662MIC0023-5530-SV-EN-0001

JANUARY 2016

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ENVIRONMENT

FMG IRON BRIDGE (AUST) PTY LTD
IRON BRIDGE NORTH STAR STAGE 2
PITYRODIA SP. MARBLE BAR REGIONAL SURVEY 2015

Document Status						
Rev	**Author**	**Reviewer**	**Date**	**Approved for Issue**		
				Name	**Distributed to**	**Date**
0	M Macdonald	M Hay	30/10/2015	S Grein	M Dowling	30/10/2015
1	M Macdonald	M Hay	30/10/2015	S Grein	M Dowling	2/11/2015

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1 INTRODUCTION

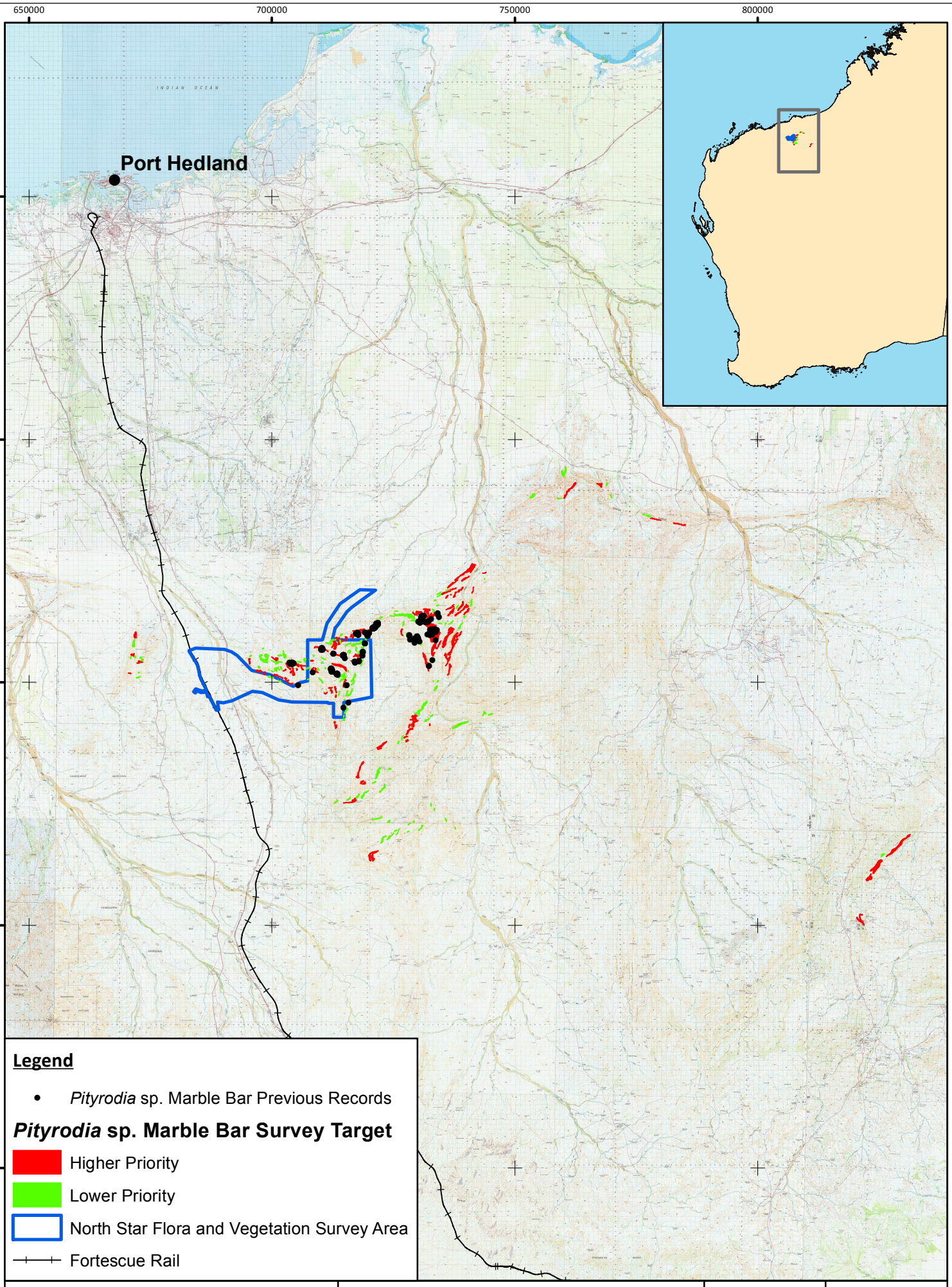
IB Operations Pty Ltd (IBO) is developing the North Star Magnetite Project (the Project), on behalf of the joint venture partners FMG Iron Bridge (Aust) Pty Ltd (FMGIB) and Formosa Steel IB Pty Ltd (Formosa). The Project is located approximately 110 km south of Port Hedland in the Pilbara region of Western Australia.

The objective of the survey was to conduct a regional survey for the Priority 1 *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) consistent with the *Pityrodia* sp. Marble Bar Regional Survey Plan (NS-PL-EN-0006) required to satisfy Condition 7 of EPA Report 1514.

Previous flora and vegetation assessments in the North Star area have recorded an estimated 2,039 *Pityrodia* sp. Marble Bar individuals. Previous studies that have recorded *Pityrodia* sp. Marble Bar include:

- Supplementary botanical surveys, rare flora searches, assessment of vegetation condition and identification of groundwater dependent ecosystems for the Sulphur Springs Project (Trudgen 2007, cited in Mattiske 2007);
- North Star Flora and Vegetation Assessment (*ecologia* 2012a);
- *Pityrodia* sp. Marble Bar Targeted Survey (*ecologia* 2012b);
- Abydos Direct Shipping Ore Project Flora and Vegetation Studies (Woodman 2012);
- Abydos Direct Shipping Ore Project Stage 2 Flora and Vegetation Studies (Woodman 2013); and
- North Star Slurry and Infrastructure Corridors Conservation Significant Flora and Vegetation Assessment (*ecologia* 2015).

The *Pityrodia* sp. Marble Bar Regional Survey Plan (NS-PL-EN-0006) included a probabilistic species distribution model which was used to identify areas of potentially suitable habitat for *Pityrodia* sp. Marble Bar. FMGIB requested *ecologia* to conduct a *Pityrodia* sp. Marble Bar regional survey of those areas identified as targets for survey according to the *Pityrodia* sp. Marble Bar Regional Survey Plan (NS-PL-EN-0006).



Legend

- *Pityrodia* sp. Marble Bar Previous Records

***Pityrodia* sp. Marble Bar Survey Target**

- Higher Priority
- Lower Priority
- North Star Flora and Vegetation Survey Area
- Fortescue Rail

0 20 40

Kilometres

Absolute Scale - 1:1,000,000

Pityrodia sp. Marble Bar Regional Survey Targets

Figure: 1.1
Project: 1652

Drawn: MM
Date: 28/10/2015

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

A4

2 METHODS

Two field botanists surveyed 144 *Pityrodia* sp. Marble Bar Regional Survey targets from 16 to 27 September 2015 (Principal Ecologist Matthew Macdonald and Botanist John Grantham). This includes 62 of the 96 higher priority targets (41 targets surveyed from the helicopter, 24 on foot or from the vehicle) identified in the *Pityrodia* sp. Marble Bar Regional Survey Plan (Table 2.1, Table 2.2, Figure 2.1, to Figure 2.6). An additional 11 higher priority targets have been surveyed during previous flora and vegetation assessments (nine from *ecologia* 2012b, one from *ecologia* 2012a, and one from Woodman 2012). Of the 144 lower priority targets identified in the *Pityrodia* sp. Marble Bar Regional Survey Plan, 79 (Table 2.1, Table 2.2, Figure 2.1, Figure 2.2 and Figure 2.3) were surveyed during this regional survey (51 targets surveyed from the helicopter, 28 on foot or from vehicle). An additional 11 targets have previously been surveyed (eight from *ecologia* 2012b, one from *ecologia* 2012a, one from Trudgen 2007 and one from Woodman 2012/2013).

A helicopter was utilised on 18 and 20 September to efficiently survey the more distant and remote targets (Figure 2.1, Figure 2.2 and Figure 2.3). Vehicle access was constrained to the north of Glacier Valley by the closure of the vehicle track by Atlas Iron due to ongoing mining activities associated with the Abydos project.

Where *Pityrodia* sp. Marble Bar targets could be satisfactorily viewed with binoculars from a distance, this was considered sufficient to determine if more intensive ground-searching was justified. Where higher priority targets were not considered safe to survey (due to distance from known access tracks), lower priority areas were surveyed where accessible instead. Target areas tended to be associated with steep terrain, and areas were avoided where ground conditions were considered unsafe for approach on foot. Some *Pityrodia* sp. Marble Bar locations are approximate due to unsafe terrain. Where *Pityrodia* sp. Marble Bar populations were encountered outside target areas, they were recorded and these areas surveyed opportunistically.

