FINAL TECHNICAL REPORT

GOODENIA HARTIANA SURVEY
TELFER

JUNE 2010

FOR
NEWCREST MINING LTD

syrinx environmental pl
restoration remediation research operations masterplanning landscape architecture design

a 12 Monger Street, Perth, WA, AUSTRALIA, 6000 **p** +[618] 9227 9355 **f** +[618] 9227 5033 **w** www.syrinx.net.au **abn** 39092638410

SYRINX ENVIRONMENTAL PL

REPORT NO. RPT- 0406 - 010

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EXECUTIVE SUMMARY

Newcrest Mining appointed Syrinx Environmental PL (Syrinx) to conduct a regional study to determine the regional distribution of *Goodenia hartiana* surrounding the Telfer mine. Previous vegetation surveys undertaken by Syrinx in 2006 and 2007 found several populations of this species totalling approximately 11,000 plants.

Goodenia hartiana is a recently taxonomically described species (Sage and Albrecht 2006). The knowledge on this species to date has been limited with previous collections made on sand dune swale and sandy areas. Sage and Albrecht (2006) commented that further survey and research is required to determine the specific habitat of this species.

The known population around the immediate impact area of Telfer was known to be approximately 11, 000 prior to this survey. A total of almost 40,000 live plants were found in 10 populations during this survey. The total number of populations now recorded during surveys as part of Newcrest Mining's work is 51,000. An additional two populations of plants that were dead at the time of this survey have the potential to add to this number in the future. Monitoring in 2009 will determine this.

The additional information collected during this survey suggests the population which will be directly impacted by the future expansion of the Telfer mine would be a maximum of 20% of the known population to date, if no additional populations are found in the future. It is likely further populations will be found given the widespread nature of the habitat for this species now defined by this survey.

Recommendations for the management of the species are:

- The healthiest population within the constructed drain on the minesite should be signposted to avoid impact on the population. The location of the population is 0417 960, 7595060 (AGD 84 Zone 51).

- All populations to be monitored in June 2009 to determine survival of populations recorded this year as showing stress, and to see if the populations recorded as dead recover in the future.

1.0 INTRODUCTION

Newcrest Mining appointed Syrinx to conduct a regional study to determine the regional distribution of *Goodenia hartiana* surrounding the Telfer mine. During previous vegetation surveys undertaken by Syrinx in 2006 and 2007 several populations of this species had been found. However, discussion of the regional impact on these populations was not possible due to the lack of survey effort for this species in surrounding areas.

Goodenia hartiana has recently been taxonomically described (Sage and Albrecht 2006). Previous to this the species had the manuscript name of *Goodenia* sp. Rudall River (RP Hart 972). It was recognised as a new species allied to *Goodenia azurea*, which is a common species in the vegetation surrounding the Telfer mine.

Prior to this survey previous collections had been made of *Goodenia hartiana* by Hart and Associates (1998) in Rudall River National Park. Ray Hart had also recorded 2 populations on the Telfer mine lease area however there are no specific location details of these populations (Florabase 2008).

The knowledge on this species to date has been limited with previous collections made on sand dune swale and sandy areas. Sage and Albrecht (2006) commented that further survey and research is required to determine the specific habitat of this species.

1.1 SCOPE OF WORK

The scope of work covered in this assessment was as follows:

1. Flora Survey. Undertake a search for *Goodenia hartiana* populations outside the immediate mine impact area surrounding Telfer.

1.2 CLIMATE

An important factor with surveying flora and fauna in the Great Sandy Desert is the impact of climate, as many of the herbaceous plant species are predominantly ephemeral. The rainfall of the three summers prior to this survey has been erratic. The season prior to the field survey recorded well below average rainfall which made it more difficult to distinguish existing populations of *Goodenia hartiana*. The last previous above average rainfall was recorded 15 months previously in March 2007 (Figure 1).

The data for Figure 1 is from Bureau of Meteorology Station 13030 (Telfer).

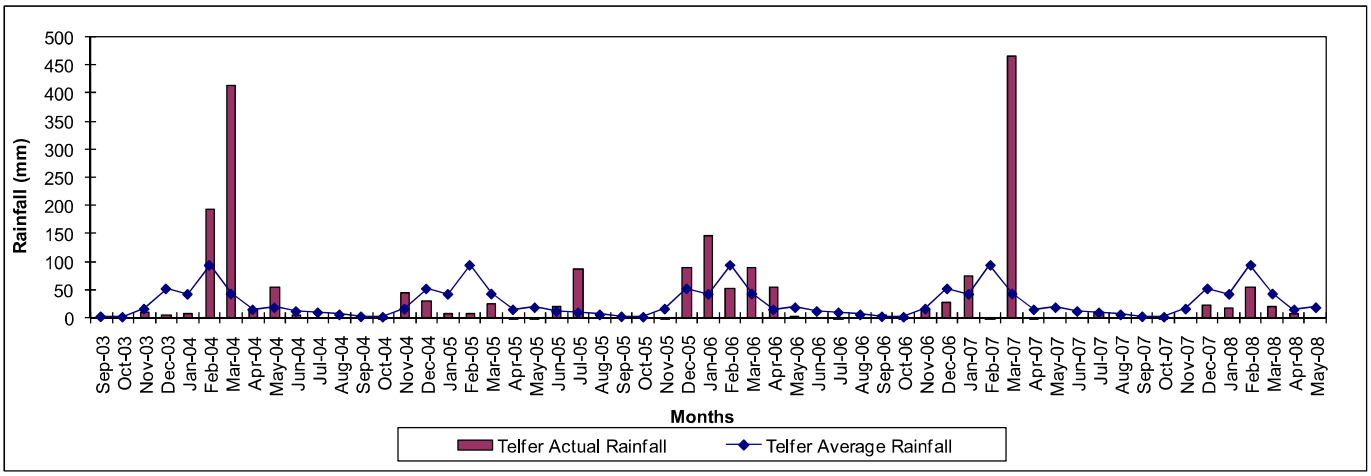


Figure 1 Actual and average rainfall recorded at Telfer between September 2003 and May 2008 (Bureau of Meteorology 2008)

2.0 METHODS

The approach taken for this survey was as follows:

1. Desktop review of the existing literature from previous reports and Department of Environment and Conservation records of *Goodenia hartiana*;
2. Field survey undertaken over 7 days from 2nd to 9th June 2008

2.1 PRE FIELDTRIP

A desktop survey of all previous information on *Goodenia hartiana* including

- Syrinx Environmental PL 2006 and 2007
- Additional vegetation surveys undertaken in areas of suitable habitat
- Florabase records

A meeting was held with Leigh Sage (DEC) regarding key identifying features and collecting requirements.

Aerial photography interpretation was undertaken to identify areas of major landforms to target during the survey, taking into account the knowledge gained from previous surveys in the Telfer region.

2.2 FIELDTRIP

Fieldwork was undertaken between the 2nd and 9th of June 2008. The flora survey work was undertaken by Sandra Santich, Jacqui Purvis and Eli Bradbury.

Previous populations recorded by Syrinx during 2006 and 2007 were revisited to determine the impact of the low rainfall from the previous season, with the condition to provide a baseline for the rest of the week.

