

# Sugarloaf Pipeline Matted Flax- lily (*Dianella amoena*) Translocation: Monitoring Spring 2014

Project: 09-008

Prepared for:  
Melbourne Water Corporation

Final



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## Summary

This report presents the results of the 5 and 12 November 2014 monitoring by Ecology Australia of the Matted Flax-lily (*Dianella amoena*) population translocated (1172 plants) to the Gibbs Road, Yarra Glen, North-South Pipeline easement in 2010 (year five of the program). Also monitored were the re-established populations of *D. amoena* x *D. admixta* at the Hunts Lane north site, Steels Creek, and the *D. amoena* re-establishment site at Hunts Lane south, Steels Creek. Both sub-populations were harvested in error in 2010.

Data are given on two subplots at the Gibbs Road site and the Hunts Lane sites. Considerable logistic difficulties were encountered in documenting plants on the other two subplots because of merging of *Dianella* plants and dense weed infestations.

Results of the 5-year monitoring program are highly reviewed. They show that:

- *Dianella amoena* is easily translocated and as a robust, rhizomatous herb it readily establishes and very soon becomes reproductive.
- Survivorship amongst the cohorts was high over the period of monitoring, ranging from 70% - 100% on the subplots/sites.
- Upward and positive trends in vegetative performance (growth) was documented in the number of shoots per plant, basal diameter of plants and leaf length, confirming ease of establishment and excellent growth under good conditions.
- Weed invasions (numerous species) present a severe problem and weed control is the only significant management issue.
- Weed invasions will destroy or substantially all *Dianella* plants over short to intermediate time-frames without appropriate management.
- Management of weeds will be an ongoing requirement.
- Three *Dianella amoena* populations in road reserves – Gulf Road, Yarraview Road and the Melba Highway, Yarra Glen- are now extinct because of weed invasions.
- Natural pollination of *D. amoena* flowers by two or three species of native bees is occurring at the Gibbs Road site.

Several other relatively minor management issues are identified and discussed, and recommendations are made in respect to some of these issues. If the populations of *Dianella* are to be retained into the future, monitoring of the plants and of weed invasions, as well as on-ground weed management actions, are essential.

## 1 Introduction

This report documents the spring 2014 monitoring of translocated Matted Flax-lily (*Dianella amoena*) plants from a plant-out site located to the south of Gibbs Road, Yarra Glen. These plants had been salvaged (then planted in 2010) from parent material occurring within the approved Construction Area of the Sugarloaf pipeline easement (refer to Draft Matted Flax Lily - Translocation Commitment Document, SPA-REP-GL-ENV-Rev A).

Matted Flax-lily plants were also monitored at Hunts Lane (south), Melba Highway, Steels Creek, where they were replanted after being 'salvaged' in error; and Hybrid Flax-lily (*Dianella amoena* x *D. admixta*) plants were monitored at Hunts Lane (north) (Melba Highway) which were also 'salvaged' in error and then replanted.

This monitoring assessment was the fifth (and final) undertaken by Ecology Australia for this project; preceding monitoring assessments were undertaken in:

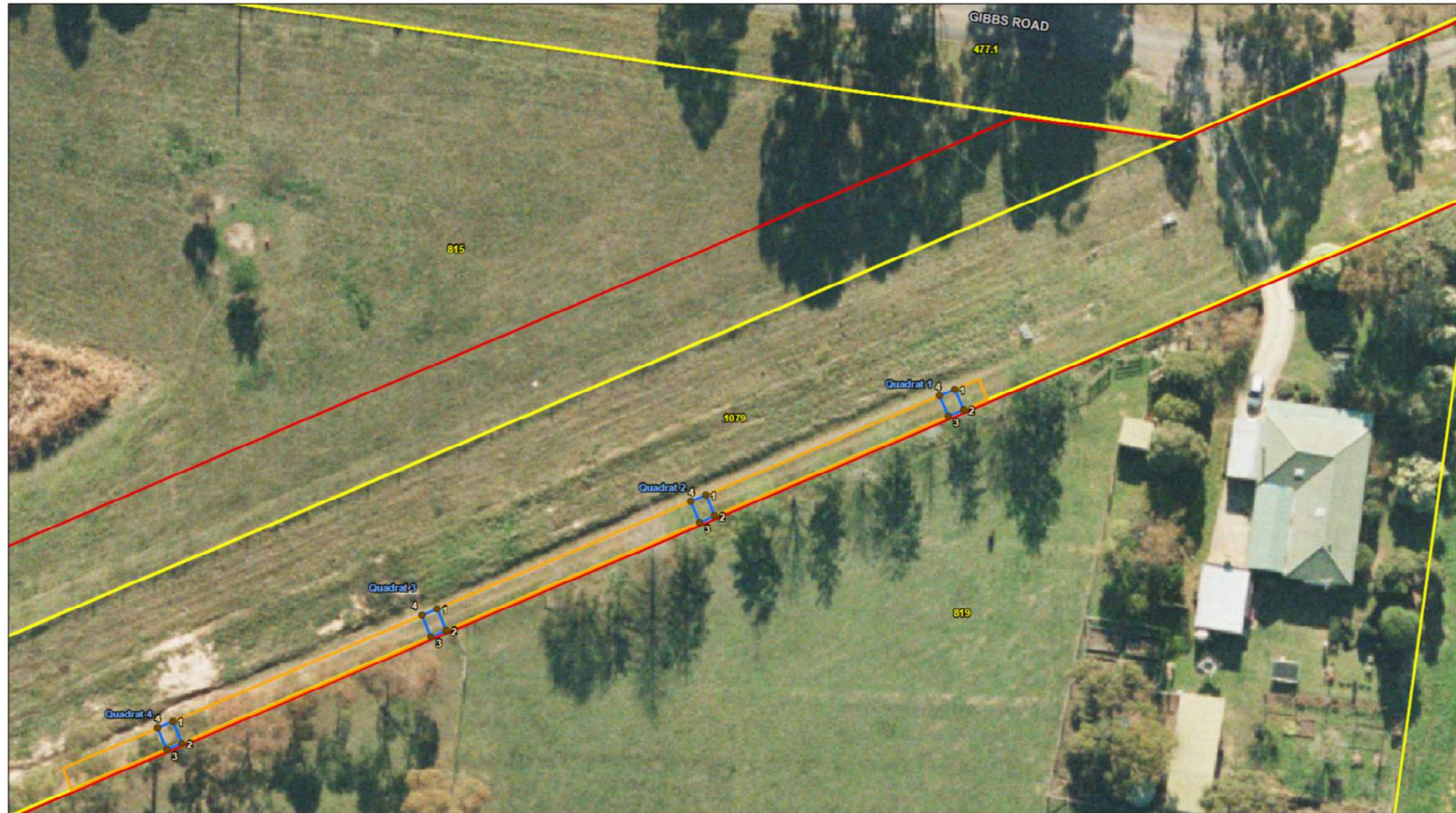
- May 2010 (Carr and Kershaw 2010);
- January 2011 (Carr and Rodda 2011);
- May 2012 (Carr and Appleby 2012); and
- May 2013 (Carr and McMahon 2013).

### 1.1 Study area

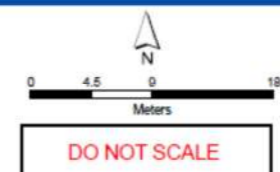
The translocated Matted Flax-lily receptor site is located just to the south of Gibbs Road, Yarra Glen, within the Sugarloaf Pipeline Alliance easement, and measures c. 120 x 3.0 m (Figure 1). It is fenced with a conventional farm fence. The southern boundary abuts private land with a narrow plantation of fairly small trees which include Silky Oak (*Grevillea robusta*), Pin Oak (*Quercus palustris*), Yellow Gum (*Eucalyptus leucoxylon*) and Red Gum (*E. camaldulensis*).

The two sites containing erroneously salvaged (and replanted) Flax-lily plants are located a short distance north and south of the intersection of Hunts Lane and Melba Highway, Steels Creek (Figure 2). The northern site contains Hybrid Flax-lily (*Dianella amoena* x *D. admixta*), while the southern site contains Matted Flax-lily (*D. amoena*).