Conditions were favourable for identifying *Pityrodia* sp. Marble Bar from a distance, with approximately 90% of individuals recorded in reproductive condition (generally late flower/early fruit). Fruit are expected to ripen within weeks of completion of field work. Care was taken to avoid double-counting previous records by carrying a hand-held GPS at all times while in the field and avoiding areas with previous records, or accounting for all previously recorded individuals in an area prior to recording additional locations.

Table 2.1 – *Pityrodia* sp. Marble Bar Regional Survey Higher Priority Targets Surveyed

Target	Area (ha)	Centroid		Surveyed	
		Easting	Northing		
1	8.3	670731	7651861	Yes*	*ecologia* 2015
2	24.6	671365	7655653	Yes*	*ecologia* 2015
3	47.9	671861	7659716	Yes*	*ecologia* 2015
4	25.8	672737	7654182	Yes*	*ecologia* 2015
5	28	695354	7654338	No	-
6	40.3	697345	7652283	No	-
7	12.2	698450	7651837	No	-
8	22.6	700657	7651501	No	-
9	40.9	700736	7654812	No	-
10	18.5	701736	7651078	No	-
11	10.3	702585	7652479	Yes	*ecologia* 2015
12	18.5	702811	7650692	No	-
13	40.1	703313	7653289	Yes	*ecologia* 2015
14	25.4	703634	7649960	No	-
15	43	703979	7653535	Yes	*ecologia* 2012b
16	54.6	704262	7652003	Yes*	*ecologia* 2015
17	8.3	705105	7652694	Yes	*ecologia* 2015
18	34.3	705182	7653605	Yes	*ecologia* 2015
19	39.6	706249	7653187	Yes	*ecologia* 2015
20	13	708230	7654445	No	-
21	9.9	708376	7652835	No	-
22	23.2	709055	7652385	No	-
23	20.4	709231	7657222	Yes	*ecologia* 2015
24	20.4	710337	7656974	Yes	*ecologia* 2012b
25	10.7	711045	7647750	Yes*	*ecologia* 2015
26	7.8	711281	7656540	Yes	*ecologia* 2015
27	14.5	712008	7648843	Yes*	*ecologia* 2015
28	17.4	712235	7648179	Yes*	*ecologia* 2015
29	69.1	712515	7652229	Yes	*ecologia* 2012a
30	85.1	712892	7657655	Yes	*ecologia* 2015
31	33.5	713051	7641130	Yes†	*ecologia* 2015
32	26.9	713068	7648542	Yes*	*ecologia* 2015
33	10.6	713149	7647172	Yes*	*ecologia* 2015
34	73.1	713378	7655755	Yes	*ecologia* 2015
35	54	713595	7658577	Yes	*ecologia* 2015
36	126	714080	7653283	Yes	*ecologia* 2015
37	17.4	714451	7658660	Yes	*ecologia* 2015
38	39.5	714884	7649743	Yes*	*ecologia* 2015
39	26.2	715259	7659012	No	-
40	32.9	716435	7659465	No	-
41	66.8	716448	7625512	Yes†	*ecologia* 2015
42	22.8	717009	7660275	No	-
43	124.8	717686	7655226	Yes	*ecologia* 2015
44	52	717794	7660114	Yes	Woodman 2012

Target	Area (ha)	Centroid		Surveyed	
		Easting	Northing		
45	85.1	718020	7631843	Yes†	*ecologia* 2015
46	49.7	718637	7660636	No	-
47	40	718714	7629322	Yes†	*ecologia* 2015
48	39.7	720443	7661039	Yes	*ecologia* 2012b
49	147.5	720614	7614278	Yes†	*ecologia* 2015
50	87.1	722491	7636894	Yes†	*ecologia* 2015
51	28.1	726675	7660354	No	-
52	15.8	727540	7638755	Yes†	*ecologia* 2015
53	14	727811	7637997	Yes†	*ecologia* 2015
54	57.3	728250	7640040	Yes†	*ecologia* 2015
55	16	728296	7641084	Yes†	*ecologia* 2015
56	143.1	729214	7642156	Yes†	*ecologia* 2015
57	21.2	729441	7664073	No	-
58	3.5	729453	7659464	No	-
59	21.6	729772	7659512	Yes	*ecologia* 2012b
60	11.2	730259	7658624	Yes	*ecologia* 2012b
61	142.5	730804	7663632	Yes	*ecologia* 2012b
62	27.7	731545	7664833	No	-
63	157.3	731828	7654152	Yes	*ecologia* 2012b
64	45.4	732098	7664569	No	-
65	5.4	732465	7641293	Yes†	*ecologia* 2015
66	119.6	732712	7663551	Yes	*ecologia* 2012b
67	835.2	733216	7659760	Yes	*ecologia* 2012b
68	45.2	735682	7668468	Yes†	*ecologia* 2015

Target	Area (ha)	Centroid		Surveyed	
		Easting	Northing		
69	14	735982	7667620	Yes†	*ecologia* 2015
70	81.5	736065	7654910	Yes†	*ecologia* 2015
71	251.2	736151	7659431	Yes†	*ecologia* 2015
72	27	736520	7665261	Yes†	*ecologia* 2015
73	54.1	736530	7652839	Yes†	*ecologia* 2015
74	2.6	736801	7668045	Yes†	*ecologia* 2015
75	56.1	736932	7664491	Yes†	*ecologia* 2015
76	6.6	737232	7665834	Yes†	*ecologia* 2015
77	21.4	737290	7669209	Yes†	*ecologia* 2015
78	2.6	737394	7665585	Yes†	*ecologia* 2015
79	236.3	737493	7658283	Yes†	*ecologia* 2015
80	25	737637	7668035	Yes†	*ecologia* 2015
81	34.1	738775	7669044	Yes†	*ecologia* 2015
82	53.6	738955	7665743	Yes†	*ecologia* 2015
83	79.6	739161	7664928	Yes†	*ecologia* 2015
84	287	739666	7672457	Yes†	*ecologia* 2015
85	43.3	739736	7671336	Yes†	*ecologia* 2015
86	36.5	740095	7664587	Yes†	*ecologia* 2015
87	18.1	741336	7668941	Yes†	*ecologia* 2015
88	7.7	743757	7672544	Yes†	*ecologia* 2015
89	103.3	761245	7689593	Yes†	*ecologia* 2015
90	47.7	767548	7690654	Yes†	*ecologia* 2015
91	32.1	778906	7683593	Yes†	*ecologia* 2015
92	39.3	783989	7682538	Yes†	*ecologia* 2015

Target	Area (ha)	Centroid		Surveyed	
		Easting	Northing		
93	87.6	821127	7601190	Yes†	*ecologia* 2015
94	87.4	822942	7609705	Yes†	*ecologia* 2015
95	222.7	824438	7612108	Yes†	*ecologia* 2015
96	216	828876	7616334	Yes†	*ecologia* 2015

Table 2.2 – *Pityrodia* sp. Marble Bar Regional Survey Lower Priority Targets Surveyed

Target	Area (ha)	Centroid		Surveyed	
		Easting	Northing		
100	6	670927	7655086	Yes*	*ecologia* 2015
101	23.8	671515	7657579	Yes*	*ecologia* 2015
102	18.2	671588	7658334	Yes*	*ecologia* 2015
103	7.8	671858	7655193	No	-
104	12.3	672452	7651010	No	-
105	4.4	672591	765198 6	No	-
106	2.2	672825	7654996	No	-
107	3.4	673077	7655184	No	-
108	6.8	673278	7654557	No	-
109	4.5	673278	7654816	No	-
110	9.5	695591	7655445	No	-
111	11.5	697317	7653120	No	-
112	3.7	698110	7656986	No	-
113	179.6	698458	7654950	No	-
114	1.8	699376	7652594	No	-
115	30.0	699692	7651089	No	-
116	4.8	700104	7652298	No	-
117	9.5	700604	7652622	No	-
118	20.9	700605	7654264	No	-
119	10.7	700946	7652593	No	-
120	14.0	701104	7653956	Yes*	*ecologia* 2015
121	10.0	701325	7652812	Yes*	*ecologia* 2015
122	16.5	701608	7655559	No	-
123	10.3	701626	7650219	No	-
124	7.2	701833	7654184	Yes	*ecologia* 2015
125	11.1	701871	7652960	Yes	*ecologia* 2015
126	10.7	702364	7655948	No	-
127	13.2	702577	7655239	Yes*	*ecologia* 2015
128	6.3	702810	7655506	No	-
129	41.8	703866	7654396	Yes*	*ecologia* 2015
130	15.9	705587	7654217	Yes	*ecologia* 2012b
131	15.5	706678	7654470	No	-