All suitable areas outside of the mine impact area were thoroughly traversed by foot using a parallel transect method of vegetation survey with each person 20m apart. Most of the survey concentrated on areas west and north of the site as these areas contained the greatest area of suitable habitat. For large population GPS locations were taken at the furtherest extents of the populations whilst smaller populations had one GPS location taken. All GPS data was recorded in WGS 84 K51.

Upon collection, specimens were identified using a field herbarium created from *Goodenia hartiana* recently collected and identified in the area (verified by Leigh Sage, DEC, Perth).

Areas of suitable habitat which were searched, with no *Goodenia hartiana* found, were also recorded.

2.2.1 Limitations of Methods

As there was only one survey effort, not all existing populations would have been collected. Due to the lack of rain in the previous summers to the survey, the conditions of the populations were generally poor and harder to distinguish.

3.0 RESULTS

3.1 PREVIOUSLY RECORDED POPULATIONS WITHIN THE MINE IMPACT AREA

Of the populations revisited on the Telfer minesite two out of the three populations were very stressed with many of the plants deceased. The main population that showed the biggest change in condition was Population 8, recorded by Syrinx in July 2007. This was a population estimated at approximately 10,000 on the western portion of the active mine area. A comparison of the two seasons is shown in Figure 2. Most of the plants were dead at the time of the 2008 survey. The population in the best condition was on a constructed drain (Figure 3). This population may have better access to surface water due to its location in the landscape.

(a) (b)

Figure 2 Change in condition of onsite *Goodenia hartiana* population 8 (Syrinx Environmental PL 2007) from 2007 (a) to 2008 (b)

Figure 3 Example of healthy population on Telfer minesite recommended for protection

3.2 POPULATIONS OUTSIDE THE MINE IMPACT AREA

A total of almost 40,000 living plants in 10 populations were found during the survey (Table 1). Two populations consisted of only dead plants (Populations 2 and 5). Further detail on each population is described below. The locations of each population are shown in Figure 4.

Table 1 Populations of *Goodenia hartiana* found outside the Telfer Minesite immediate impact area

	Population Size (Live)	Population Size (Dead)	GPS Location (AGD 84 Zone 51)
1	561	204	Eastern extent 04122503, 7591363 Western Extent 0412346, 7591482
2		125	0410586, 7595897
3	678		Start 0412410, 7595897 End 0412579, 7595770
5		111	0414144, 7601415
6	8,000		Start 0406225, 7605270, End 0404732, 7606085
7	749	40	0406522, 7604661
8	27		0408194, 7604653
9	3,200		0427210, 7575502
10	1,139		**Population Number**
11	14,356		0402422, 7605340
12	8,800		0396228, 7610808
13	2,064		0397631, 7612371
TOTAL	**39,574 plants**	**480 plants**	

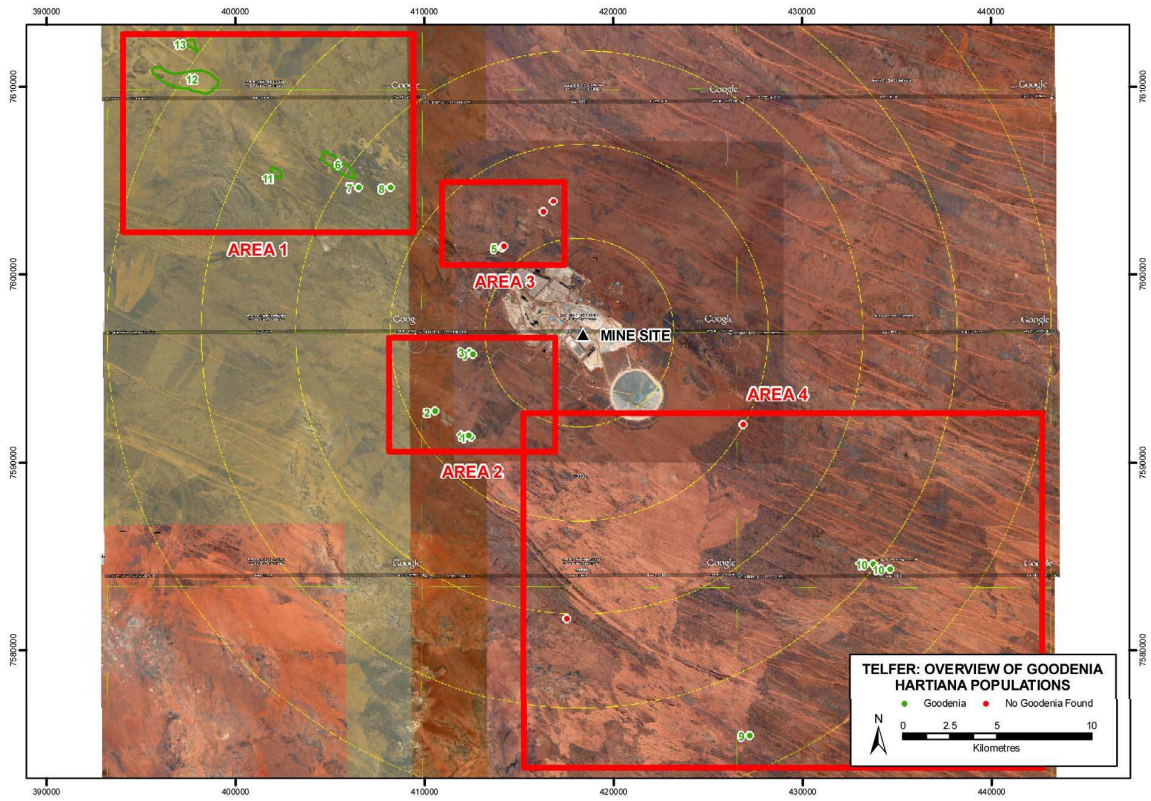


Figure 4 Location of *Goodenia hartiana* populations (overview)