**Sugarloaf Pipeline Project**  
Matted Flax-Lily Quadrat Co-Ordinates



- Quadrat Numbers
- Matted Flax-Lily Translocation Site
- Matted Flax-Lily Quadrat Site
- Construction ROW
- Property Boundary

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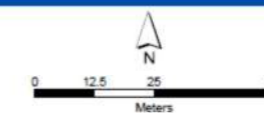
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Figure 1 Translocated Matted Flax-lily (*Dianella amoena*) plant-out site, Gibbs Road, Yarra Glen



**Sugarloaf Pipeline Project**  
Extent of Planting Sites around Hunt's Lane

- Planting Site
- Construction ROW
- Property Boundary



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Figure 2 Matted Flax-lily (*Dianella amoena*) 'replanting' sites, Hunts Lane, Yarra Glen

## 2 Methods

Details concerning the propagation of the *D. amoena* plants, and the planting-out procedures are given in the 2012 monitoring report by Ecology Australia (Carr and Appleby 2012).

### 2.1 Monitoring

As per monitoring prescriptions established for previous monitoring events by Ecology Australia (Carr, Kershaw and McMahon 2013, Carr and Kershaw 2010, Carr and Rodda 2011, Carr and Appleby 2011), the following data were collected for all *Dianella* plants within the Gibbs Road and Hunts Lane monitoring plots:

- Locations/ coordinates – collected for individual plants using a Real Time Kinematic Global Positioning System (datum MGA94);
- Basal diameter (centimetres) of plant – measured at soil level to the outside of the outermost shoots;
- Number of shoots - counted as accurately as possible within a single plant, without unduly disturbing the plant
- Maximum leaf length (cm) – measured from the soil level to leaf apex;
- Number of leaves per shoot – the range of number of leaves per shoot were recorded (e.g. 2 – 6 leaves on shoot A; 3- 9 leaves on shoot B);
- Height of inflorescence/ infructescence – for fertile shoots; this was measured in (cm) from the soil level up to the top of the peduncle;
- Presence of flower buds – recorded as a simple presence/ absence designation;
- Stage of flowering – assessed subjectively as: early, mid, or late
- Stage of fruiting – assessed subjectively as: early, mid, or late.

### 2.2 Representative quadrats (subplots)

Documenting of all of the 1172 *D. amoena* plants translocated to the Gibbs Road receptor site was undertaken for the first round of monitoring in May 2010 (Kershaw and Carr 2010). Since then monitoring has only been conducted for a subset of plants, the data from which is representative of the survival and performance of the full translocated population. This subset of plants occur within four permanent subplots evenly distributed along the receptor site (Figure 1), each measuring 2 x 2.7 m (i.e. the full width of the receptor site) (Figures 2- 5). In the preceding three assessments (2011, 2012 and 2013), all *D. amoena* plants occurring within these permanent plots were documented; the current assessment only documents plants in two of the four subplots (refer to Section 3.4).

Data from these subplots are given in Appendix 1. The plant number and location of planted *D. amoena* in each subplot is shown in Appendix 2. The data presented in this report were collected according to the above protocols and were collected on 5 November 2014. Additionally, all plant species recorded in the plant-out site were documented (12 November

2014) and assigned a cover value from the Braun-Blanquet cover/abundance scale for the translocation site (Gullan 1978, see below). These data on plants other than *D. amoena* (given in Table 1) were collected to indicate weeds of management concern and indigenous species colonising the site.

Braun-Blanquet cover/abundance scale:

+	cover < 5%, few individuals
1	cover < 5%, any number of individuals
2	cover 5-20%, any number of individuals
3	cover 20-50%, any number of individuals
4	cover 50-75%, any number of individuals
5	cover 75-100%, any number of individuals

### 2.3 Plant names

Names for indigenous and exotic plant species in this report follow *A Census of the Vascular Plants of Victoria* by Walsh and Stajsic (2007). An asterisk \* denotes exotic species.

### 2.4 Limitations

A very high cover of weeds (Section 3.2, Plates 1 and 2), merging of *Dianella* plants, and difficulty in locating plant identification tags meant that quantitative data could not be meaningfully collected from the Hunts Lane south plant-out site and Quadrats 1 or 2 from the Gibbs Road translocation site. To address this limitation qualitative data on the general survivorship, health and long-term viability of planted *Dianella* were collected for each of these sites.

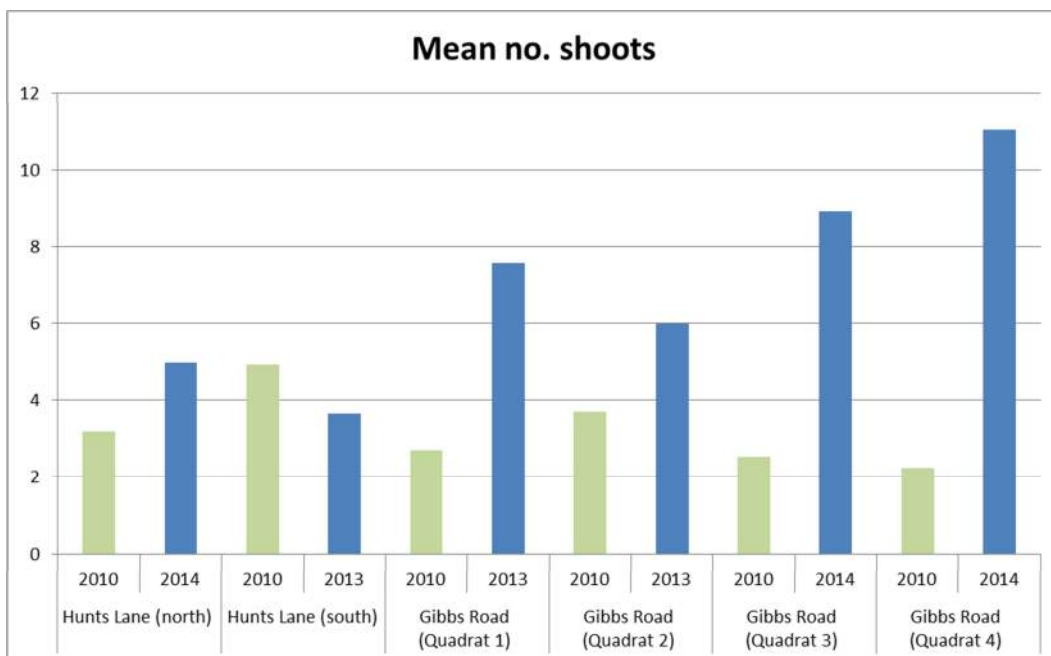
### 3 Results

#### 3.1 Performance of *Dianella amoena* plants

Data from the 5 November 2014 monitoring are shown in Table 1 and Figures 3, 4 and 5, and in Appendix 1 and 2. Data collection methods are discussed in Section 2.2; and limitations are outlined in Section 2.4.

**Table 1** Percentage survival of translocated *Dianella* plants for each monitoring site, Gibbs Road and Hunts Lane, Yarra Glen

Site	No. of <i>Dianella</i> planted	No. recorded at last survey (2013 or 2014)	% survival
Hunts Lane (north)	20	19	95
Hunts Lane (south)	20	14	70
Gibbs Road (Quadrat 1)	34	34	100
Gibbs Road (Quadrat 2)	18	15	83
Gibbs Road (Quadrat 3)	29	27	93
Gibbs Road (Quadrat 4)	30	28	93



**Figure 3** Average number of shoots per *Dianella* plant for initial survey (2010) and final survey (2013 or 2014), Gibbs Road and Hunts Lane, Yarra Glen.

