Woolgoolga to Ballina Pacific Highway upgrade

Operational Monitoring of In-situ Threatened Flora Species (non-rainforest)

Annual Report 2020

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Woolgoolga to Ballina Pacific Highway Upgrade

In-situ Threatened Flora (non-rainforest flora) Annual Monitoring Report 2020

FINAL | v.1

September 2021

Transport for NSW

Pacific Complete

Woolgoolga to Ballina Pacific Highway Upgrade

Project No:	IA136900
Document Title:	In-situ Threatened Flora Annual Monitoring Report 2020
Document No.:	Final report
Revision:	v.1
Date:	September 2021
Client Name:	Transport for NSW
Project Manager:	Chris Thomson
Author:	Chris Thomson
File Name:	W2B_in-situ flora_annual_report _2020_v.1

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Document history and status

Revision	Date	Description	Author	Reviewed	Approved
v.1	2/09/2021	Final Draft	C.Thomson	J.Carr	K.Collings
v.1	23/09/2021	Final Report	C.Thomson	J.Carr	K.Collings

Contents

1. Introduction

1.1 Background and objectives

As part of the Woolgoolga to Ballina (W2B) Pacific Highway upgrade project, a Threatened Flora Management Plan (TFMP) was developed to meet approval of the NSW condition requirements of MCoA D8 and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Condition of Approval (CoA) 12. The TFMP identified potential impacts to threatened flora species listed under the EPBC Act and formerly under the *Threatened Species Conservation Act 1995*, now *Biodiversity Conservation Act 2016* (BC Act). Threatened plant species are being managed in two ways, 1) by the protection, monitoring and management of plants that remain in-situ adjacent to the W2B upgrade, and 2) by the translocation, monitoring and management of plants that are located within the road construction footprint. This report addresses the monitoring requirements for in-situ threatened plant species during construction and early operation.

The in-situ threatened plant monitoring program documented in the TFMP outlines the methods and timing for targeted surveys of threatened plant species that are located in proximity to the project. The program aims to identify potential direct and indirect impacts during construction and the early stages of operation of the project by monitoring the performance of mitigation measures against management goals and implementing required corrective actions for adaptive management of the program.

The program commenced during the pre-construction phase in which (baseline) data was collected for a series of impact and control plots for each threatened species. Impact and control plots were monitored in the first year of construction in 2017 from two monitoring events for sections 1 to 2 and four quarterly monitoring events (Q1-Q4) for sections 3 to 10 of the W2B upgrade (Jacobs 2018). Monitoring in 2018 was completed in two (biannual) events in autumn and spring and transitioned to annual spring monitoring in 2019 (year 3). The current report describes the results of the third and final year of operational monitoring for Section 1 and 2 of the project and, the first year of operational monitoring for Sections 3-10. Operational monitoring is conducted annually in spring.

The report provides discussion on avoiding and minimising impacts to threatened plant species with reference to the goals in the TFMP. Suggestions for adaptive management and corrective actions is also provided where deemed to be required.

The in-situ threatened flora monitoring program is specific to 20 threatened plant species, these are listed in Table 1-1 along with their status and relevant project section.

Table 1-1 Threatened flora species targeted in the construction monitoring

Species	Common Name	Status		Project section for monitoring
		EPBC Act	BC Act	
Angophora robur	Sandstone Rough Barked Apple	V	V	3
Arthraxon hispidus	Hairy Joint Grass	V	V	8, 9, 10
Cyperus aquatilis	Water Nutgrass	-	E	1, 2, 3, 6, 7
Eleocharis tetraquetra	Square-stemmed Spike-rush	-	E	1, 2, 3
Endiandra muelleri subsp. *bracteata*	Green-leaved Rose Walnut	-	E	4
Eucalyptus tetrapleura	Square-fruited Ironbark	V	V	2
Grevillea quadricauda	Four-tailed Grevillea	V	V	3
Lindernia alsinoides	-	-	E	1, 2, 3
Lindsaea incisa	Slender Screw Fern	-	E	1, 2, 3, 6

Species	Common Name	Status		Project section for monitoring
		EPBC Act	BC Act	
Macadamia tetraphylla	Rough-shelled Bush Nut	V	V	7, 8
Maundia triglochinoides	-	-	V	1, 2, 3, 6, 7
Melaleuca irbyana	Weeping Paperbark	-	E	7
Oberonia complanata	-	-	E	8
Oberonia titania	-	-	V	10
Persicaria elatior	Tall Knotweed	V	V	4, 5
Prostanthera cineolifera	Singleton Mint Bush	V	V	6
Quassia sp. Moonee Creek	Moonee Quassia	E	E	1, 3
Rotala tripartita	-	-	E	6
V=vulnerable, E=endangered				

1.2 Detailed design outcomes

A small number of the in-situ sites established during the pre-construction phase of the project, were inadvertently placed in areas that were subject to approved clearing associated from the detailed design. These sites, which were removed during Year 1 construction activities, were documented in the 2017 annual report (Jacobs 2018) and will be excluded from future annual reports. Details are provided in Appendix B. Following review of the detailed design and comparison with concept design the total number of remaining in-situ populations being monitored were reset across the whole project. Monitoring plots partially impacted in 2017 were continually monitored to examine any change post impact or from future direct or indirect impacts. Where possible, additional plots were established to monitor remaining populations adjacent to pre-existing impacted sites.