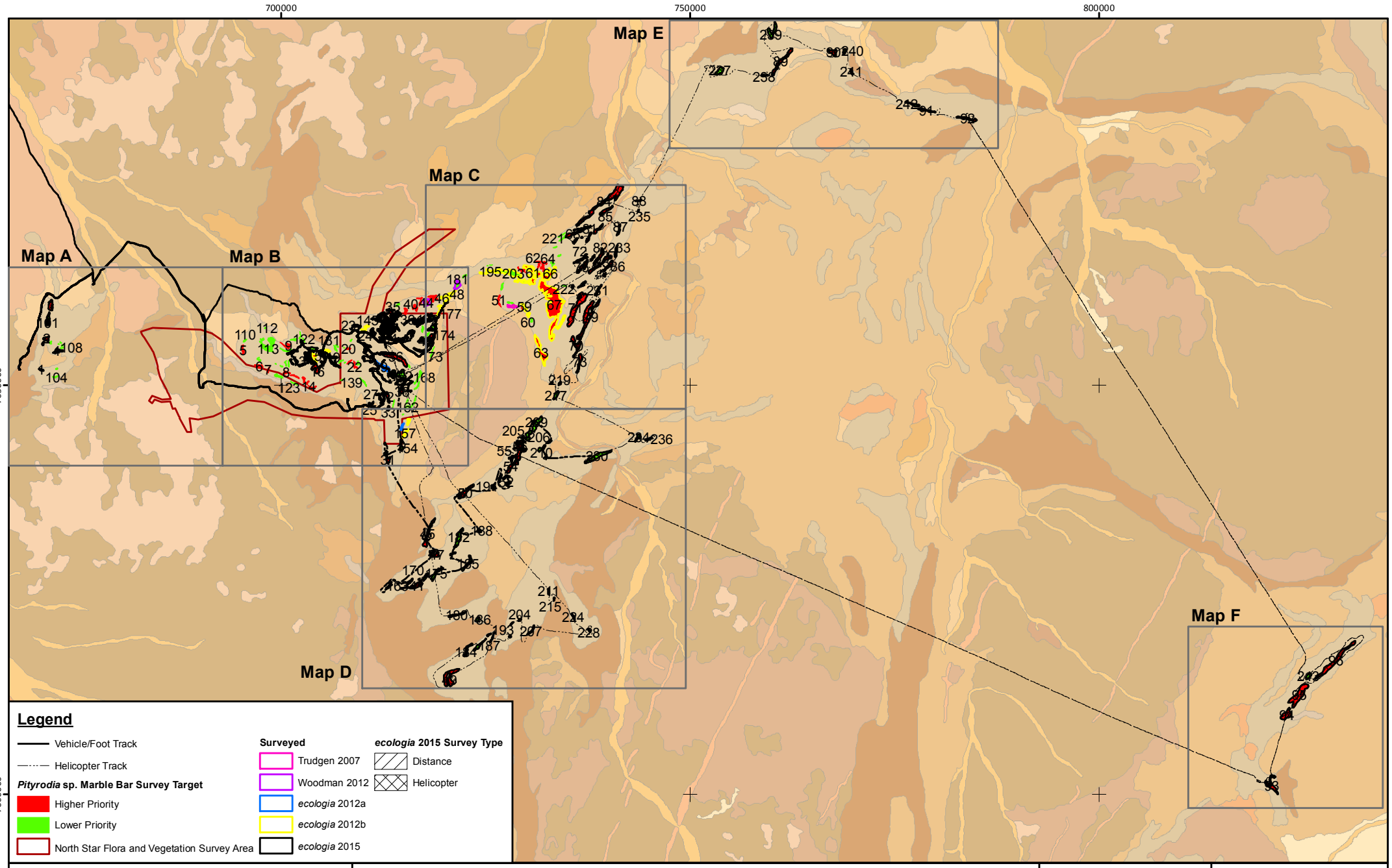
Target	Area (ha)	Centroid		Surveyed	
		Easting	Northing		
132	7.0	706879	7654767	No	-
133	11.2	707328	7652902	No	-
134	4.8	707458	7650630	No	-
135	1.5	707742	7654591	No	-
136	2.1	707837	7652757	No	-
137	3.6	708582	7655475	No	-
138	12.7	709481	7652633	No	-
139	19.6	710121	7650374	No	-
140	6.7	710297	7654058	Yes	*ecologia* 2015
141	10.7	710588	7654873	Yes*	*ecologia* 2015
142	3.6	710955	7652884	Yes	*ecologia* 2015
143	6.2	711374	7658070	Yes	*ecologia* 2015
144	6.2	712273	7658714	Yes	*ecologia* 2015
145	33.9	712335	7658258	Yes	*ecologia* 2015
146	15.2	713161	7625345	Yes†	*ecologia* 2015
147	16.8	713470	7651145	Yes*	*ecologia* 2015
148	10.5	713779	7647757	No	-
149	15.1	713802	7651581	Yes*	*ecologia* 2015
150	13.0	714066	7658392	Yes	*ecologia* 2015
151	12.0	714303	7659808	No	-
152	95.6	714683	7651087	Yes*	*ecologia* 2015
153	6.4	714762	7642986	Yes†	*ecologia* 2015
154	11.8	714769	7642280	Yes†	*ecologia* 2015
155	13.0	714810	7644926	Yes	*ecologia* 2012a
156	3.5	714939	7646425	No	-
157	26.7	715219	7644113	Yes	*ecologia* 2012b
158	9.8	715439	7647993	No	-
159	16.0	715601	7645551	Yes	*ecologia* 2012b
160	23.4	715623	7657803	Yes*	*ecologia* 2015
161	6.4	715694	7652314	No	-
162	28.2	715759	7647455	No	-
163	17.0	715810	7625995	Yes†	*ecologia* 2015
164	24.2	715919	7656381	Yes	*ecologia* 2015
165	9.6	716432	7648340	No	-
166	9.9	716624	7657765	Yes	*ecologia* 2015
167	18.0	716681	7649893	No	-
168	40.1	716817	7650957	No	-
169	17.1	717330	7656839	No	-
170	24.1	717651	7626534	Yes†	*ecologia* 2015
171	15.5	717911	7656143	No	-
172	73.1	717929	7658052	Yes	*ecologia* 2015
173	16.5	718477	7653957	No	-
174	20.2	718629	7657057	Yes*	*ecologia* 2015
175	48.1	718956	7626910	Yes†	*ecologia* 2015
176	13.4	719239	7658645	Yes	*ecologia* 2012b
177	16.7	719638	7659508	Yes	*ecologia* 2012b
178	19.8	720338	7660371	Yes	*ecologia* 2012b
179	11.0	721034	7629405	Yes†	*ecologia* 2015

Target	Area (ha)	Centroid		Surveyed	
		Easting	Northing		
180	31.3	721555	7621938	Yes†	*ecologia* 2015
181	46.0	721580	7662225	Yes	Woodman 2012
182	80.3	721745	7631326	Yes†	*ecologia* 2015
183	12.8	722446	7663332	No	-
184	38.9	722775	7617617	Yes†	*ecologia* 2015
185	46.0	722868	7628202	Yes†	*ecologia* 2015
186	16.9	724047	7621336	Yes†	*ecologia* 2015
187	33.8	724233	7618175	Yes†	*ecologia* 2015
188	12.5	724241	7632194	Yes†	*ecologia* 2015
189	6.2	724669	7663673	Yes	*ecologia* 2012b
190	0.8	725273	7664601	No	-
191	7.5	725401	7619475	Yes†	*ecologia* 2015
192	2.7	725685	7664685	No	-
193	12.7	725868	7619132	Yes†	*ecologia* 2015
194	9.2	725982	7637593	Yes†	*ecologia* 2015
195	88.3	726621	7663891	Yes	*ecologia* 2012b
196	15.3	726783	7638593	Yes†	*ecologia* 2015
197	16.0	727046	7662040	No	-
198	4.6	728009	7619249	Yes†	*ecologia* 2015
199	15.9	728096	7660040	No	-
200	5.8	728229	7620857	Yes†	*ecologia* 2015
201	24.9	728250	7659626	Yes	Trudgen 2007
202	6.5	728788	7662682	Yes	*ecologia* 2012b
203	133.1	729005	7663307	Yes	*ecologia* 2012b