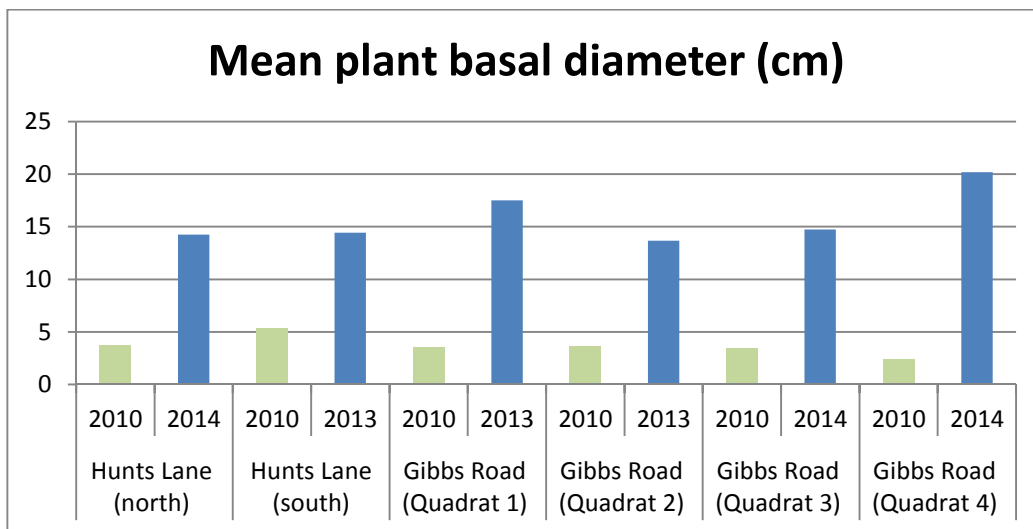


Figure 4 Average basal diameter of *Dianella* plants for initial survey (2010) and final survey (2013 or 2014), Gibbs Road and Hunts Lane, Yarra Glen.

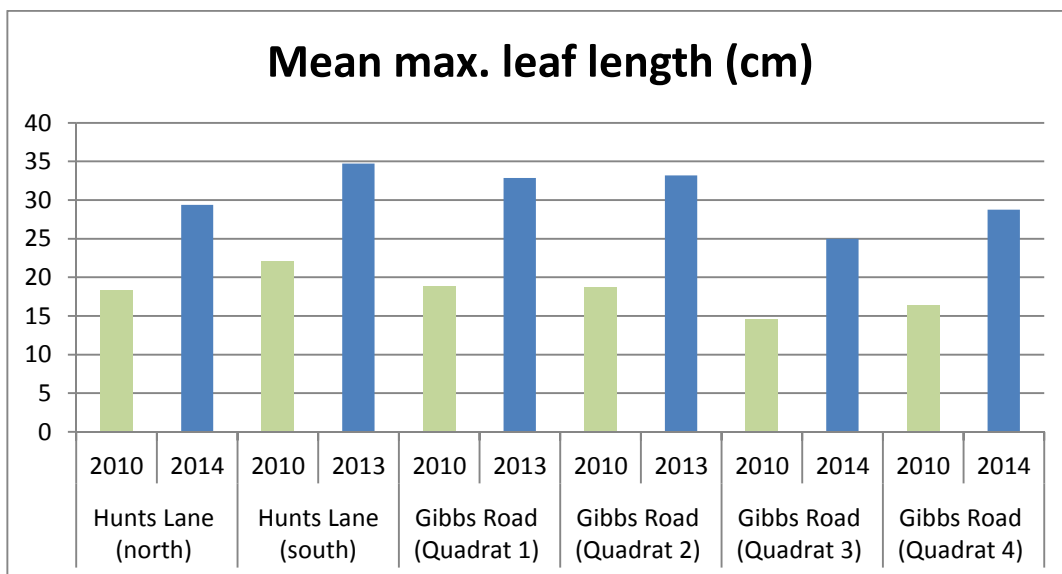


Figure 5 Average maximum leaf length of *Dianella* plants for initial survey (2010) and final survey (2013 or 2014), Gibbs Road and Hunts Lane, Yarra Glen.

### 3.2 Weed invasions on the Sugarloaf Pipeline easement plant-out site

The indigenous flora and the weed flora of the plant-out site was documented in the previous reports (Carr & Rodda 2011, Carr & Appleby 2011; Carr & Kershaw 2010) and the primary aim on each occasion has been to identify weed species which require management.

Weeds in this context are plant species that require management because of adverse or potentially adverse competition to *D. amoena* plants. The species include indigenous plants that have colonised the site from soil-stored seed, and seed that has been dispersed to the site

by birds, wind or other factors, possibly including people and contaminated equipment. Similar origins apply to the exotic flora.

The weed flora and indigenous flora on the site in November 2014 was species rich and with very high cover, approaching 100% over the whole site. Table 1 lists plant species recorded on 12 November 2014.

The cover of weeds recorded across the site indicates that weed management has been inadequate but a number of the species identified for control in 2013 were no longer present, indicating effective management for some species.

It is evident that there has been low mortality in *D. amoena* plants attributable to weed competition, but the growth of plants as well as flowering, has been seriously compromised. These observations indicate that weed invasion on the site will substantially destroy the *Dianella* population in a few years without timely, high-quality, ongoing weed management.

In the 2013 report we identified the very difficult task of weed control where rhizomatous weeds are thoroughly integrated with the *Dianella* plants. These rhizomatous weed species include: *\*Acetosella vulgaris* (Sheep Sorrel), *\*Agrostis capillaris* (Brown-top Bent) and *\*Trifolium repens* (White Clover). This is to some extent still the case although some of the control of such species has been effective: Three of the rhizomatous species previously identified were not evident on the site in November 2014 (*\*Agrostis stolonifera* Creeping Bent, *\*Cynodon dactylon* var. *dactylon* Couch, and *\*Trifolium fragiferum* Strawberry Clover). Whether or not these species have been effectively controlled is not known; these species could have disappeared or severely declined because of competition with other weed species.

A corollary problem is that long-term, soil-stored seed-banks have developed in some species (*Acetosella* and *Trifolium*) that will endure for decades; the problem will be ongoing. Additionally the *Trifolium* (clovers) are nitrogen-fixing and the soil will have elevated fertility, predisposing the site to weed invasion of the same or other weed species.

**Table 2 Plant species recorded in the Matted Flax-lily (*Dianella amoena*) receptor site, Sugarloaf Pipeline easement, Yarra Glen, 12 November 2014**

Plant species	Common name	Family name	Cover / abundance values
<i>Acaena novae-zealandiae</i>	Bidgee-widgee	Rosaceae	+
<i>*Acetosella vulgaris</i> M	Sheep Sorrel	Polygonaceae	1
<i>*Agrostis capillaris</i> M	Brown-top Bent	Poaceae	1
<i>Anthosachne scabra</i>	Common Wheat-grass	Poaceae	1
<i>*Anthoxanthum odoratum</i> M	Sweet Vernal-grass	Poaceae	1
<i>Austrostipa nervosa</i> subsp. <i>nervosa</i>	Veined Spear-grass	Poaceae	+
<i>*Avena barbata</i>	Bearded Oat	Poaceae	1
<i>*Briza minor</i>	Lesser Quaking-grass	Poaceae	1

Sugarloaf Pipeline Matted Flax-lily (*Dianella amoena*)  
 Translocation: Monitoring Spring 2014