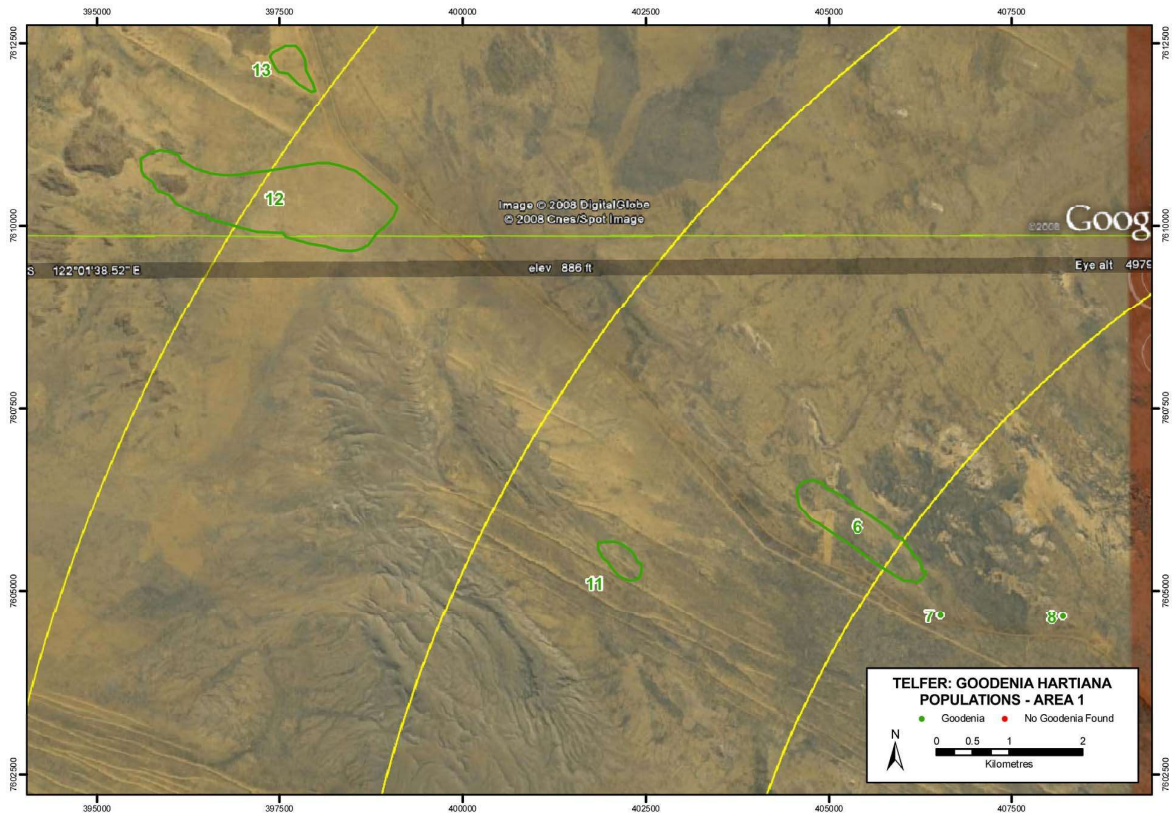


Figure 5 *Goodenia hartiana* populations - Area 1

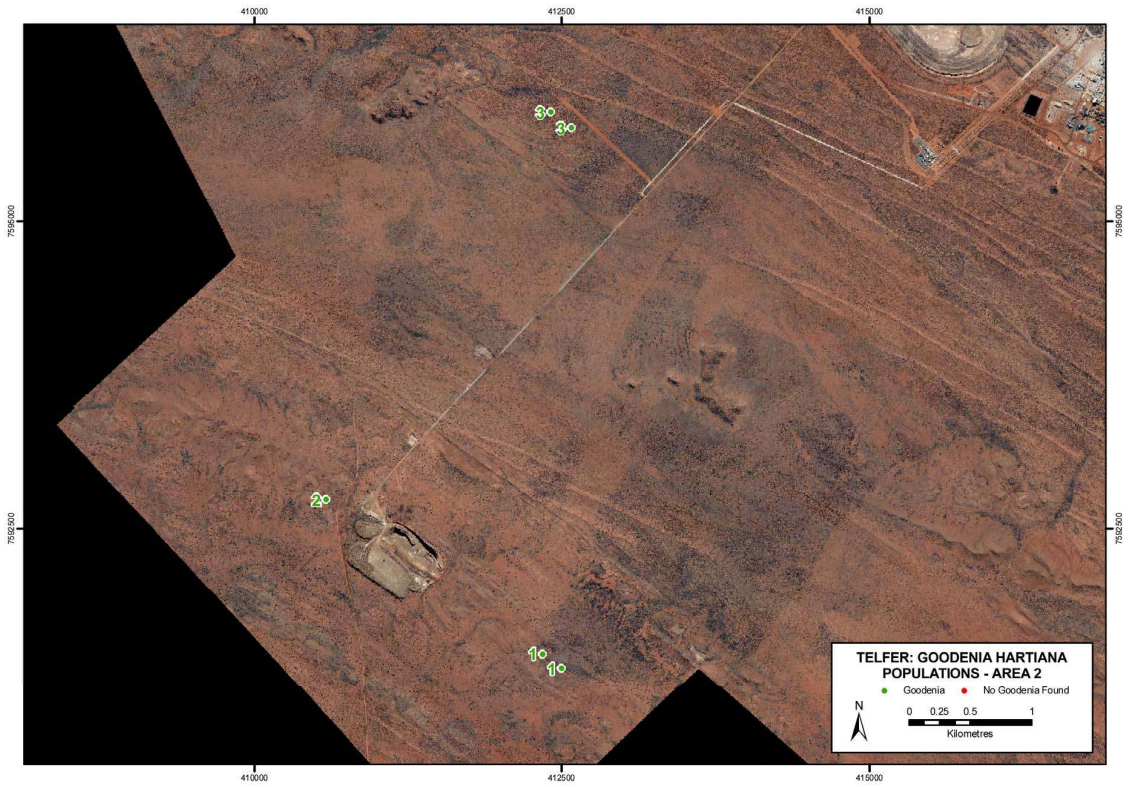


Figure 6 *Goodenia hartiana* populations - Area 2

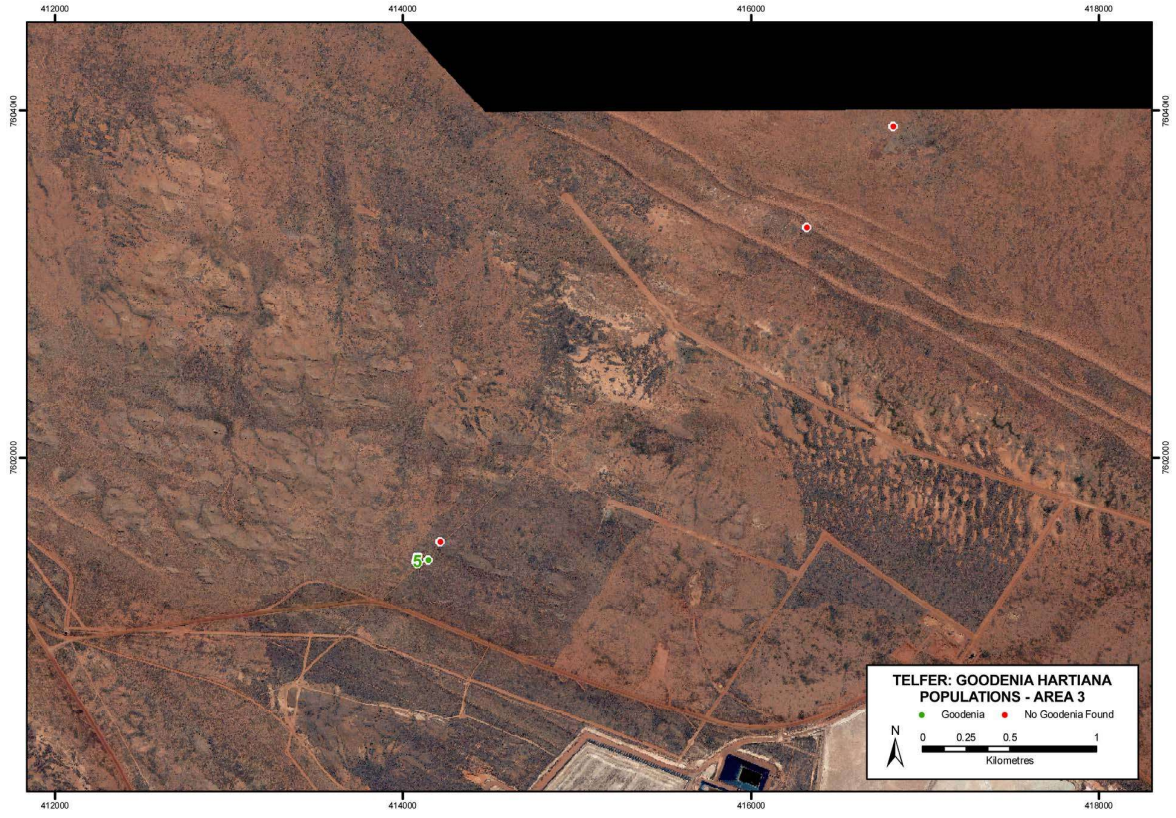


Figure 7 *Goodenia hartiana* populations - Area 3

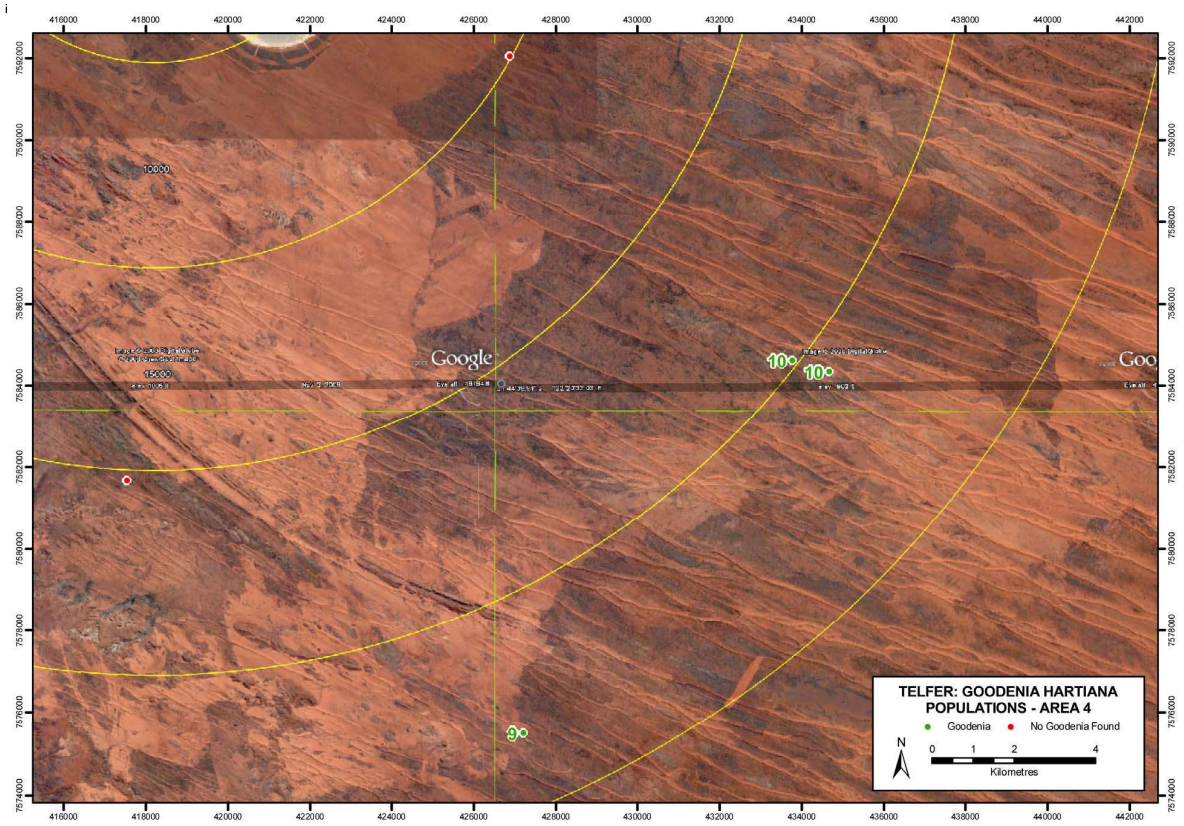


Figure 8 *Goodenia hartiana* populations - Area 4

3.2.1 Population 1

Vegetation type: *Acacia stipuligera* over mixed shrubland over *Triodia basedowii*
Hart, Simpson and Associates (2002) vegetation type: Sandplain (Variation 2)
Syrinx Environmental PL (2007): n/a
Bagas (2000) Geological type: Czz (Silcrete)
Location: East of Pit 13, south east of Telfer minesite

This population followed a valley between siltstone hills and rocky outcrops in deep red sand over sedimentary rocks along both sides of a track for approximately 150m (Figure 9). The majority of plants were very mature with only leaves along the bottom of the stems, although there were several patches of healthy plants. No plants were flowering although dead flowering material was evident from the previous season. There was a total 765 plants including 561 alive and 204 dead with a small amount of recruitment recorded (26 seedlings). The patches of *Goodenia hartiana* consisted of 20-50 plants being 10-20m apart.

Associated vegetation included *Gompholobium polyzygum, Grevillea stenobotrya*, *Isotropis sp.* and *Acacia ancistrocarpa.*

(a) (b)

Figure 9 *Goodenia hartiana* Population 1 (a: general habitat and b: closeup)

3.2.2 Population 2

