive	Dead	Alive	Dead
	87	13	222	68
Survival	**87.0 %**		**76.6 %**	

Three zones were surveyed: Rising Ground (4), Slope Embankment (5) and Sandhill (8), with most plants in the Sandhill zone.

Survivorship was good across the site, which was typified by low pasture grasses that appear to be slashed periodically, although weedy grasses dominated on the slopes. Planting was mostly performed as infill of 2013 plantings and was surveyed in patches. Plant vigour appeared good and no significant pest plant or animal impacts were recorded.

10.1.55 Yalkuri Gahnia - PlanID 416

10.1.55.1 Site map



10.1.55.2 Site photo

10.1.55.3 Survivorship results

Yalkuri Gahnia	Spring 2014		Autumn 2015	
	Alive	**Dead**	**Alive**	**Dead**
	Not surveyed		133	160
Survival	**-**		**45.4 %**	

All surveyed plants were in the Saline Edge (3) zone. Survival and vigour of plants was generally very poor with less than half of surveyed plants still alive. Kangaroos had damaged tree guards and grazing pressure was evident.

An unplanted tray of *Duma florulenta* was found along transect 4598. Some of the areas seemed to be unplanted and had cattle grazing. These grazed areas contained transects – 4610, 4611, 4612, 4614 and 4615.

11. APPENDIX E. Survival_rel database and site photographs in digital format (see attached disk)