Plant species	Common name	Family name	Cover / abundance values
* <i>Bromus catharticus</i> var. <i>cartharticus</i> M	Prairie Grass	Poaceae	1
* <i>Bromus hordeaceus</i> ssp. <i>hordeaceus</i> M	Soft Brome	Fabaceae	3
* <i>Bromus madritensis</i> M	Madrid Brome	Poaceae	2
<i>Carex inversa</i> s.l. (mat-forming)	Common Sedge	Cyperaceae	1
<i>Carex inversa</i> s.l. (tussock forming)	Common Sedge	Poaceae	+
<i>Carex iynx</i>	Tussock Sedge	Poaceae	+
<i>Carex</i> sp.	Sedge	Cyperaceae	+
* <i>Centaureum erythraea</i>	Common Centuary	Gentianaceae	+
* <i>Cerastium glomeratum</i> s.s	Common Mouse-ear Chickweed	Caryophyllaceae	+
* <i>Cirsium vulgare</i> M	Spear Thistle	Asteraceae	+
* <i>Dactylis glomerata</i> M	Cocksfoot	Poaceae	1
<i>Dianella amoena</i>	Matted Flax-lily	Hemerocallidaceae	2
<i>Dianella laevis</i>	Smooth Flax-lily	Hemerocallidaceae	+
<i>Dichondra repens</i>	Kidney-weed	Convolvulaceae	1
* <i>Ehrharta erecta</i> var. <i>erecta</i> M	Panic Veldt-grass	Poaceae	1
<i>Epilobium hirtigerum</i>	Hairy Willow-herb	Onagraceae	1
* <i>Eucalyptus camaldulensis</i> subsp. <i>camaldulensis</i> M	River Red-gum	Myrtaceae	1
* <i>Euphorbia peplus</i>	Petty Spurge	Euphorbiaceae	1
* <i>Fraxinus angustifolia</i> ssp. <i>angustifolia</i> M	Desert Ash	Oleaceae	+
* <i>Geranium dissectum</i>	Cut-leaf Crane's-bill	Gerianaceae	1
<i>Geranium</i> sp. 2	Variable Crane's-bill	Geraniaceae	1
* <i>Holcus lanatus</i> M	Yorkshire Fog	Poaceae	1
* <i>Hordeum leporinum</i>	Barley Grass	Poaceae	1
* <i>Hypochoeris radicata</i> M	Flatweed	Asteraceae	1
<i>Juncus amabilis</i>	Hollow Rush	Juncaceae	1
<i>Juncus bufonius</i>	Toad Rush	Juncaceae	1
<i>Juncus pallidus</i>	Pale Rush	Juncaceae	1
<i>Juncus sarophorus</i>	Broom Rush	Juncaceae	1
<i>Juncus subsecundus</i>	Finger Rush	Juncaceae	1
* <i>Kniphofia uvaria</i> M	Red-hot Poker	Aloeaceae	+
* <i>Lolium perenne</i> var. <i>perenne</i> M	Perennial Rye-grass	Poaceae	1
* <i>Lotus angustissimus</i> M	Slender Birds-foot Trefoil	Fabaceae	1
* <i>Lysimachia arvensis</i>	Scarlet Pimpernel	Primulaceae	1



Plant species	Common name	Family name	Cover / abundance values
<i>Lythrum hyssopifolia</i>	Small Loosestrife	Lythraceae	1
<i>Oxalis perennans</i>	Grassland Wood-sorrel	Oxalidaceae	+
* <i>Paspalum dilatatum</i> M	Paspalum	Poaceae	+
* <i>Plantago coronopus</i>	Buck's-horn Plantain	Plantaginaceae	+
* <i>Plantago lanceolata</i> M	Ribwort	Plantaginaceae	1
<i>Poa labillardieri</i> var. <i>labillardierei</i>	Common Tussock-grass	Poaceae	+
* <i>Poa pratensis</i> M	Meadow-grass	Poaceae	1
* <i>Romulea rosea</i> var. <i>australis</i>	Common Onion-grass	Iridaceae	1
* <i>Rubus anglocandicans</i> M	Blackberry	Rosaceae	1
* <i>Rumex conglomeratus</i> M	Clustered Dock	Polygonaceae	+
* <i>Rumex crispus</i> M	Curled Dock	Polygonaceae	+
<i>Rytidosperma erianthum</i>	Hill Wallaby-grass	Poaceae	2
<i>Rytidosperma pilosum</i>	Velvet Wallaby-grass	Poaceae	1
<i>Rytidosperma racemosum</i>	Slender Wallaby-grass	Poaceae	1
<i>Rytidosperma setaceum</i>	Bristly Wallaby-grass	Poaceae	2
* <i>Sisyrinchium iridifolium</i>	Blue Pigroot	Iridaceae	+
* <i>Sonchus asper</i> M	Rough Sow-thistle	Asteraceae	1
* <i>Sonchus oleraceus</i> M	Common Sow-thistle	Asteraceae	1
* <i>Taraxacum</i> sp.	Dandelion	Asteraceae	+
<i>Tricoryne elatior</i>	Yellow Rush-lily	Hemerocallidaceae	+
* <i>Trifolium repens</i> M	White Clover	Fabaceae	1
* <i>Vicia hirsuta</i> M	Tiny Vetch	Fabaceae	2
* <i>Vicia sativa</i> subsp. <i>nigra</i> M	Narrow-leaf Vetch	Fabaceae	1
* <i>Vicia sativa</i> subsp. <i>sativa</i> M	Common Vetch	Fabaceae	1
* <i>Vicia tetrasperma</i> M	Slender Vetch	Fabaceae	1
* <i>Vulpia bromoides</i> M	Squirrel-tail Fescue	Poaceae	2

### 3.3 Indigenous species

A suite of indigenous plant species colonised the site over the monitoring period and many of these needed to be removed because they would have adversely competed with *Dianella* plants; this particularly applied to *Acacia* spp. (wattles) and *Kunzea ericoides* (Burgan) and robust herbs such as *Poa labillardierei* var. *labillardierei* (Common Tussock-grass). There has been effective control or elimination of many of these species identified previously (as evidenced for example by dead stumps sawn off at ground level).

The most abundant native plant species now occupying the site with high cover are Wallaby-grasses, *Rytidosperma* species, viz. *R. erianthum* (Hill Wallaby-grass), *R. pilosum* (Velvet

Wallaby-grass), *R. setaceum* (Bristly Wallaby-grass) as well as *Juncus subsecundus* (Finger Rush) (see Table 1).

Removal of these indigenous species is not advocated in the interests of retaining some indigenous plant species rather than only *Dianella*.

### 3.4 Weed species outside the plant-out site

Weed-management issues outside the *Dianella amoena* plot were addressed in the 2013 report. Slashing along the full easement to keep the weedy exotic grassy vegetation low to minimise seed-set, as seeds will disperse to the *Dianella* plot, was advocated. A herbicide regime was recommended between the fence and the gravel-surfaced track to likewise prevent or minimise weed-seed dispersal into the plot. At the 12 November 2014 inspection it was evident that the pipeline easement had been recently slashed, presumably utilising a tractor. This left a band of weeds along the fence of the plot.

At least seven tree and shrub species were recruiting (as observed in 2012) around the *Dianella* plot - on the north side and eastern end (as well as within the plot). These arose from seed dispersal from the farm plantation on the south side of the plot and from the garden of the nearby residence. The following species were recorded as seedlings or young recruits in January 2012:

- Eucalyptus botryoides* (Southern Mahogany)
- Eucalyptus camaldulensis* (Red Gum)
- Eucalyptus leucoxylon* (Yellow Gum)
- Eucalyptus melliodora* (Yellow Box)
- Melaleuca armillaris* ssp. *armillaris* (Giant Honey-myrtle)
- Melaleuca lineariifolia* var. *lineariifolia* (Flax-leaf Paperbark)
- Melaleuca styphelioides* var. *styphelioides* (Prickly Paperbark)

All that remained of this woody weed flora in November 2014 is Red Gum *Eucalyptus camaldulensis* (c. 15 small plants) within the plot.

### 3.5 Hunts Lane north

The degradation of the vegetation at the Hunts Lane north site where *Dianella amoena* x *D. admixta* was planted out was documented in earlier reports. Weed invasions on the site are worsening and the 12 November 2014 inspection revealed that the site supports about 100% cover of weeds. The principal weed species recorded were grasses, viz: Great Brome (*\*Bromus diandrus*), Panic Veldt-grass (*\*Ehrharta erecta*), Annual Veldt-grass (*\*Ehrharta longiflora*), Large Quaking Grass (*\*Briza maxima*), Cocksfoot (*\*Dactylis glomerata*), Squirrel-tail Fescue (*\*Vulpia bromoides*), Sweet Vernal Grass (*\*Anthoxanthum odoratum*), Brown-top Bent (*\*Agrostis capillaris*). Non-grass weeds included Onion Grass (*\*Romulea rosea* var. *australis*), Sourgrass (*\*Oxalis articulata*), Flatweed (*\*Hypochaeris radicata*), Capeweed (*\*Arctotheca calendula*), and suckers of Blackwood (*Acacia melanoylon*) (an in-situ indigenous species).

Data on the *Dianella* plants at this site are given in Section 3.1.