Vegetation type: *Acacia stipuligera* over mixed shrubland over *Triodia basedowii*
Hart, Simpson and Associates (2002) vegetation type: Sandplain (Variation 2)
Syrinx Environmental PL (2007): n/a
Bagas (2000) Geological type: PLw (quartz sandstone)
Location: West of Pit 13, south of Telfer mine site

This was a population of 125 mature plants that seemed to have been dead for longer than a year as all plants were very dry and appeared to have been dead for a prolonged period of time (Figure 10). It is likely that all plants have flowered and dropped seed for recruitment after rain. The plants were located on the eastern side of a small rocky hill within a swale.

Associated vegetation included *Acacia ancistrocarpa* and *Grevillea wickhammii.*

Goodenia hartiana

Figure 10 *Goodenia hartiana* Population 2 showing dead plants

3.2.3 Population 3

Vegetation type: *Acacia stipuligera* shrubland over open *Aluta maisonneuvei* shrubland over mixed tussock grassland
Hart, Simpson and Associates (2002) vegetation type: Sandplain (Variation 2)
Syrinx Environmental PL (2007): n/a
Bagas (2000) Geological type: Czz (silcrete)
Location: 100m off transmission line access track south of Telfer mine site

The Goodenia hartiana were located around the base of a small rocky outcrop in deep sands but also extended over the top of a small rocky hill (
(a) (b)
Figure 11). There were no areas of completely healthy plants, although a few seedlings were recruiting in the rocky substrate.

The plants on top of the hill were either very stressed or dead. A total of 678 plants were recorded of which 129 were dead.