Target	Area (ha)	Centroid		Surveyed	
		Easting	Northing		
204	6.9	729214	7621296	Yes†	*ecologia* 2015
205	8.6	729578	7643610	Yes†	*ecologia* 2015
206	47.7	730268	7643878	Yes†	*ecologia* 2015
207	18.7	730642	7620033	Yes†	*ecologia* 2015
208	9.6	730659	7657907	No	-
209	76	731308	7645284	Yes†	*ecologia* 2015
210	26.1	731849	7642231	Yes†	*ecologia* 2015
211	10.6	732744	7624785	Yes†	*ecologia* 2015
212	11.1	732840	7643077	Yes†	*ecologia* 2015
213	1.6	733169	7650262	Yes†	*ecologia* 2015
214	13.9	733207	7664825	No	-
215	4.5	733396	7623851	Yes†	*ecologia* 2015
216	7.2	733555	7666851	No	-
217	32.0	733660	7648755	Yes†	*ecologia* 2015
218	7.7	734057	7665826	No	-
219	7.2	734116	7650205	Yes†	*ecologia* 2015
220	11.3	734367	7668348	No	-
221	14.5	734420	7667896	No	-
222	9.1	734661	7662140	No	-
223	5.4	735670	7662073	Yes†	*ecologia* 2015
224	11.6	735786	7621679	Yes†	*ecologia* 2015
225	8.3	736121	7669019	Yes†	*ecologia* 2015
226	6.5	736644	7662075	Yes†	*ecologia* 2015
227	8.8	737077	7662475	Yes†	*ecologia* 2015

Target	Area (ha)	Centroid		Surveyed	
		Easting	Northing		
228	5.6	737696	7620013	Yes†	*ecologia* 2015
229	13.8	738131	7665545	Yes†	*ecologia* 2015
230	113.8	738704	7641284	Yes†	*ecologia* 2015
231	27.5	738771	7661562	Yes†	*ecologia* 2015
232	10.0	739598	7663495	Yes†	*ecologia* 2015
233	25.9	740998	7666334	Yes†	*ecologia* 2015
234	22.9	743678	7643604	Yes†	*ecologia* 2015
235	2.8	743694	7671315	Yes†	*ecologia* 2015
236	13.8	744940	7643394	Yes†	*ecologia* 2015
237	52.2	753664	7688398	Yes†	*ecologia* 2015
238	14.3	759132	7687829	Yes†	*ecologia* 2015
239	77.4	760105	7693271	Yes†	*ecologia* 2015
240	16.4	768939	7690795	Yes†	*ecologia* 2015
241	10.6	769777	7688303	Yes†	*ecologia* 2015
242	31.7	777270	7684333	Yes†	*ecologia* 2015
243	26	825652	7614433	Yes†	*ecologia* 2015

Datum: GDA 1994 MGA Zone 50
* denotes targets surveyed from distance (with binoculars)
† denotes targets survyed by helicopter