### 3.6 Hunts Lane south

As with the Hunts Lane north site, the southern site likewise supported (12 November 2014) a near 100% cover of exotic grasses and other weeds, notably: Yorkshire Fog (*\*Holcus lanatus*), Sweet Vernal Grass (*\*A. oleratum*), Cocksfoot (*\*D. glomerata*), Flatweed (*\*H. radicata*), and a few Bulbil Watsonia (*\*Watsonia meriana* var. *bulbillifera*). A few species of native plants occupy the site e.g. Veined Spear-grass (*Austrostipa nervosa* subsp. *nervosa*), while the dense patch of Bracken (*Pteridium esculentum*) is expanding into the site from its northern edge.

Data on the *Dianella amoena* plants at this site are given in Section 3.1.



Plate 1 General view of the Gibbs Road *Dianella amoena* plant-out site showing high weed cover (12 Nov 2014)



Plate 2 View of the Gibbs Road site showing high weed cover, the plantation of trees on private property to the immediate south, and the recently slashed North-South pipeline easement (12 Nov 2014)



Plate 3 Overhanging trees, with Pin Oak (*Quercus palustris*) casting heavy shade (12 Nov 2014)



Plate 4 Flowering *Dianella amoena* under the dense Pin Oak (12 Nov 2014)



Plate 5 Cattle have broken down the fence on the south side of the Gibbs Road plant-out site, causing some *Dianella amoena* plants to be grazed (12 Nov 2014)



Plate 6 The Hunts Lane north *Dianella amoena* X *D. admixta* plant-out site showing dense exotic grass cover (12 Nov 2014)



Plate 7 A *Dianella amoena* X *D. admixta* plant in bud, growing in the dense exotic sward, Hunts Lane north (12 Nov 2014)



Plate 8 The Hunts Lane south *Dianella amoena* plant-out site showing a very dense cover of exotic grasses (12 Nov 2014)



Plate 9 Very dense exotic grass sward at the Hunts Lane south planting site (12 Nov 2014)



Plate 10     Quadrat 1 at the Gibbs Road *Dianella amoena* plant-out site (5 Nov 2014)



Plate 11     Quadrat 2 at the Gibbs Road *Dianella amoena* plant-out site (5 Nov 2014)





Plate 12     Quadrat 3 at the Gibbs Road *Dianella amoena* plant-out site (5 Nov 2014)



Plate 13     Quadrat 4 at the Gibbs Road *Dianella amoena* plant-out site (5 Nov 2014)

## 4 Management issues

Management issues have been discussed in previous reports and are discussed below as they relate to observations made on 12 November 2014.

### 4.1 Weed invasions – see Section 5

### 4.2 Cattle breaking fence

Cattle on the private property on the south side of the plot have broken the fence down in one location (Plate 5) allowing more *Dianella* plants to be grazed. This fence needs to be re-instated.

### 4.3 Cattle in the plot

A cow gained access to the plot in recent times but how it got there is not known. Evidence of the cow includes pugging, deposition of faeces and fairly limited grazing of *Dianella* plants. Hopefully there will not be a repeat of this event.

### 4.4 Hard rubbish

A small scattering of hard rubbish in the form of plastic bags and bottles was noted in the plot. How rubbish gets there, other than being wind-blown, is not known; any rubbish should be removed because of its visual impact and potential physical harm to plants and fauna (e.g. the solitary burrowing bees).

### 4.5 Overhanging trees

Low branches of trees in the adjoining plantation are overhanging the plot and in time will adversely shade *Dianella* plants though significant negative impacts are not yet evident. This applies particularly to the Pin Oak (*Quercus palustris*) (Plate 3). All that is required is removal of a few lower branches.

### 4.6 Weeds in the tree plantation

The plantation on the private property which runs the length of the plot (Plate 2) is fenced off from the adjoining paddock which is grazed by cattle and other stock. It is highly desirable to keep this grazed to reduce competition from weeds which may adversely impact on nearby *Dianella* plants in the plot and to minimise weed seed dispersing into the plot. An arrangement with the landowner may be easily achieved.

## 5 Factors affecting the survival and performance of *Dianella amoena*

### 5.1 Performance of translocated *Dianella*

Performance of translocated *Dianella amoena* plants at the Gibbs Road plant-out site (Quadrats 1- 4) and Hunts Lane north and south sites (*D. amoena* x *D. admixta* and *D. amoena* respectively) are given in Table 2 from the plant-out time (2010) up to the present (November 2014). At the Gibbs Road site survival has been high, ranging from 83% to 100%, while at the Hunts Lane sites survival has been 70% and 95% respectively (Table 2).

The data on the vegetative performance of the *Dianella* as a function of mean shoot number, mean plant basal diameter and mean maximum leaf length are given in Figures 3, 4 and 5. Data are not given for flowering/ fruiting performance because of considerable variation in climatic factors. With one exception (when the mean number of shoots declined - 2010-2013) there has been an upward trend, sometimes considerable (a four or five-fold mean increase in Quadrat 4). For the other two parameters – mean plant basal diameter and mean maximum leaf length – all trends have been upwards. Without weed competition the figures may have been significantly greater, however these combined data clearly show that *Dianella* plants have experienced good survivorship and upward trending vegetative growth parameters.

### 5.2 Weed invasions

Over the five-year period the plant-out site has been invaded by numerous weed species and this is the only significant factor influencing survival and performance – growth and flowering - of the *Dianella* plants. If left unmanaged weed invasions would essentially eliminate *Dianella* at the site in perhaps a five-year time-frame by competition for light and water. That weeds will eliminate *Dianella* plants is clearly evidenced by the extinction of the three roadside *D. amoena* populations required to be monitored under the agreement – on Gulf Road, Yarraview Road and Melba Highway. Inspection on three occasions has not revealed any *Dianella* plants and each site now supports a dense sward of exotic weeds, mostly grasses, with ± 100% cover.

Weed management at the site has been variable in terms of timing and intensity, and has often been left too late, when weeds have achieved maximum growth and reproductivity, overtopping and smothering *Dianella* plants. This has made weed management much more difficult, i.e. the difficulty controlling weeds, particularly rhizomatous species in mixed *Dianella* and weed populations without adverse impacts on the *Dianella*. When mobilised weed management has generally been of high quality. We are unaware of the management arrangements with the contractor and if funding has been adequate.

Weed control is and will remain the outstanding management issue for the site and must be continued indefinitely; although the requisite management intensity is likely to diminish if *timely* weed control can be effected. A situation whereby the site will develop resistance to weed invasion is not foreseeable.

### **5.3 Pollination of *Dianella amoena***

During the 12 November 2014 site visit *D. amoena* was flowering well but the population was by no means yet in full flower. At least two species of solitary (non-colonial) native bees were observed in abundance pollinating the *Dianella* flowers. Abundant fruit production is likely, however there is nowhere for the *Dianella* to recruit outside the plot and within the plot the vegetation is too dense to allow effective recruitment. This information on pollination is offered as a note on the biology of *D. amoena*.

### **5.4 Other factors**

Several other factors, all easily managed have had a minor influence on *Dianella* performance but probably not survival. These factors included: shading by the trees in the adjoining plantation, and recent grazing by a cow placed by person(s) unknown in the plot.

## 6 Outcomes of the *Dianella amoena* translocation program

We summarise here the findings from *Dianella amoena* translocation program in the Sugarloaf Pipeline easement.

1. *Dianella amoena*, as a robust, long-lived, rhizomatous perennial herb, is highly amenable to translocation to an environmentally suitable site (in terms of soil conditions, light and moisture availability).
2. Under appropriate conditions plants will flourish and be highly reproductive (flowering and fruiting).
3. In situ natural populations on roadsides which were to be monitored as part of the translocation program have been eliminated by weed invasions (mostly rank exotic grasses).
4. Weed management will be an ongoing (annual) requirement for the translocated populations as well as natural in situ populations in the wider landscape. *Dianella amoena* is and will remain a critically endangered management-dependent species.
5. Weed monitoring needs to occur at least twice a year.
6. Survival and growth of *Dianella* plants is crucially dependant on appropriate management of weed invasions which would otherwise eliminate the translocated population.
7. Pollination by native solitary bees (at least two species) is effective, thus seed production is high, however there is nowhere for *Dianella* plants to recruit given the locational context of the plant-out site.
8. Survivorship of plants on the site has been high but performance of individual plants has varied considerably, some remaining small while others have expanded considerably. The differential performance of individual plants is directly related to colonisation of the site by indigenous plant species (from soil-stored seed-banks and off-site sources dispersed by wind and probably birds).
9. Once-annual monitoring of *Dianella* plants at the appropriate time (flowering-fruiting stage between spring and early summer) has proved perfectly adequate to document the fortunes of plants.
10. Monitoring of a sub-set of the population (four plots) rather than all 1172 plants has proven effective and adequate.