Associated vegetation included *Triodia basedowii, Triodia schinzii, Grevillea wickhamii* and *Tephrosia sp.*

(a) (b)

Figure 11 *Goodenia hartiana* Population 3 (a: general habitat and b: closeup)

3.2.4 Population 5

Vegetation type: *Acacia stipuligera* over mixed shrubland over *Triodia basedowii*
Hart, Simpson and Associates (2002) vegetation type: Sandplain (Variation 2)
Syrinx Environmental PL (2007): n/a
Bagas (2000) Geological type: Czz (silcrete)
Location: North of mine impact area

This was another small population where all of the 111 Goodenia hartiana were dead (Figure 12). Leaves were still attached to the plants and there was no evidence of flowering material. The substrate was sand over siltstone and all the associated *Triodia basedowii* were also dead.

Associated vegetation included *Acacia ancistrocarpa* and *Jacksonia aculeata.*

(a) (b)

Figure 12 *Goodenia hartiana* Population 5 (a: general habitat and b: closeup)

3.2.5 Population 6

Vegetation type: Open *Grevillea wickhamii* woodland over open mixed shrubland over closed *Triodia schinzii* tussock grassland

Hart, Simpson and Associates (2002):n/a

Syrinx Environmental PL (2007): Scattered shrubs over mixed *Triodia* grassland

Bagas (2000) Geological type: PLm (sandstone and shale)

Location: 10-15km North west of mine site

This population was the first to be observed to be growing amongst *Triodia schinzii* (Figure 13). Following the base of rocky hills covered with deep red sands the population extended for approximately 500m and into an adjacent drainline. The plants also existed on top of the rocky hills. There were several habitat types within this population. Some plants were amongst more open vegetation whilst others were associated with different species to previous communities where *Goodenia hartiana* was found. The health of the plants ranged from very healthy to stressed. One patch of very large healthy plants were the first to be found associated with *Goodenia azurea*. The patches with *Eucalyptus kingsmillii* had a different substrate consisting of sand with small amounts of gravel. Some of the best patches in this area were found in soils with a high clay content. There were approximately 8000 plants recorded in this population.

Associated vegetation included *Aluta maisonneuvei, Acacia hilliana, Acacia tumida, Acacia stellaticeps, Goodenia azurea, Eucalyptus kingsmillii, Gompholobium polyzygum, Jacksonia aculeata, Goodenia azurea* and *Acacia ancistrocarpa.*

(a) (b)

Figure 13 *Goodenia hartiana* Population 6 (a: general habitat and b: closeup)

3.2.6 Population 7

Vegetation type: *Triodia schinzii* tussock grassland

Hart, Simpson and Associates (2002) vegetation type: Stony Hills

Syrinx Environmental PL (2007): *Triodia schinzii* grassland

Bagas (2000) Geological type: Czz (siltstone)

Location: North west of mine site

A population of 789 plants were found along a small rocky hill on the eastern facing side and extending into an adjacent drainage line (Figure 14). Only 5% of the total population were dead which were in patches of up to 20 plants, although the majority of plants were very stressed with not much leaf material present.

Associated vegetation included *Scaevola parviflora.*

(a) (b)

Figure 14 *Goodenia hartiana* Population 7 (a: general habitat and b: closeup)

3.2.7 Population 8

Vegetation type: Open *Grevillea wickhamii* woodland over scattered mixed shrubs over open *Triodia* tussock grassland

Hart, Simpson and Associates (2002) vegetation type: n/a

Syrinx Environmental PL (2007): Scattered shrubs over mixed *Triodia* grassland

Bagas (2000) Geological type: Czz (siltstone)

Location: North west of mine site

This was a small population at the base of a small rocky hill which consisted of 27 healthy mature plants (Figure 15). Associated vegetation included *Triodia basedowii* and *Triodia schinzii*.

(a) (b)

Figure 15 *Goodenia hartiana* Population 8 (a: general habitat and b: closeup)

3.2.8 Population 9

Vegetation type: Scattered *Eucalyptus kingsmillii* and *Grevillea wickhamii* over mixed shrubland over tussock grassland.

Hart, Simpson and Associates (2002) vegetation type: n/a

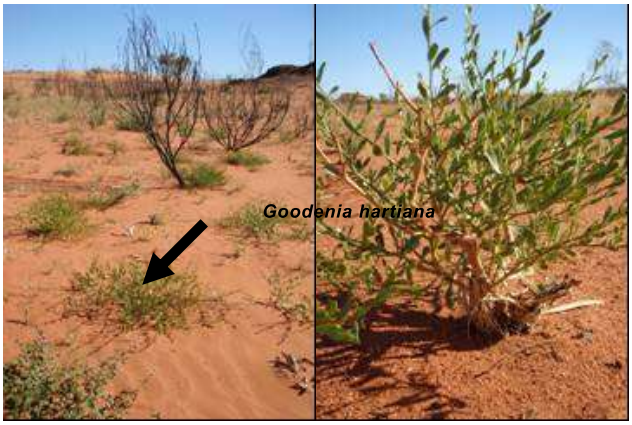
Syrinx Environmental PL (2007): Scattered *Eucalyptus kingsmillii* subsp. *kingsmillii* and/or *Corymbia opaca* over *Acacia stipuligera* open shrubland over *Acacia stellaticeps* low open shrubland over *Triodia basedowii* grassland

Bagas (2000) Geological type: Qs (sand dunes with intervening sandy valleys)

Location: South east of minesite adjacent to track to Mesa 2

This area had been recently burnt (2008) with observations of plants resprouting from the base (Figure 16). Some plants had been grazed and there was evidence that camels had been chewing and spitting out the new growth. The population was within an interdunal swale in deep red sands with siltstone hills. There were approximately 3,200 plants recorded with only a small proportion being dead. The majority of plants were existing and resprouting with a recruitment of 72 seedlings.

Associated vegetation included *Scaevola parviflora*, *Dicrastylis cordifolia*, *Grevillea pyramidalis* and *Corymbia opaca.*



(a) (b)

Figure 16 *Goodenia hartiana* Population 9 (a: general habitat and b: closeup)

3.2.9 Population 10

Vegetation type: Scattered *Eucalyptus kingsmillii* and *Acacia ancistrocarpa* over *Acacia stellaticeps* open shrubland over *Tridodia basedowii* closed tussock grassland

Hart, Simpson and Associates (2002) vegetation type: n/a

Syrinx Environmental PL (2007): *Eucalyptus kingsmillii* subsp. *kingsmillii* low open woodland over mixed shrubland over *Triodia basedowii* grassland

Bagas (2000) Geological type: PLp (carbonate rocks interspersed with siltstone and shale)

Location: along Backdoor – Dolphy Rd east of mine site

This population extended for 83m and was amongst mature vegetation, although some plants were along the side of the tracks. The majority of the 1,139 plants recorded were found within a swale in recently burnt areas (Figure 17). The substrate was different from other populations in this area, being a mixture of sand and rocks, as opposed to deep red sands. The plants were more mature than other plants in recently burnt areas and very healthy, 22 seedlings were recorded with the majority having resprouted post fire.