700000
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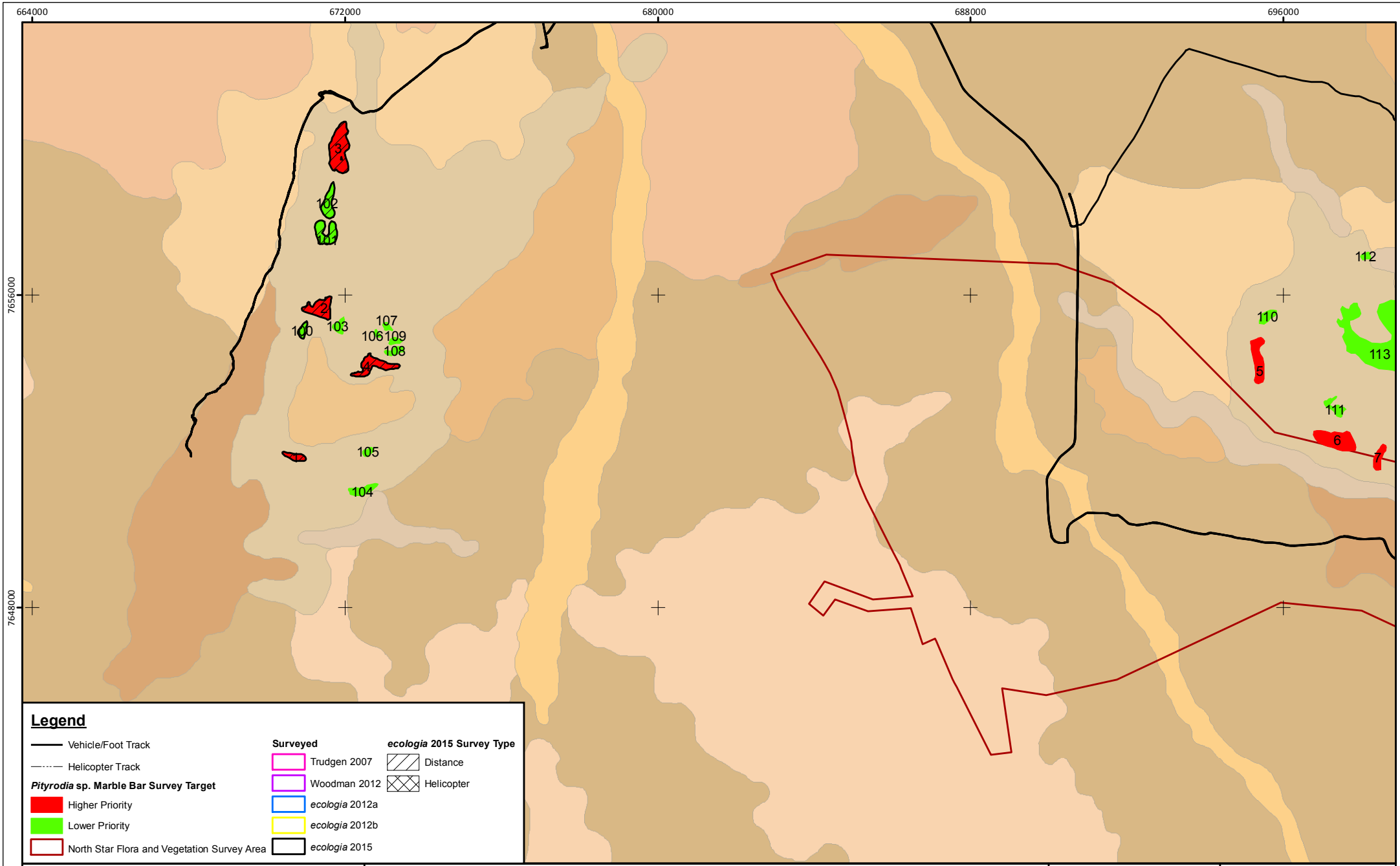
Map A
Map B
Map C
Map D
Map E
Map F
Legend
Vehicle/Foot Track
Helicopter Track
Pityrodia sp. Marble Bar Survey Target
Higher Priority
Lower Priority
North Star Flora and Vegetation Survey Area
Surveyed
Trudgen 2007
Woodman 2012
ecologia 2012a
ecologia 2012b
ecologia 2015
ecologia 2015 Survey Type
Distance
Helicopter
0
10
20
Kilometres
Absolute Scale - 1:599,995
Pityrodia sp. Marble Bar
regional targets surveyed - Overview
Figure: 2.1
Project: 1652
Drawn: MM
Date: 28/10/2015
Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
A4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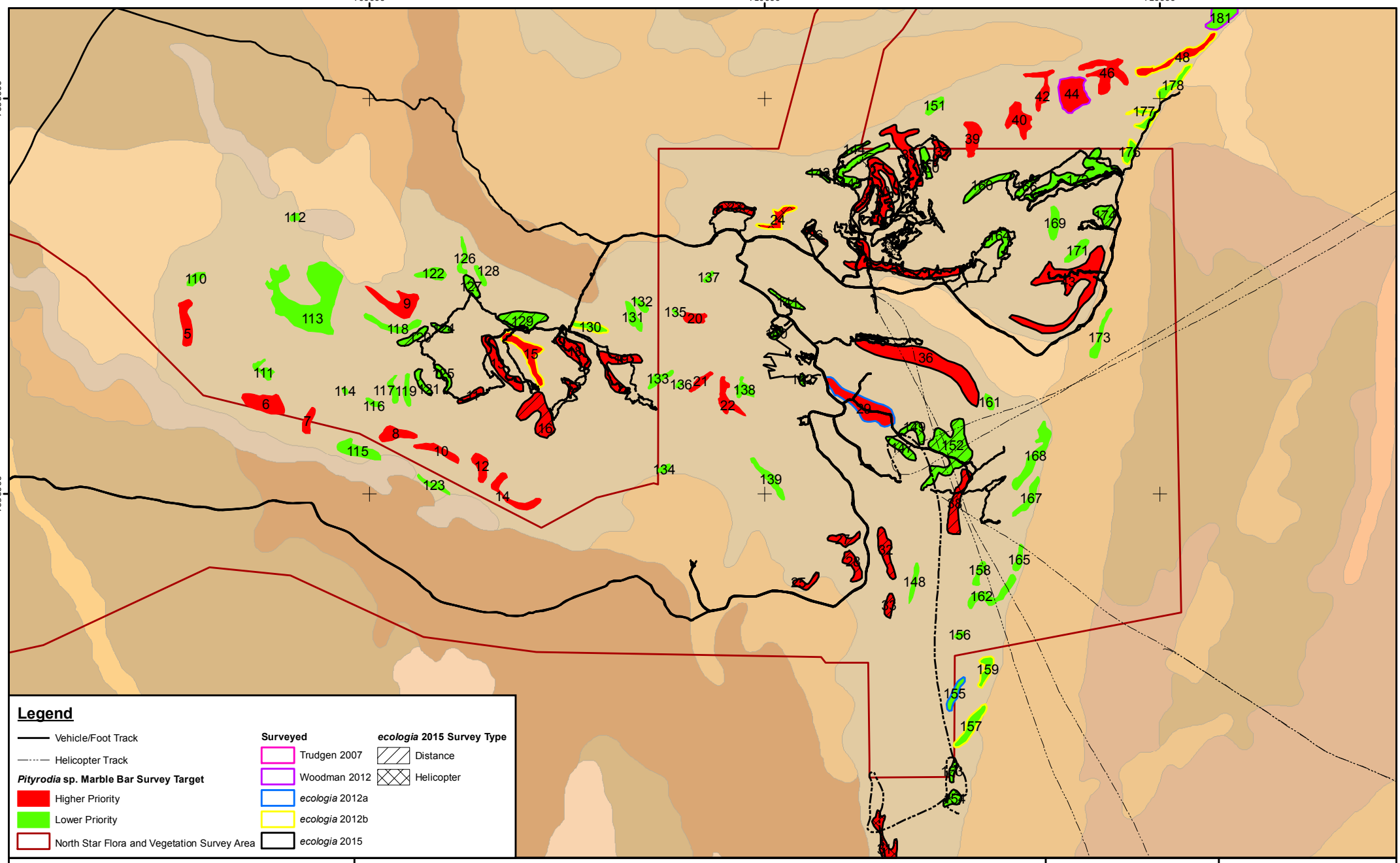
Legend
Vehicle/Foot Track
Helicopter Track
Pityrodia sp. Marble Bar Survey Target
Higher Priority
Lower Priority
North Star Flora and Vegetation Survey Area
Surveyed
Trudgen 2007
Woodman 2012
ecologia 2012a
ecologia 2012b
ecologia 2015
ecologia 2015 Survey Type
Distance
Helicopter
N
0
2.5
5
Kilometres
Absolute Scale - 1:125,000
Pityrodia sp. Marble Bar
regional targets surveyed - Map A
Figure: 2.2
Project: 1652
Drawn: MM
Date: 28/10/2015
Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
A4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710000
720000
7660000
7650000
Legend
Vehicle/Foot Track
Helicopter Track
Pityrodia sp. Marble Bar Survey Target
Higher Priority
Lower Priority
North Star Flora and Vegetation Survey Area
Surveyed
Trudgen 2007
Woodman 2012
ecologia 2012a
ecologia 2012b
ecologia 2015
ecologia 2015 Survey Type
Distance
Helicopter
N
0
2.5
5
Kilometres
Absolute Scale - 1:125,000