## 7 Recommendations

The following recommendations are made which largely repeat those from former reports.

### Weed management

1. Continue management of identified weed species – either control or elimination from the site.
2. Ensure that weed populations on the pipeline easement outside the receptor site are regularly controlled by slashing.
3. Conduct regular monitoring of weed populations and respond to weed invasion as appropriate and in a timely fashion.

### General

4. Ensure regular evaluation of and implementation of management on the receptor site. It will also be necessary to ensure that the infrastructure remains functional (i.e. shade cloth, gate, farm fencing).
5. Remove recruiting trees and shrubs ('native' plants) from the vicinity of the *Dianella* plot if they should recolonise.
6. Remove indigenous plant species which have recruited in the *Dianella* plot from soil-stored, wind-blown or otherwise imported seed – see Table 1 for the current list of species. These will negatively impact *D. amoena* because of competition for light and water.

### *Dianella* monitoring

7. Monitoring of the performance of the *Dianella* plants according to the agreement and commitment was to include all 1172 plants in the receptor site. A once-yearly spring/summer monitoring of the *D. amoena* is adequate to document the survival and performance of plants.

### Other issues

8. Ensure adjoining landowner maintains a stock-grazing regime on the property to the immediate south of the fence of the *Dianella* plot.
9. Some trees in the plantation on the south side of the *Dianella* plot are excessively shading the *Dianella* plants. Negotiate with the landowner to remove some of the lower branches. This will have a very minor impact on the trees.

## 8 References

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- Walsh NG and Stajsic V (2007) A Census of the Vascular Plants of Victoria. 8<sup>th</sup> edition (Royal Botanic Gardens: Melbourne)

Sugarloaf Pipeline Matted Flax-lily (*Dianella amoena*) Translocation: Monitoring Spring 2014

**Appendix 1** *Dianella amoena* data collected from two 2 x 2.7 m quadrats (Quadrats 3 and 4) at Gibbs Road, Yarra Glen, plant-out site, November 2014.

Translocated <i>Dianella amoena</i> monitoring – Sugarloaf Pipeline Alliance - Quadrat 3											
Plant no.	Coordinates (GDA94)		Plant basal diam. (cm)	No. shoots	Max. leaf length (cm)	No. leaves /shoot (range)	Inflorescence/infructescence				Notes
	Eastings	Northing					Height (cm)	Buds	Flowering (1 - 3)	Fruiting (1 - 3)	
679	357206.9	5833268.2	6	2	24	2-3	-	-	-	-	can't find tag
680	357207.1	5833268.1	14	8	20	2-4	-	-	-	-	-
681	357207.4	5833268	-	-	-	-	-	-	-	-	not part of quadrat
682	357207.1	5833267.8	32	8	20	3-4	15	14	-	-	-
683	357207.3	5833267.6	28	16	33	2-5	-	-	-	-	-
684	357207.6	5833267.2	-	-	-	-	-	-	-	-	not part of quadrat
685	357207.5	5833266.9	8	5	18	3-4	27	23	1	-	-
686	357208	5833267	17	7	19	2-5	22	-	-	-	-
687	357207	5833267	16	7	25	3-5	33	12	1	-	-
688	357207	5833267	-	-	-	-	-	-	-	-	no sign of plant
689	357207	5833268	11	15	25	2-5	-	-	-	-	-
690	357207	5833268	5	3	9	2-3	-	-	-	-	-
691	357207	5833268	5	2	19	3	-	-	-	-	-
692	357206	5833269	20	10	33	2-4	-	-	-	-	-
693	357206	5833268	17	12	32	3-6	-	-	-	-	-
694	357206	5833268	10	5	26	2-4	7	10	1	-	-
695	357206	5833267	8	2	21	2-3	15	11	1	-	-
696	357206	5833267	14	7	22	3-5	-	-	-	-	-
697	357206	5833267	2	1	28	7	35	12	1	-	-
698	357207	5833267	5	2	20	2-3	-	-	-	-	-
699	357207	5833266	15	8	27	3-4	-	-	-	-	-
700	357206	5833266	30	10	26	4-6	-	-	-	-	-
701	357206	5833267	8	5	24	3-4	-	-	-	-	-
702	357206	5833267	11	5	17	3-4	-	-	-	-	-
703	357206	5833268	14	13	31	3-5	-	-	-	-	-
704	357205	5833268	28	31	35	2-5	35	37	1-2	-	-
705	357205	5833268	24	15	31	3-4	-	-	-	-	-
706	357205	5833268	-	-	-	-	-	-	-	-	not part of quadrat
707	357205	5833267	14	7	26	2-3	-	-	-	-	-
708	357205	5833267	-	-	-	-	-	-	-	-	no sign of plant or tag
709	357206	5833266	28	28	36	3-5	-	-	-	-	no sign of tag
710	357206	5833266	-	-	-	-	-	-	-	-	not part of quadrat
711	357207	5833267	8	7	28	3-4	-	-	-	-	-



Sugarloaf Pipeline Matted Flax-lily (*Dianella amoena*) Translocation: Monitoring Spring 2014