Associated vegetation included *Grevillea wickhamii, Aluta maisonneuvei*, *Scaevola parviflora*, *Jacksonia aculeata* and *Newcastelia cladotricha.*

(a) (b)

Figure 17 *Goodenia hartiana* Population 10 (a: general habitat and b: closeup)

3.2.10 Population 11

Vegetation type: Scattered *Eucalyptus odontocarpa/G. wickhamii* over open mixed shrubland over *Triodia basedowii* closed tussock grassland and open mixed grassland
Hart, Simpson and Associates (2002) vegetation type: n/a
Syrinx Environmental PL (2007): Scattered shrubs over mixed *Triodia* grassland
Bagas (2000) Geological type: PLw (quartz sandstone)
Location: 2.2km South of Telfer rd, 10km West of mine site

This was the largest population found estimating 14,356 plants and was situated between two rocky outcrops where a valley has formed and wind has moved existing red sand to the base of the hills (Figure 18). The area was burnt in January 2008 and contained some of the most mature and healthiest specimens, with some plants flowering. The population extended into the rocky areas and some were on top of the hills.

Associated vegetation included *Scaevola parviflora*, *Gompholobium polymorphum*, *Keraudrenia velutina*, *Otion simplicifolium, Triodia* ?*epactia* and annual grasses.

(a) (b)

Figure 18 *Goodenia hartiana* Population 11 (a: general habitat and b: closeup)

3.2.11 Population 12

Vegetation type: Scattered G*revillea wickhamii* over open mixed shrubland over *Triodia* closed tussock grassland and open mixed grassland
Hart, Simpson and Associates (2002) vegetation type: n/a
Syrinx Environmental PL (2007): Scattered shrubs over mixed *Triodia* grassland
Bagas (2000) Geological type: Pg (granitoid rock)
Location: Most western survey point south of Telfer Rd.

This was a large population of 8,800 plants extending into an interdunal swale between two rocky outcrops (Figure 19). Some large mature plants existed within the mature vegetation where a small portion of dead plants were observed. A higher density of healthy plants was recorded within recently burnt areas. Overall the highest density was on the east facing slope at the edges of the swale. Two communities were recorded within the population with one in an area burnt in January 2008, which had very little recruitment of additional species including *Trioda sp.*, *Gompholobium polymorphum* and annual grasses.

(a) (b)

Figure 19 *Goodenia hartiana* Population 12 (a: general habitat and b: closeup)

Associated vegetation included *Scaevola parviflora*, *Gompholobium polymorphum*, *Jacksonia aculeata*, *Triodia schinzii, Dampiera cinerea, Calytrix sp., Acacia stipuligera, Calytrix sp.* and *Dicrastylis cordifolia.*

3.2.12 Population 13

Vegetation type: Scattered G*revillea. wickhamii* over open mixed shrubland over *Triodia* tussock grassland
Hart, Simpson and Associates (2002) vegetation type: n/a
Syrinx Environmental PL (2007): Scattered shrubs over mixed *Triodia* grassland
Bagas (2000) Geological type: Pg (granitoid rock)
Location: West of mine site

The largest part of this population of 2,064 plants was on the eastern side of a dune mainly in recently burnt areas with plants extending along a strip of approximately 100m (Figure 20). There were some mature plants within the mature vegetation although these were stressed. There were some very healthy specimens within the burnt areas amongst the rocky substrate as well as in deep sands over rock.

Associated vegetation included *Scaevola parviflora*, *Triodia schinzii* and *Dicrastylis cordifolia.*

(a) (b)

Figure 20 *Goodenia hartiana* Population 13 (a: general habitat and b: closeup)

4.0 DISCUSSION

4.1 FACTORS INFLUENCING DISTRIBUTION

The 2 main contributing factors influencing distribution appears to be the

- underlying landform;
- vegetation association; and
- time elapsed since fire.

The landforms where the largest populations were found were always low lying hills with silcrete rocks and deep sands within interdunal swales that had been burnt within the previous 12 months. These areas represented the highest density of *Goodenia hartiana* present whilst the adjacent unburnt areas had very low densities of *Goodenia hartiana* present.

The majority of populations were mainly found on the south east of Telfer minesite on small rocky outcrops which were mainly silt stone or red rock. There was always a layer of soil between 1 and 10cm thick, always overlying rocks. The only population found within a dune swale was dead.

The most common vegetation association where *Goodenia hartiana* was present was general scattered shrubs over *Triodia basedowii* or *Triodia shinzii*. The most common species of scattered shrubs were *Grevillea wickhamii*, *Acacia stipuligera* and *Acacia ancistrocarpa*.

4.2 DISCUSSION

The total of almost 40,000 live plants within 10 populations provides a significant amount of information of the distribution of a species which previously very limited information was known. The total number of populations now recorded during surveys as part of Newcrest Mining's works is 51,000. The additional two populations of plants that were dead at the time of survey have the potential to add to this number in the future. Monitoring in 2009 will determine this.

The known population around the Telfer immediate impact area was known to be approximately 11,000 plants prior to this survey. The additional information collected during this survey suggests the population which will be directly impacted by the future expansion of the Telfer mine would be a maximum of 20% of the known population to date if no additional populations are found in the future. However, given the widespread nature of the preferred habitat, it is likely that the species will be found in additional locations now that the specific habitat of *Goodenia hartiana* has been defined.

The findings that the species is common after fire in dune swales will also make targeting the species easier in the future. This suggests that preventing fires impacting on populations close to the minesite is not required and in fact fire seems to be an important factor in the regeneration of populations.

The very low rainfall has affected the health of the populations present. Only one population recorded plants which were all healthy. These plants were within an incised streamline in deep

sands at the base of a rocky hill where there may have been better access to water than in locations higher upslope where the condition of specimens were not as good. Two of the populations (2 and 5) only recorded dead plants. The plants had grown to maturity and it is recommended these populations are monitored in 2009 to determine their recruitment potential and whether they should be considered a live population even though all were dead at the time of survey.

The stress of most of the adult plants observed suggests the deaths within the populations on the minesite recorded previously (Syrinx Environmental PL 2006 and 2007) are part of a regional trend impacting this species due to the much lower then average rainfall during the summer of 2007-08.

5.0 RECOMMENDATIONS

- The healthiest population within the constructed drain on the minesite should be signposted to avoid impact on the population. The location of the population is 0417 960, 7595060 (AGD 84 Zone 51)

- All populations to be remonitored in June 2009 to determine survival of populations recorded this year as showing stress (Population numbers 1, 3, 4, 6) and to see if the populations recorded as dead this year (Populations 2 and 5) record any seedlings from the soil seed bank.

ADDENDUM

6.0 SURVEY REVISIT MAY 2010

6.1 INTRODUCTION

Fieldwork was undertaken between May 19th and May 22nd 2010 by Matt Claughton (Flora Collection Licence: SL008811) and Shenandoah Bruce (Flora Collection Licence SL008808) to revisit *Goodenia hartiana* populations that were either dead or stressed at the time of the June 2008 field survey. Submission of Rare Flora Reports to the WA Herbarium was not required for this survey as they were submitted following the July 2008 survey. At the time of the survey *Goodenia hartiana* remained a Priority 2 species (Smith 2010).