Pityrodia sp. Marble Bar
regional targets surveyed - Map B
Figure: 2.3
Project: 1652
Drawn: MM
Date: 28/10/2015
Coordinate System
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Projection: Transverse Mercator
Datum: GDA 1994
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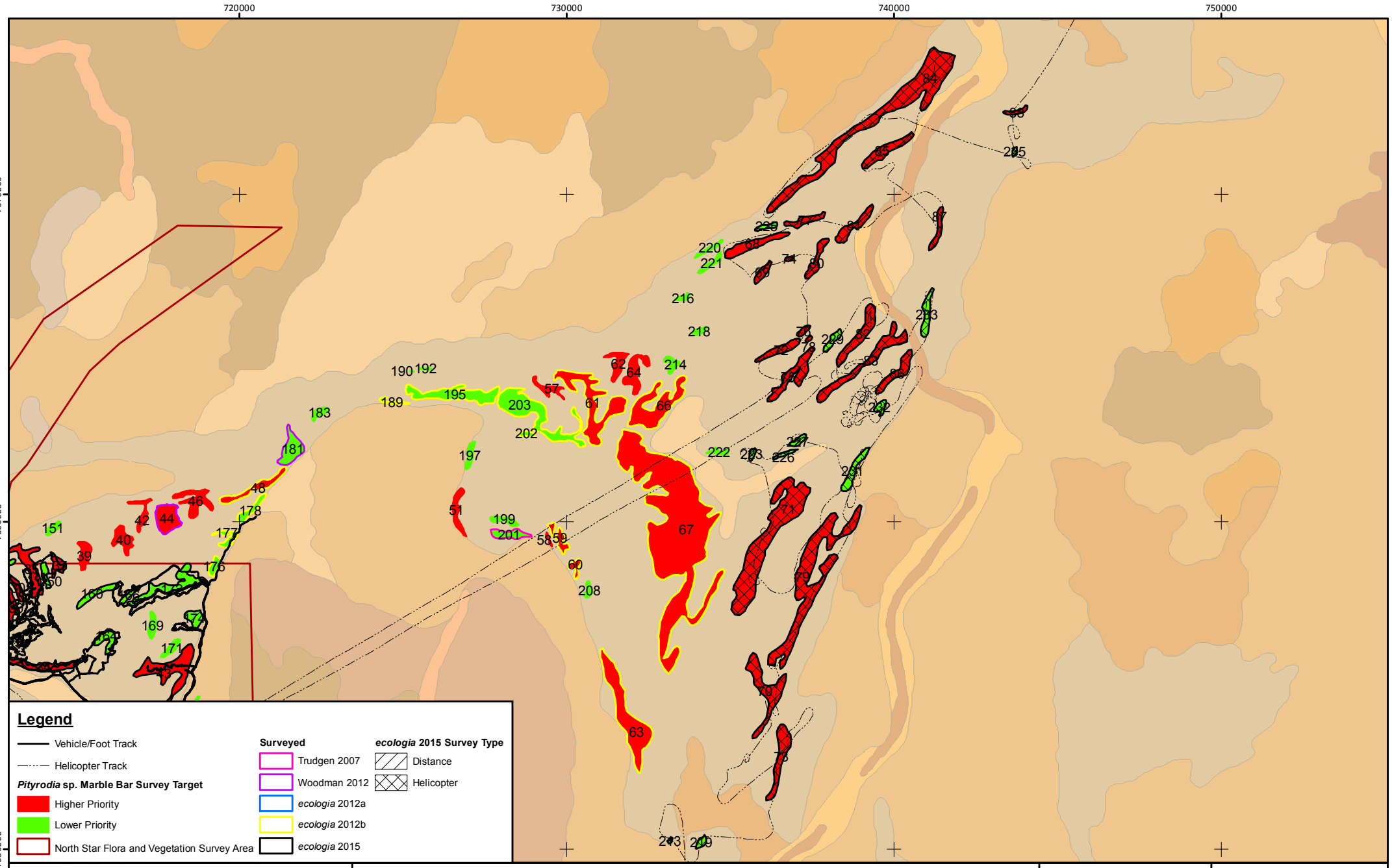
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Legend
Vehicle/Foot Track
Helicopter Track
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Higher Priority
Lower Priority
North Star Flora and Vegetation Survey Area
Surveyed
Trudgen 2007
Woodman 2012
ecologia 2012a
ecologia 2012b
ecologia 2015
ecologia 2015 Survey Type
Distance
Helicopter
0
3
6
Kilometres
Absolute Scale - 1:150,000
Pityrodia sp. Marble Bar
regional targets surveyed - Map C
Figure: 2.4
Project: 1652
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Date: 28/10/2015
Coordinate System
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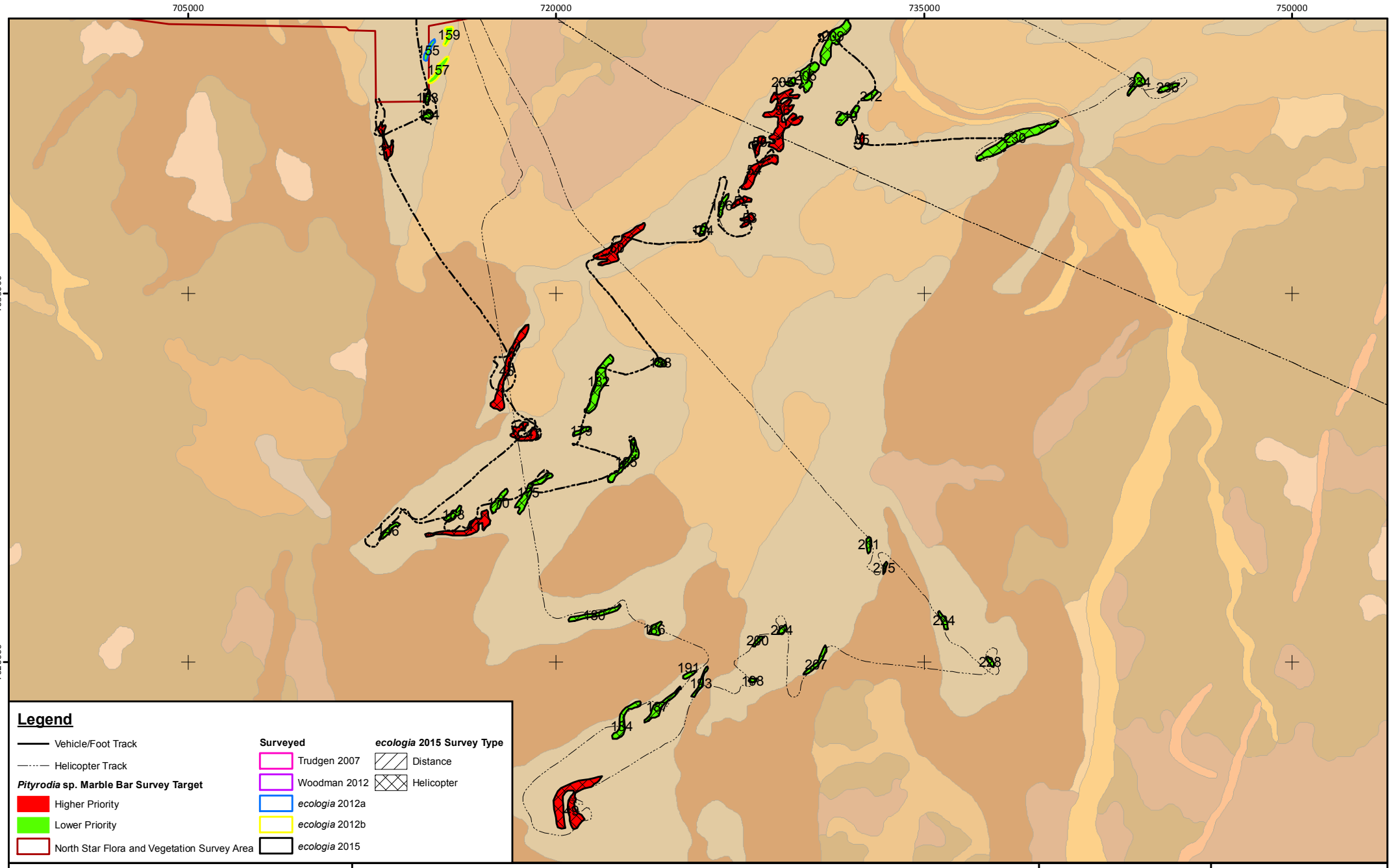
705000
720000
735000
750000
7635000
7620000
Legend
Vehicle/Foot Track
Helicopter Track
Pityrodia sp. Marble Bar Survey Target
Higher Priority
Lower Priority
North Star Flora and Vegetation Survey Area
Surveyed
Trudgen 2007
Woodman 2012
ecologia 2012a
ecologia 2012b
ecologia 2015
ecologia 2015 Survey Type
Distance
Helicopter
0
4
8
Kilometres
Absolute Scale - 1:200,000
Pityrodia sp. Marble Bar
regional targets surveyed - Map D
Figure: 2.5
Project: 1652
Drawn: MM
Date: 28/10/2015
Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
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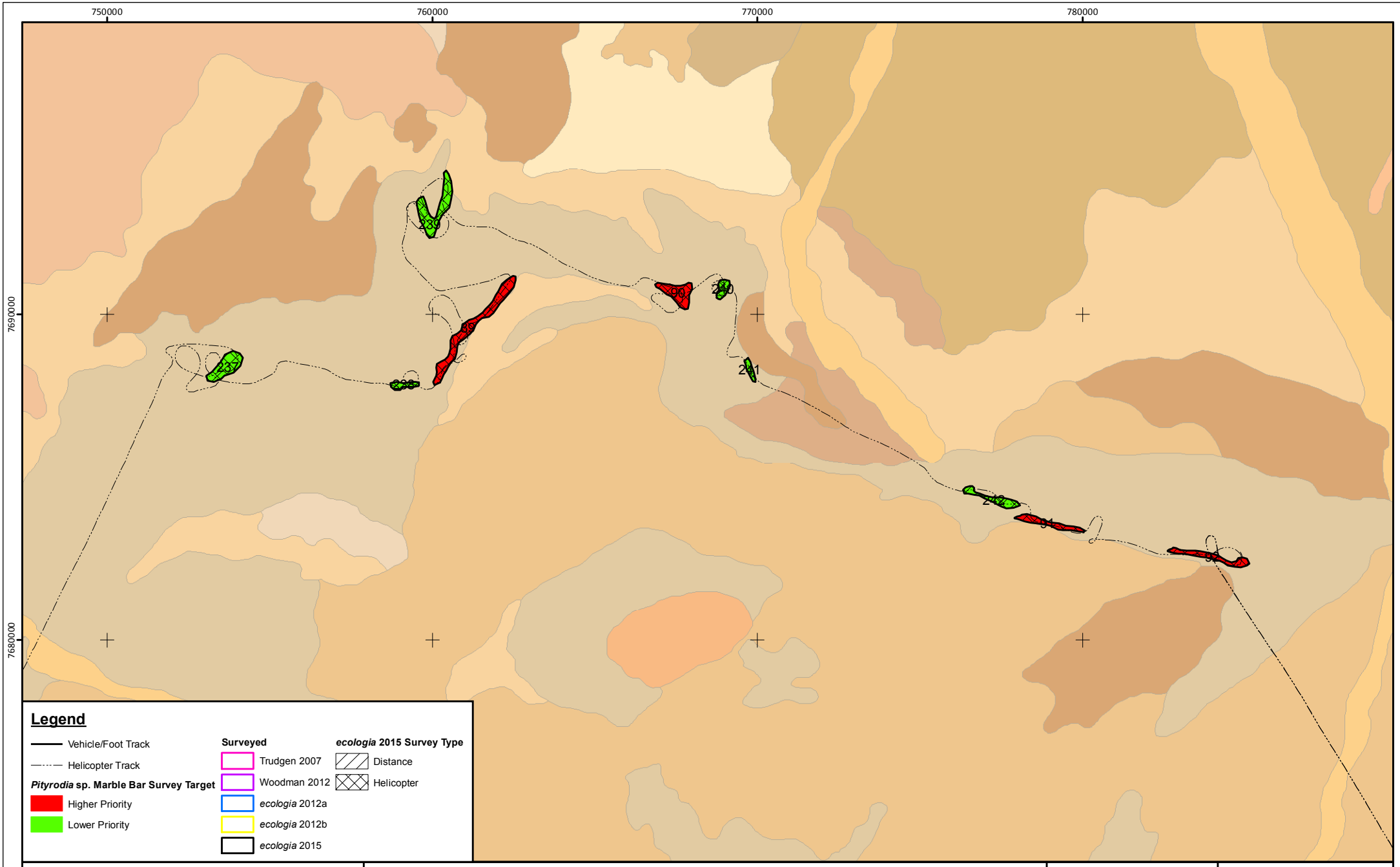