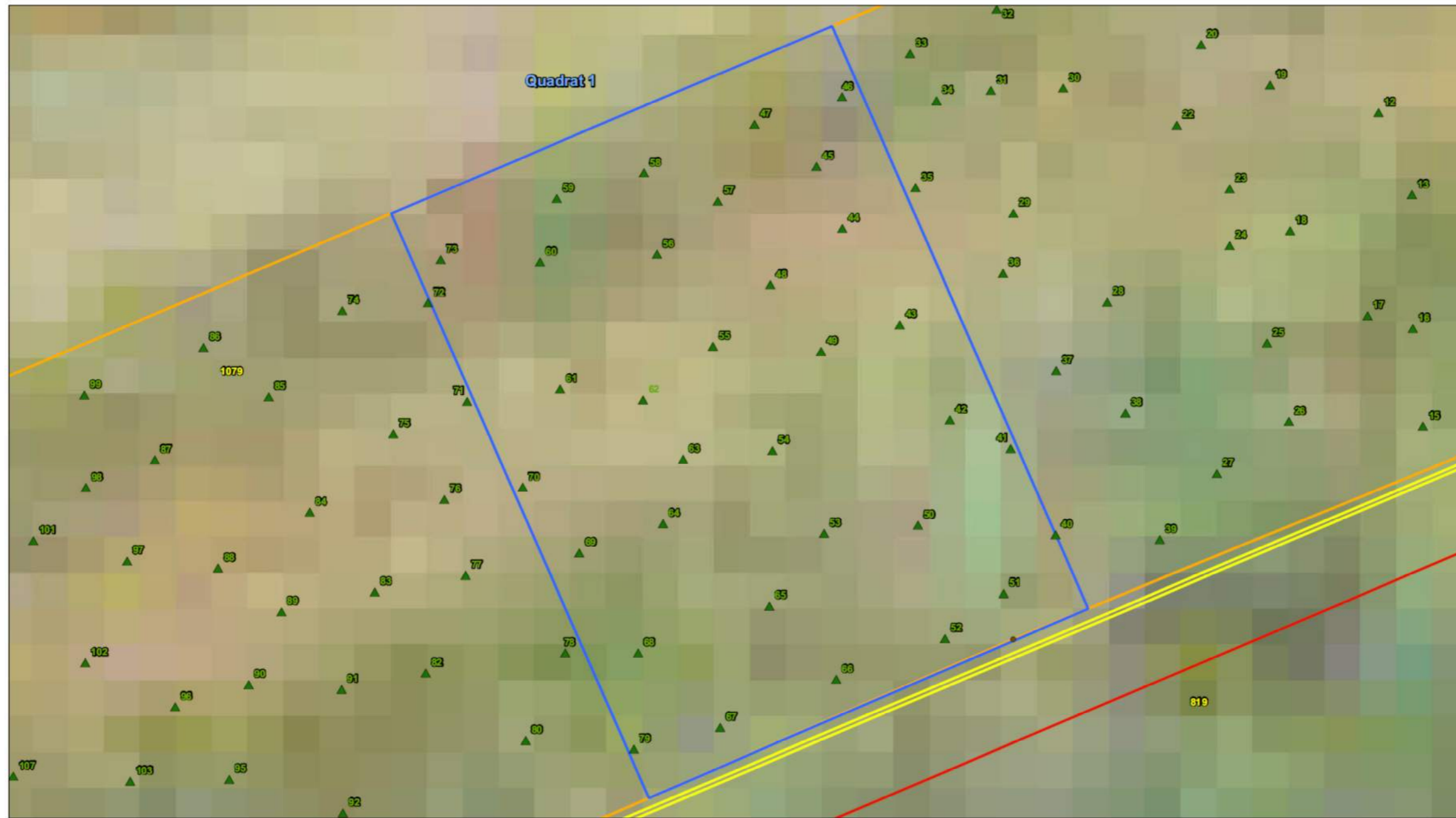
Translocated <i>Dianella amoena</i> monitoring – Sugarloaf Pipeline Alliance - Quadrat 4											
Plant no.	Coordinates (GDA94)		Plant basal diam. (cm)	No. shoots	Max. leaf length (cm)	No. leaves /shoot (range)	Inflorescence/infructescence				Notes
	Easting	Northing					Height (cm)	Buds	Flowering (1 - 3)	Fruiting (1 - 3)	
1025	357175	5833255	12	9	20	2-4	-	-	-	-	-
1026	357175	5833255	14	6	25	3-7	-	-	-	-	-
1027	357175	5833255	17	6	31	4-5	25	25	1	-	-
1028	357175	5833254	17	14	29	3-4	-	-	-	-	-
1029	357175	5833254	-	-	-	-	-	-	-	-	couldn't find plant
1030	357176	5833253	19	20	27	2-8	-	-	-	-	-
1031	357175	5833253	26	21	29	3-5	-	-	-	-	-
1032	357175	5833254	15	15	25	3-5	-	-	-	-	-
1033	357175	5833254	22	18	28	3-7	-	-	-	-	-
1034	357175	5833255	32	16	30	2-5	-	-	-	-	-
1035	357175	5833255	22	11	32	3-6	-	-	-	-	-
1036	357174	5833255	18	4	25	3	-	-	-	-	-
1037	357174	5833254	23	16	29	3-5	25	16	1	-	-
1038	357174	5833254	15	6	27	3-4	-	-	-	-	-
1039	357175	5833254	7	7	30	4-5	15	9	1	-	-
1040	357175	5833253	23	14	32	3-4	26	34	1	-	-
1041	357175	5833253	14	7	28	3-5	-	-	-	-	-
1042	357175	5833253	22	16	30	2-6	36	15	1	-	-
1043	357174	5833253	32	11	35	3-7	43	50	1	-	-
1044	357174	5833254	23	12	25	3-6	-	-	-	-	-
1045	357174	5833254	18	5	26	3-5	-	-	-	-	-
1046	357174	5833255	22	11	30	3-9	57	63	1,2,3	1	-
1047	357173	5833255	27	11	31	3-6	-	-	-	-	-
1048	357174	5833254	30	22	32	2-6	-	-	-	-	-
1049	357174	5833254	20	6	30	1-4	-	-	-	-	-
1050	357174	5833253	20	8	29	3-5	34	20	1	-	-
1051	357174	5833253	19	9	32	3-5	49	55	1,2	-	-
1052	357174	5833252	-	-	-	-	-	-	-	-	Not rooted in quadrat
1053	357173	5833253	-	-	-	-	-	-	-	-	way out of quadrat
1054	357174	5833253	15	5	27	3-4	31	16	1	-	-
1055	357173	5833253	-	-	-	-	-	-	-	-	no sign of plant / out of quadrat?
1056	357173	5833254	-	-	-	-	-	-	-	-	way out of quadrat
1057	357173	5833254	21	3	31	2-4	-	-	-	-	-

## Sugarloaf Pipeline Matted Flax-lily (*Dianella amoena*) Translocation: Monitoring Spring 2014

**Appendix 2** *Dianella amoena* data collected from Hunts Lane (north) plant-out site, Yarra Glen, November 2014.

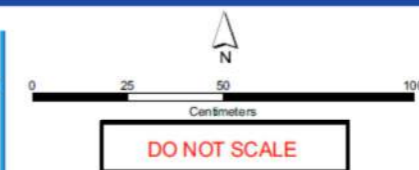
Translocated <i>Dianella amoena</i> monitoring – Sugarloaf Pipeline Alliance – Hunts Lane north											
Plant no.	Coordinates (GDA94)		Plant basal diam. (cm)	No. shoots	Max. leaf length (cm)	No. leaves /shoot (range)	Inflorescence/infructescence				Notes
	Easting	Northing					Height (cm)	Buds	Flowering (1 - 3)	Fruiting (1 - 3)	
1	359656	5839341	30	9	29	2-5	52	27	1	-	Merged plants? May include some of Plant 18.
2	359657	5839340	19	3	33	1-3	-	-	-	-	Can't find tag
3	359657	5839340	15	6	31	1-4	-	-	-	-	Can't find tag
4	359658	5839341	9	3	30	5-6	-	-	-	-	Can't find tag
5	359659	5839341	8	2	32	2-3	-	-	-	-	Can't find tag
6	359658	5839341	15	4	29	1-5	-	-	-	-	-
7	359657	5839341	15	5	27	2-4	-	-	-	-	Can't find tag
8	359657	5839342	29	7	29	3-6	-	-	-	-	-
9	359657	5839341	-	-	-	-	-	-	-	-	No sign of plant or tag
10	359656	5839341	18	5	30	2-5	58	43	2	-	-
11	359655	5839340	8	3	29	3-4	-	-	-	-	-
12	359655	5839339	22	8	30	3-4	37	13	1	-	Can't find tag
13	359655	5839339	11	8	31	2-5	22	6	1	-	Can't find tag
14	359655	5839338	5	4	26	2-5	26	11	1	-	-
15	359655	5839339	18	9	34	3-4	-	-	-	-	-
16	359656	5839339	2	1	25	5	-	-	-	-	Can't find tag
17	359656	5839340	18	6	28	3-7	-	-	-	-	-
18	359656	5839340	17	6	31	2-6	35	19	1	-	-
19	359658	5839342	6	4	29	3-6	-	-	-	-	-
20	359657	5839341	6	2	25	1-3	-	-	-	-	-

**Appendix 3** Location of planted Matted Flax-lily (*Dianella amoena*) within Quadrats (subplots) 1 – 4 in the Gibbs Road translocation site, Yarra Glen