6.2 CLIMATE

Telfer has experienced below average rainfall in the period between the initial survey (June 2008) and this most recent survey (May 2010), although tropical cyclone Laurence brought above average rainfall in December 2009. The below average rainfall will have an effect on the health of *Goodenia hartiana* populations outside the mine impact area.

The data for Figure 21 is from Bureau of Meteorology Station 13030 (Telfer).

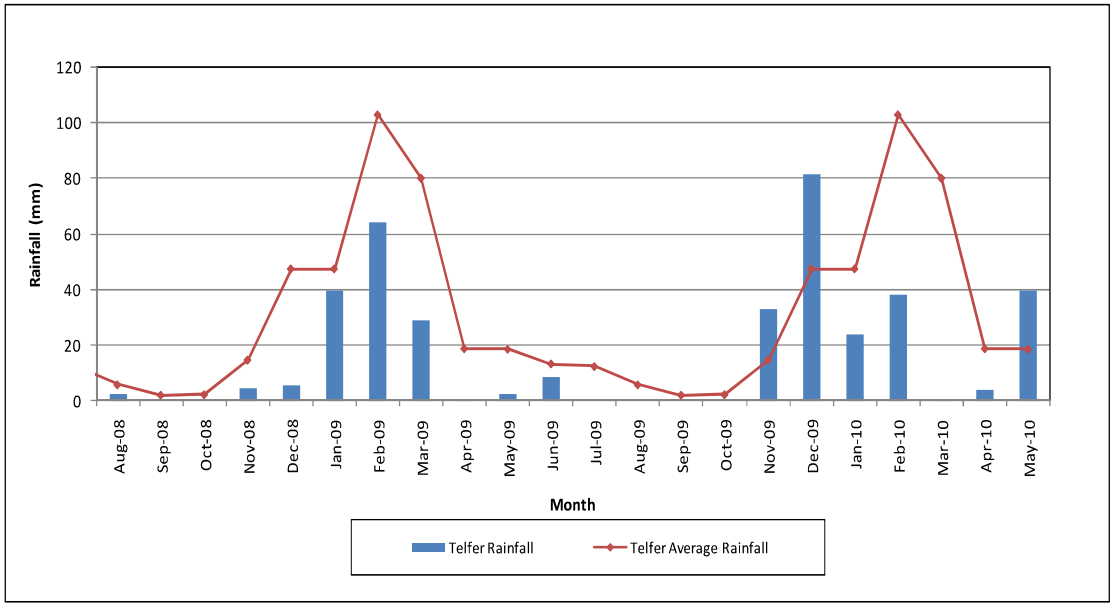


Figure 21 Actual and average rainfall recorded at Telfer between August 08 and May 10

6.3 RESULTS

6.3.1 Populations within the mine impact area

Populations 1 to 4 initially surveyed in July 2006 (Syrinx, 2006) were revisited. Population 2 and 4 no longer exist due to ongoing expansion works (waste dumps, topsoil stockpiles). Population 1 has increased from 50 to 240 plants as it extends along a temporary pipeline towards population 3 which has slightly increased in numbers. The majority of plants in this population were healthy due to the constant source of moisture from the pipeline. Refer to Table 2 for comparison from the two surveys.

A general observation was made of population 8 which has shown a recovery of approximately 10% of the original population of >10,000 (Syrinx, 2007).

Table 2 Changes in *Goodenia hartiana* populations within the Telfer mine site impact area

Population Number	Population Size (Syrinx 2006)	Population Size (Live) 2010	Population Size (Dead) 2010	GPS Location (AGD 84 Zone 51)
1	50	240	30	0417960, 7595060 to 0417397, 7595245
2	2	0	0	0418362, 7594566
3	20	35	15	0417722, 7594915
4	100	0	0	0418227, 7594977

6.3.2 Populations outside the mine impact area

Populations 1 to 13 from the previous survey were revisited. There was a reduction in approximately 11,000 plants across all populations with 6, 9 and 10 having the greatest decrease in numbers. Populations 2 and 5 are now showing signs of resprouting. The majority of plants were showing signs of stress with the exception of population 10 which had lots of healthy regrowth. Refer Table 3 for the changes in populations and Table 4 for further comments on each population. Populations 3 and 13 had slight changes in their extent which is presented in Figure 22.

Table 3 Changes to populations of *Goodenia hartiana* outside the Telfer Mine site impact area

Population Number	Population Size (Live)	Population Size (Dead)	Population Size (Live) 2010	Population Size (Dead) 2010	% Change in live	% Change in dead	GPS Location
1	561	204	563	247	0.36%	21.08%	Start 0412503, 7591363 End 0412346, 7591482
2		125	2	55	100.00%	-56.00%	0410586, 7592736
3	678		565	269	-16.67%	100.00%	Start 0412410, 7595897 to 0412303, 7595716 End 0412579, 7595770 to 0412281, 7595894
5		111	49	61	100.00%	-45.05%	0414144, 7601415
6	8,000		42	90	-99.48%	100.00%	Start 0406225, 7605270, End 0404724, 7606166
9	3,200		634		-80.19%	0.00%	0427210, 7575502
10	1,139		597	7	-47.59%	100.00%	Start 0433767, 7584627 to End 0434684, 7584355
13	2,064		2,176	1024	5.43%	100.00%	Start 0397631, 7612371 to 0397798, 7612429 End 0397363, 7612523 to 0397691, 7612141
TOTAL	**15642**	**440**	**4628**	**1753**			

Table 4 Comments on *Goodenia hartiana* populations revisited in June 2010

Pop No	Comments
1	The majority of plants have resprouted from older dead plants although they were all stressed. There is burnt material around but resprouted Eucalyptus are up to 3m tall.
2	Of the dead population recorded in 2008 only 2 plants have resprouted of which both were stressed.
3	Most plants are stressed. There is no signs of recent fire.
5	Approximately 45% of dead mature plants have resprouted.
6	All plants were slightly stressed.
9	Population was reduced from that surveyed in 2008.
10	Lots of healthy regrowth. Almost all plants are healthy one plant had one flower.
13	No healthy plants, all were yellowing and senessing.