Pityrodia sp. Marble Bar regional targets surveyed - Map E

Figure: 2.6
Project: 1652

Drawn: MM
Date: 28/10/2015

Coordinate System
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Projection: Transverse Mercator
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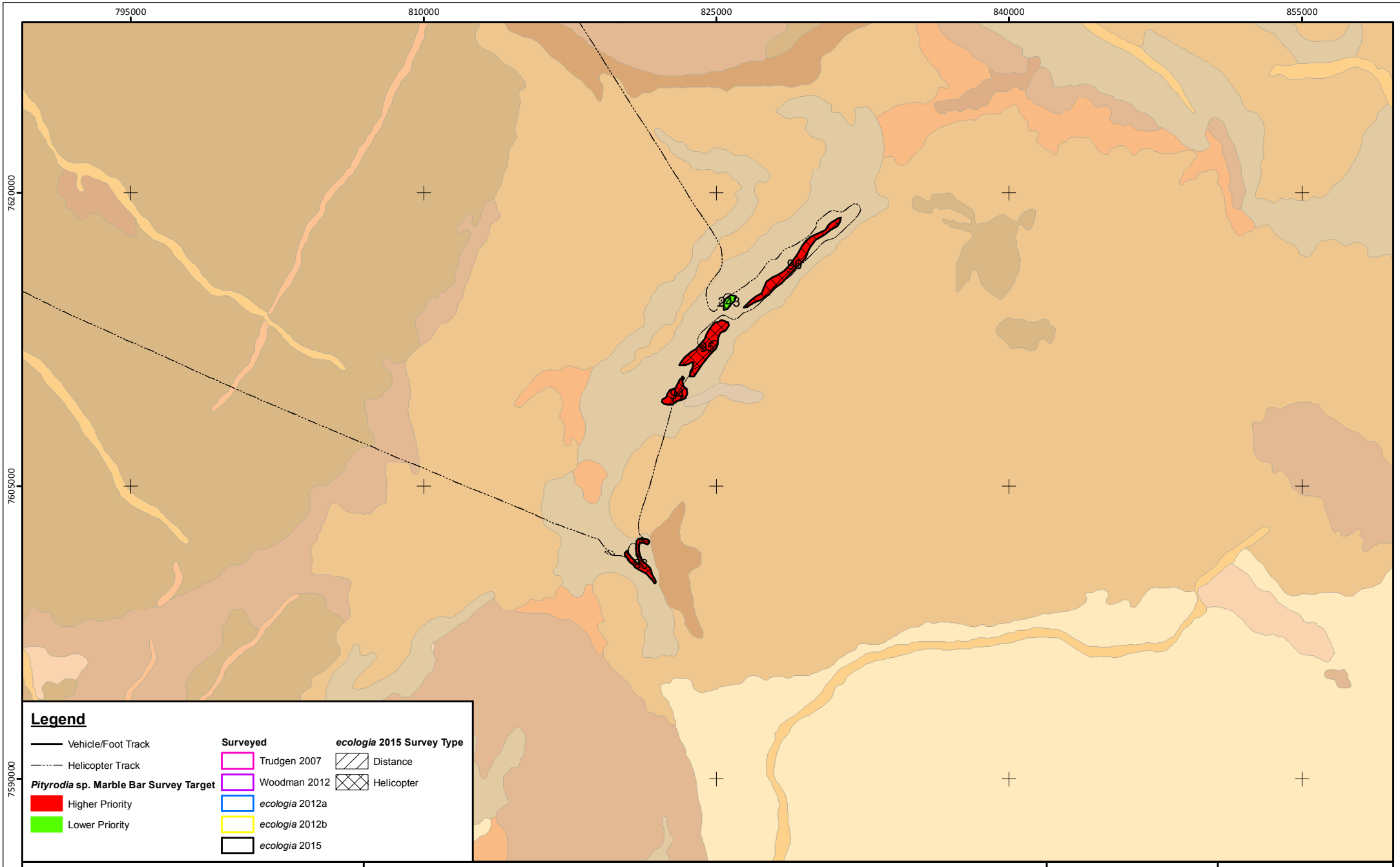

Pityrodia sp. Marble Bar regional targets surveyed - Map F

Figure: 2.7
Project: 1652

Drawn: MM
Date: 28/10/2015

Coordinate System
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Projection: Transverse Mercator
Datum: GDA 1994

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3 RESULTS

3.1 *PITYRODIA* SP. MARBLE BAR RECORDS

In total 2,114 new locations of *Pityrodia* sp. Marble Bar were recorded, representing 7,473 previously unrecorded mature individuals, with an additional 269 juveniles and 45 seedlings recorded. Of the 7,473 newly recorded mature individuals 5,425 (72.6%) were at the immature fruit developmental stage; 369 (4.9%) were recorded with flowers and immature fruit; 196 (2.6%) were in flower only. Not all individuals were scored for developmental stage, such as those recorded from helicopter. New *Pityrodia* sp. Marble Bar records are provided in Appendix A. All *Pityrodia* sp. Marble Bar records from this and previous surveys are shown in Figure 3.6.

Based on all known records of *Pityrodia* sp. Marble Bar, there is an estimated 9,848 individuals (including 269 juveniles and 45 seedlings) recorded. The records have been assembled into 67 "populations" (Table 3.1, Figure 3.5) which are separated by at least 500 m, according to DPaW guidelines (DEC 2010). This includes records from the current survey, the records from previous surveys incorporated into the *Pityrodia* sp. Marble Bar Regional Survey Plan (NS-PL-EN-0006), and records obtained since the development of the Survey Plan including:

- Four records from the 2015 North Star Conservation Significant Fauna Monitoring (Ecoscape 2015); and
- Two records from the North Star Slurry and Infrastructure Corridors Conservation Significant Flora and Vegetation Assessment (*ecologia* 2015).

The single largest population (Population 6) includes an estimated 3,048 individuals, approximately 30% of the number of *Pityrodia* sp. Marble Bar individuals recorded. Population 8 is the second largest population, with an estimated 1,222 individuals. Six populations are represented by a single individual, an additional two populations represented by two individuals, and four populations represented by three individuals.

The records obtained from helicopter searches (which represent populations 52 to 67) are necessarily less precise than those obtained on foot and the accuracy (± 100 m) of these records should be considered when revisiting these sites, with a view to obtaining more precise location and count data for these populations in the future.

A substantial extension to the extent of occurrence was recorded with new *Pityrodia* sp. Marble Bar records approximately 6 km east of previous most easterly record, towards the Shaw River. The extent of occurrence is defined for use in the determination of species conservation status (IUCN 2014). Based on the additional locations recorded since the development of the *Pityrodia* sp. Marble Bar Regional Survey Plan (NS-PL-EN-0006), the known extent of occurrence for *Pityrodia* sp. Marble has increased from 338.6 km^2 to 422.4 km^2.

The records of *Pityrodia* sp. Marble Bar are found overwhelmingly within the Capricorn land system, with only six records (from all surveys) recorded in any other land system (these six records are all within the Rocklea land system).

Table 3.1 – All *Pityrodia* sp. Marble Bar Records

Population	Western Australian Herbarium		Trudgen (2007)		*ecologia* (2012a)		*ecologia* (2012b)		Woodman (2012)		Woodman (2013)		Ecoscape (2015)		*ecologia* (2015)		*ecologia* (2015)		Total #
	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	
1							53	115											**115**
2					1	1													**1**
3					1	1													**1**
4*					15	254											21	118	**372**
5					16	80													**80**
6*					2	5							1	1			960	3,036	**3,042**
7					13	65													**65**
8*	3	50			9	68											211	1,036	**1,104**
9					1	2													**2**
10					2	12													**12**
11					1	12													**12**
12							1	1											**1**
13					7	27													**27**
14					3	9													**9**
15					1	3							2	8			13	30	**41**
16*					2	2											37	168	**170**
17							14	43			1	9							**43**
18	3	59			39	69	28	29	4	30	20	73							**73**
19							2	2	9	80	9	23							**80**
20			1	6			6	19			15	92							**92**
21			2	10			13	20			4	66							**66**
22							220	438			63	524							**524**
23			2	241															**241**
24			1																
25			1																
26			5				6	21											
27			2																
28			1																
29									3	3									**3**

Population	Western Australian Herbarium		Trudgen (2007)		*ecologia* (2012a)		*ecologia* (2012b)		Woodman (2012)		Woodman (2013)		Ecoscape (2015)		*ecologia* (2015)		*ecologia* (2015)		Total #
	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	
30											22	160							**160**
31									1	6									**6**
32											1	6							**6**
33											1	19							**19**
34											1	30							**30**
35											2	38							**38**
36											1	1							**1**
37																	1	1	**1**
38*																	175	400	**400**
39*																	3	9	**9**
40*																	86	411	**411**
41																	2	6	**6**
42															2	12			**12**
43*																	311	1,047	**1,047**
44																	10	36	**36**
45*																	90	220	**220**
46*																	39	198	**198**
47													1	1					**1**
48																	1	6	**6**
49																	1	4	**4**
50*																	51	173	**173**
51*																	68	236	**236**
52																	1	20	**20**
53																	1	30	**30**
54																	1	50	**50**
55																	1	10	**10**
56																	3	61	**61**
57																	1	2	**2**
58																	3	47	**47**
59																	3	200	**200**
60																	2	3	**3**
61																	2	58	**58**

Population	Western Australian Herbarium		Trudgen (2007)		*ecologia* (2012a)		*ecologia* (2012b)		Woodman (2012)		Woodman (2013)		Ecoscape (2015)		*ecologia* (2015)		*ecologia* (2015)		Total #
	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	
62																	1	3	**3**
63																	2	7	**7**
64																	1	3	**3**
65																	8	144	**144**
66																	1	5	**5**
67																	3	9	**9**
Total	**4**	**109**	**15**	**257**	**113**	**610**	**343**	**688**	**17**	**119**	**140**	**1,041**	**4**	**10**	**2**	**12**	**2,114**	**7,787**	**9,848**

*Population 4 includes 6 juveniles;
*Population 6 includes 33 juveniles;
*Population 8 includes 16 juveniles;
*Population 16 includes 1 juvenile;
*Population 38 includes 94 juveniles & 17 seedlings;
*Population 39 includes 6 seedlings;
*Population 40 includes 62 juveniles & 22 seedlings;
*Population 43 includes 32 juveniles;
*Population 45 includes 1 juvenile;
*Population 46 includes 3 juveniles;
*Population 50 includes 5 juveniles; and
*Population 51 includes 16 juveniles.