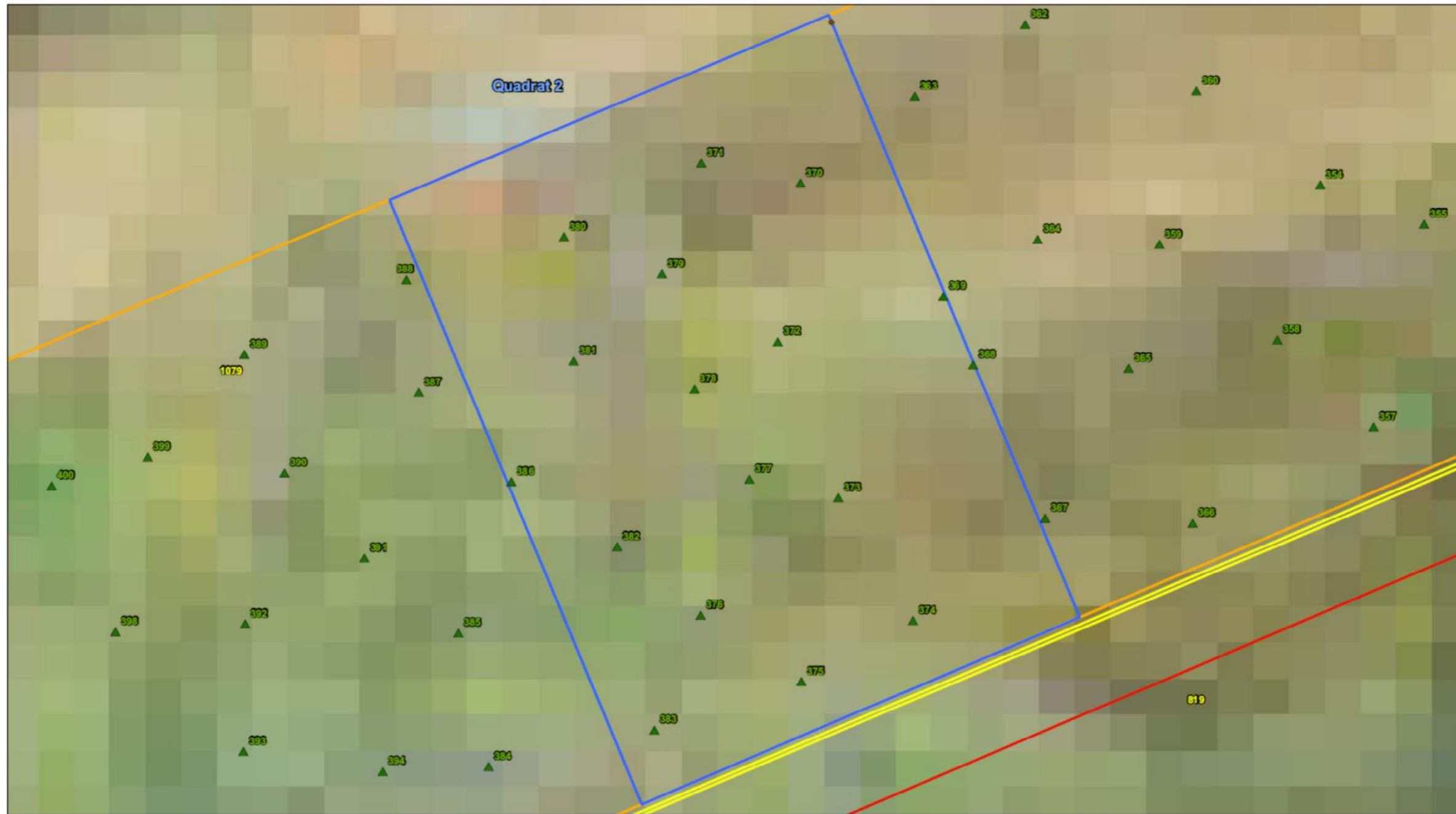
**Sugarloaf Pipeline Project**  
Matted Flax-Lily Quadrat Sites - Quadrat 1

- Fence Post
- ▲ Matted Flax-Lily Plant
- ▭ Matted Flax-Lily Translocation Site
- ▭ Matted Flax-Lily Quadrat Site
- ▭ Construction ROW
- ▭ Property Boundary



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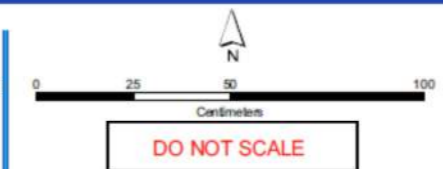
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**Sugarloaf Pipeline Project**  
Matted Flax-Lily Quadrat Sites - Quadrat 2

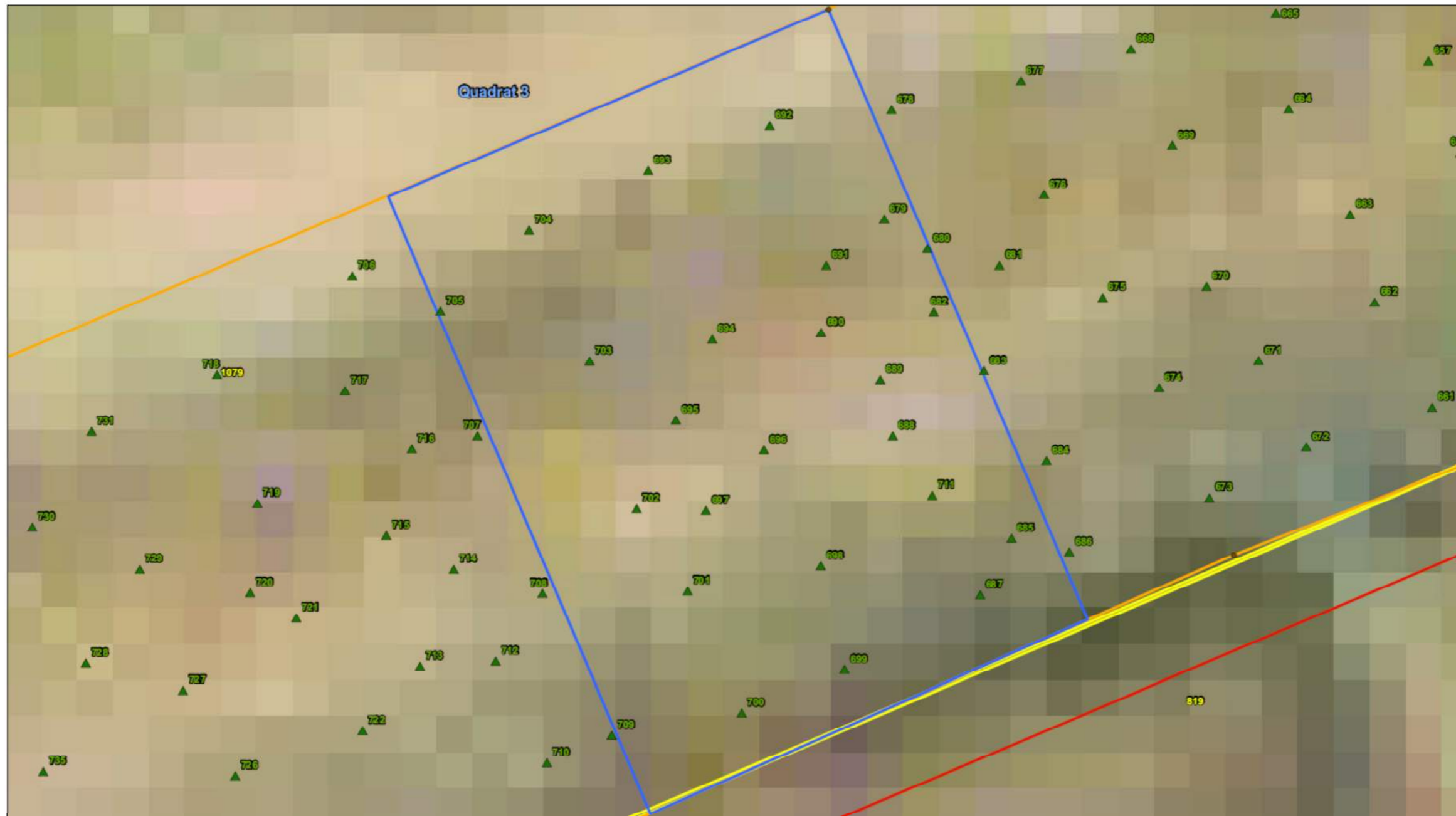


- Fence Post
- ▲ Matted Flax-Lily Plant
- ▭ Matted Flax-Lily Translocation Site
- ▭ Matted Flax-Lily Quadrat Site
- ▭ Construction ROW
- ▭ Property Boundary



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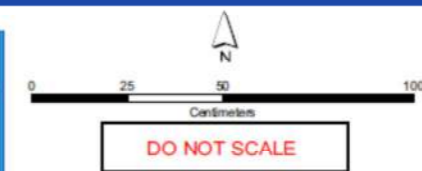
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**Sugarloaf Pipeline Project**  
Matted Flax-Lily Quadrat Sites - Quadrat 3



- Fence Post
- ▲ Matted Flax-Lily Plant
- ▭ Matted Flax-Lily Translocation Site
- ▭ Matted Flax-Lily Quadrat Site
- ▭ Construction ROW
- ▭ Property Boundary



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