TELFER: OVERVIEW OF GOODENIA HARTIANA POPULATIONS

Altered extent based on 2010 survey
Existing exent
Altered extents of populations based on 2010 survey
Previous extent of populations

N

0 2.5 5
kilometers

Figure 22 Changes to population extent of *Goodenia hartiana* June 2010 (Overview)

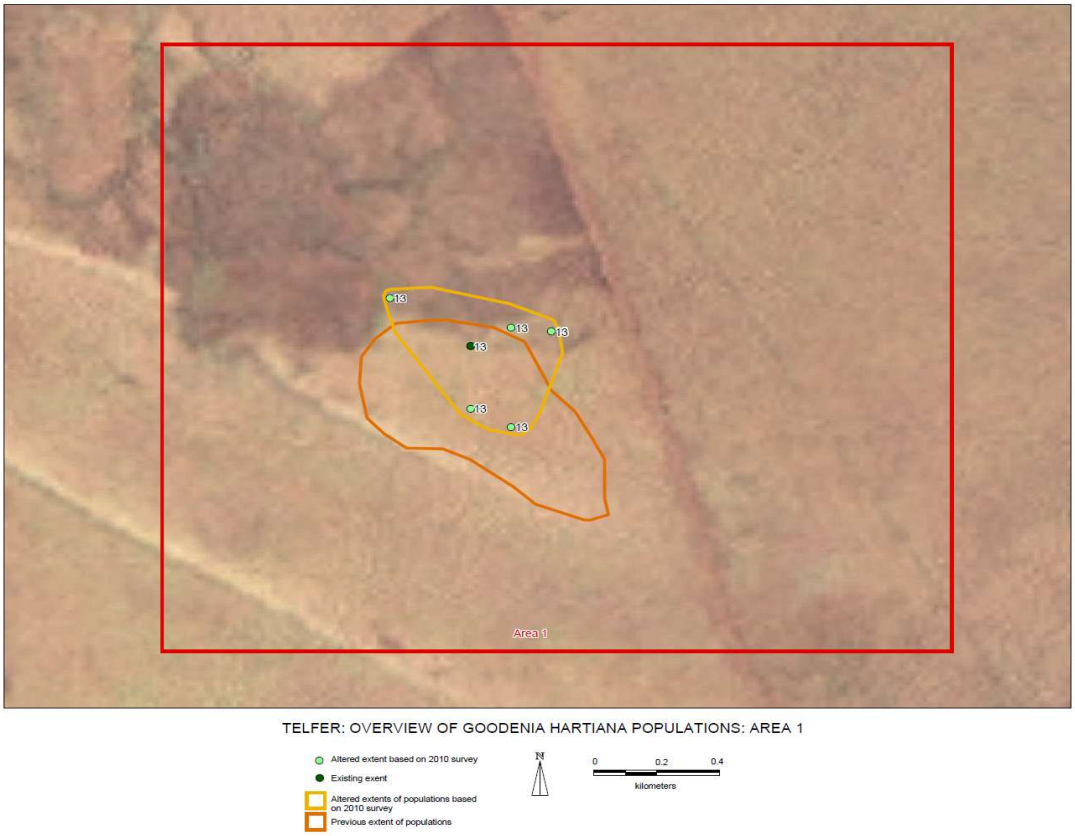
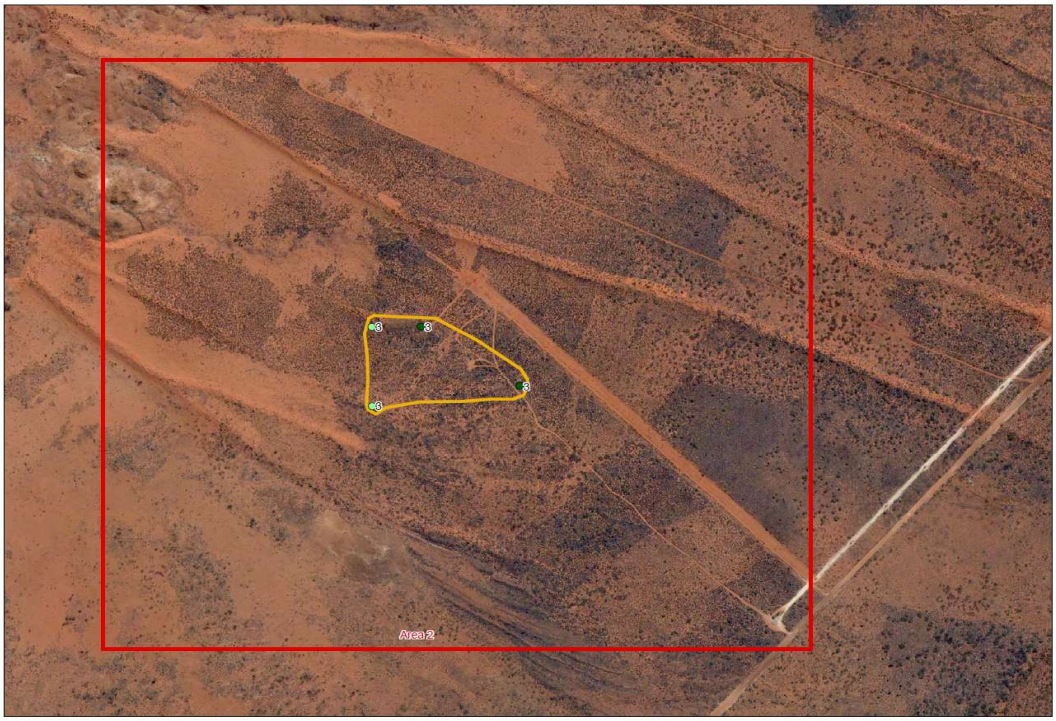


Figure 23 Changes to population 13 extent of *Goodenia hartiana* - Area 1



TELFER: OVERVIEW OF GOODENIA HARTIANA POPULATIONS: AREA 2

Altered extent based on 2010 survey
Existing exent
Altered extents of populations based on 2010 survey
Previous extent of populations

N

0 0.1 0.2
kilometers

Figure 24 Changes to population 3 extent of *Goodenia hartiana* - Area 2

6.4 DISCUSSION

The populations of *Goodenia hartiana* are highly dynamic, with some staying relatively similar between survey events (2 year period) and others decreasing dramatically. Population extents did not alter except for populations 3 and 13 which show some movement in the location of plants, which may be due to the movement of soil and *Goodenia hartiana* seed bank. The health and resprouting of populations varied between locations also. Fire seems to play a large role in the resprouting and emergence of seedlings as population 10 was the only location that had signs of recent fire and the healthiest population. The erratic timing and intensity of rainfall and fire events experienced in the arid zone makes it difficult to gain a full understanding of the ecology of *Goodenia hartiana* over such a short period.

Plant numbers in populations 1 and 13 remained relatively static whilst populations 2 and 5 showed some recovery from the dead populations previously surveyed. The majority of plants have disappeared within the remaining populations (3, 6 and 9) expect those in response to fire in population 10. This may suggest that there is a correlation between fire and rain required for seeds to germinate and mature plants to resprout.

6.5 RECOMMENDATIONS

The information recommended to collect over time to assist with management options for the protection of populations within the mine impact area include:

- *Population dynamics:* Due to dynamic nature of the *Goodenia hartiana* populations and the lack of ecological information on this species, all populations recorded thus far should be regularly monitored. Given that large populations have dramatically reduced within 2 years this should occur annually and if possible at least one month following a large fire or rain event. This will allow better prediction of population dynamics of the populations remaining within the mine impact area.

- *Representative populations*: Populations to be chosen as indicators of population types (e.g mature, young, burnt) to reduce the amount of survey work and costs required.

- *Soil seed bank studies:* Undertake studies to determine the reproductive capacity of existing populations both inside and outside the mine impact area; and

- *Regional survey:* In order for the priority status for the *Goodenia hartiana* to be reduced, there must be populations existing within conservation reserves. As populations have been previously recorded in Rudall River National Park it is recommended that this area be surveyed.

7.0 REFERENCES

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