3.2 FIELD OBSERVATIONS

Most mature plants were in late flower/early fruit at the time of survey, with most flowers withered and green immature fruit developing within the corolla and obscured by the persistent sepals (Figure 3.1). Two colour forms of mature individuals were noticed at some locations, a “green” (less frequent) form and a “grey” (more common) form (Figure 3.1, Figure 3.5). “Grey” form individuals appear to have an indumentum almost entirely of white hairs, whereas the stem and leaf of “green” form individuals have yellow hairs and sepal hairs are pink. The inflorescence structure may also be more open in “green” form plants, with possibly a later, albeit overlapping flowering period.

Plants in areas which had apparently been burnt within the past year had resprouted and were flowering/fruiting prolifically (Figure 3.2). The juveniles and seedlings were recorded almost exclusively in areas recently (<1 year) burnt (Figure 3.3). Some individual plants which have apparently established since the recent fire appear to have flowered within one year of germination.

Two potential insect pollinators were observed on flowering *Pityrodia* sp. Marble Bar. The most prevalent was an unidentified jewel beetle (Figure 3.4), but feral honey bees (*Apis melifera*) were also observed visiting some flowering *Pityrodia* sp. Marble Bar plants.

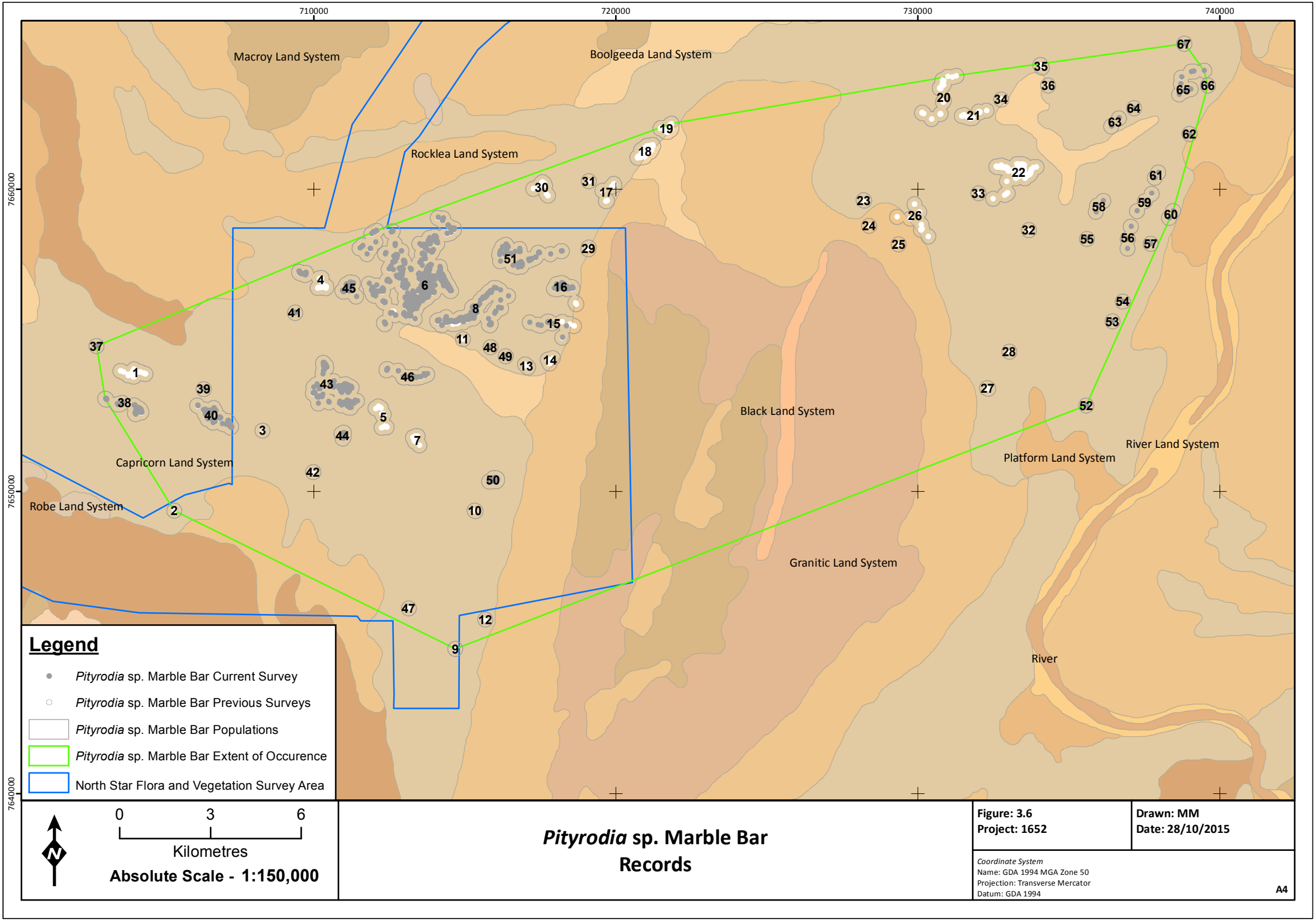
Figure 3.1 – Two forms: green (left) and grey (right) MJM247 (Population 50)

Figure 3.2 – Mature resprout with juveniles

Figure 3.3 – Seedling

Figure 3.4 – Jewel beetle (potential pollinator)

Figure 3.5 – Green (left) and grey (right) forms


710000
720000
730000
740000
7660000
7650000
7640000
Macroy Land System
Boolgeeda Land System
Rocklea Land System
Black Land System
Granitic Land System
Capricorn Land System
Robe Land System
Platform Land System
River Land System
River
Legend
Pityrodia sp. Marble Bar Current Survey
Pityrodia sp. Marble Bar Previous Surveys
Pityrodia sp. Marble Bar Populations
Pityrodia sp. Marble Bar Extent of Occurence
North Star Flora and Vegetation Survey Area
0
3
6
Kilometres
Absolute Scale - 1:150,000
Pityrodia sp. Marble Bar Records
Figure: 3.6
Project: 1652
Drawn: MM
Date: 28/10/2015
Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
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4 DISCUSSION AND CONCLUSIONS

During the *Pityrodia* sp. Marble Bar regional survey 2,114 new locations of *Pityrodia* sp. Marble Bar were recorded, representing 7,473 previously unrecorded mature individuals, with an additional 269 juveniles and 45 seedlings recorded. Therefore, based on all known records of *Pityrodia* sp. Marble Bar, there is an estimated 9,848 individuals recorded (including 9,534 mature individuals, 269 juveniles and 45 seedlings). The records include the 2,039 reported in the *Pityrodia* sp. Marble Bar Regional Survey Plan (NS-PL-EN-0006), 7,787 from this survey and 22 from other surveys since the development of the *Pityrodia* sp. Marble Bar Regional Survey Plan (NS-PL-EN-0006). All records have been assembled into 67 "populations" which are separated by at least 500 m, according to DPaW guidelines (DEC 2010). The single largest population (Population 6) includes an estimated 3,048 individuals, approximately 31% of the number of *Pityrodia* sp. Marble Bar individuals known.

A substantial extension to the extent of occurrence was recorded with new *Pityrodia* sp. Marble Bar records approximately 6 km east of previous most easterly record, towards the Shaw River. Since the development of the *Pityrodia* sp. Marble Bar Regional Survey Plan (NS-PL-EN-0006), the extent of occurrence for *Pityrodia* sp. Marble Bar has increased from 338.6 km^2 to 422.4 km^2.

Records of *Pityrodia* sp. Marble Bar are found overwhelmingly within the Capricorn land system, with only six records (from all surveys) recorded in any other land system (these six records are all within the Rocklea land system). The results of this regional survey are not exhaustive, and additional *Pityrodia* sp. Marble Bar individuals are likely to be recorded in and around known records, particularly in areas around Populations 6, 30 and 51, and between Populations 40 and 43. Populations surveyed from the helicopter (Populations 52 to 67) are also likely to yield higher abundance estimates if surveyed on ground, however remoteness and difficult terrain may limit the feasibility of accessing some of these areas. Therefore the total population of *Pityrodia* sp. Marble Bar is likely to be larger than that estimated, however large increases in the extent of occurrence from additional survey effort are considered less likely.

Several potentially important ecological observations were also made during the survey, including observations of potential pollinators (jewel beetles and feral honey bees) visiting *Pityrodia* sp. Marble Bar flowers. *Pityrodia* sp. Marble Bar individuals reshooting after fire, with prolific flowering/fruiting following fire and evidence of recruitment observed only in areas recently burnt. Some individuals which appeared to be less than one year old were also observed flowering. Therefore an increase in fire frequency is not expected to be detrimental to the *Pityrodia* sp. Marble Bar population.

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APPENDIX A NEW *PITYRODIA* SP. MARBLE BAR RECORDS