2. Methods

2.1 Timing and conditions

2.1.1 Survey timing

The timing of surveys followed in accordance with the monitoring program in the TFMP which prescribes that monitoring events be undertaken once annually during the operational phase of the project.

As different sections of the W2B upgrade are being constructed independently, the timing of monitoring events have occurred at different phases for 2020 as follows:

- Section 1-2 – Year 3 operation (2020). Final annual survey completed in spring.
- Section 3-10 – Operation of the remaining sections of the highway had commenced in late 2020, hence the annual monitoring event was conducted in late spring (October-November 2020) to coincide with the first year of operation.

2.1.2 Climatic conditions

Given the length of the project study area spanning over 160 km, localised climatic conditions and rainfall vary across this extent and it is important to identify these conditions in interpreting the data and trends in natural variation of plants and changes in their health, abundance and occurrence. This is particularly important for threatened flora that grow in wetland and riparian habitats and depend on rainfall.

Total annual rainfall for 2020 ranged from a high of 2,368 mm at Lower Bucca (Sections 1 and 2), to 1,600.2 mm at Grafton Research Station (Sections 3-5), and 1808.7 mm at New Italy (Sections 6-10).

All sites received well below average annual rainfall (49-75 percent) preceding the 2020 surveys, particularly compared with previous monitoring years, primarily between March and November with the greatest decrease at Grafton which received just 7 mm of rain during November 2020. Monthly rainfall trends were variable across the whole region though generally always below average (refer to Figure 2-1, Figure 2-2 and Figure 2-3). Summer 2020 rainfall was the highest across the region, particularly during February. Whereas, March to November was variable with slight above average rainfall in July and October in Lower Bucca and Grafton, and, July and September in New Italy. Overall mean maximum and minimum temperatures were average for majority of months in 2020.

A summary of all monitoring events, survey timing and local weather conditions is presented in Table 2-1, monthly rainfall data against historical averages is illustrated on Figure 2-1, Error! Reference source not found. and Figure 2-3 and a comparison of annual rainfall data against historical averages is illustrated in Figure 2-4.

Table 2-1 Survey timing and rainfall total for procedding months from monitoring program

Season	Monitoring period 2020 (survey dates)			Total mean rainfall three months preceding survey (mm)*		
	Section 1-2	Section 3-5	Section 6-10	Lower Bucca	Grafton	Woodburn
Spring	Annual (13-15 October)	Annual (4-6 Nov)	Annual (7-12 Nov)	136.6	54	139

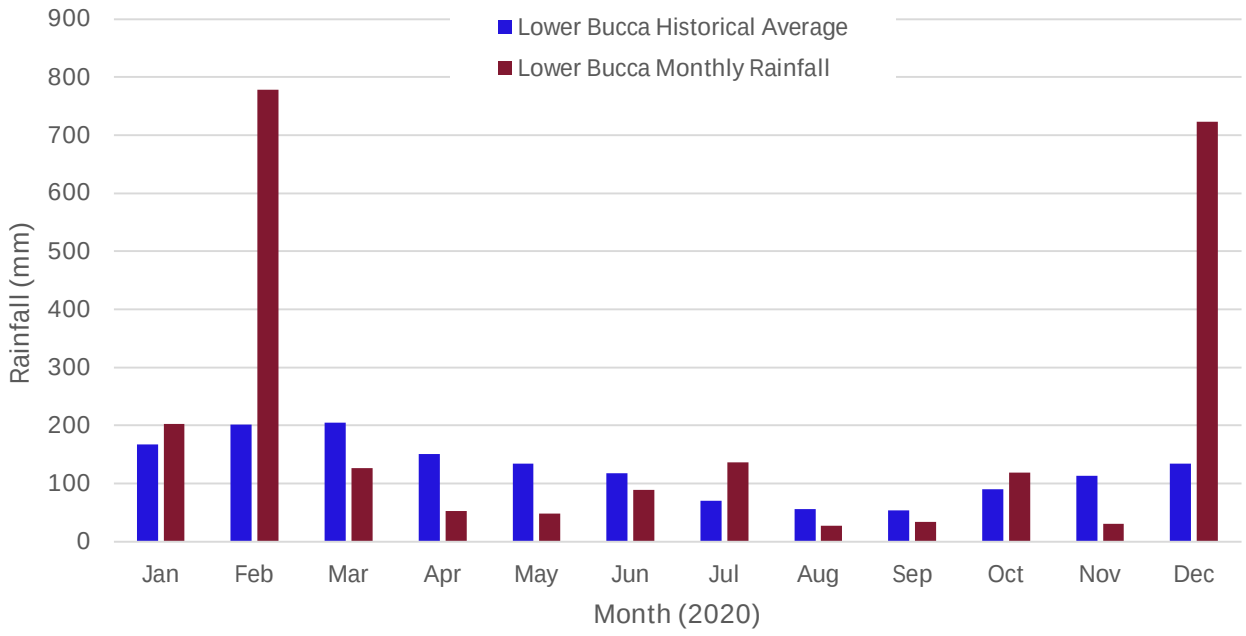

Figure 2-1 Monthly rainfall data and monthly historical average from Lower Bucca (059006) for 2020

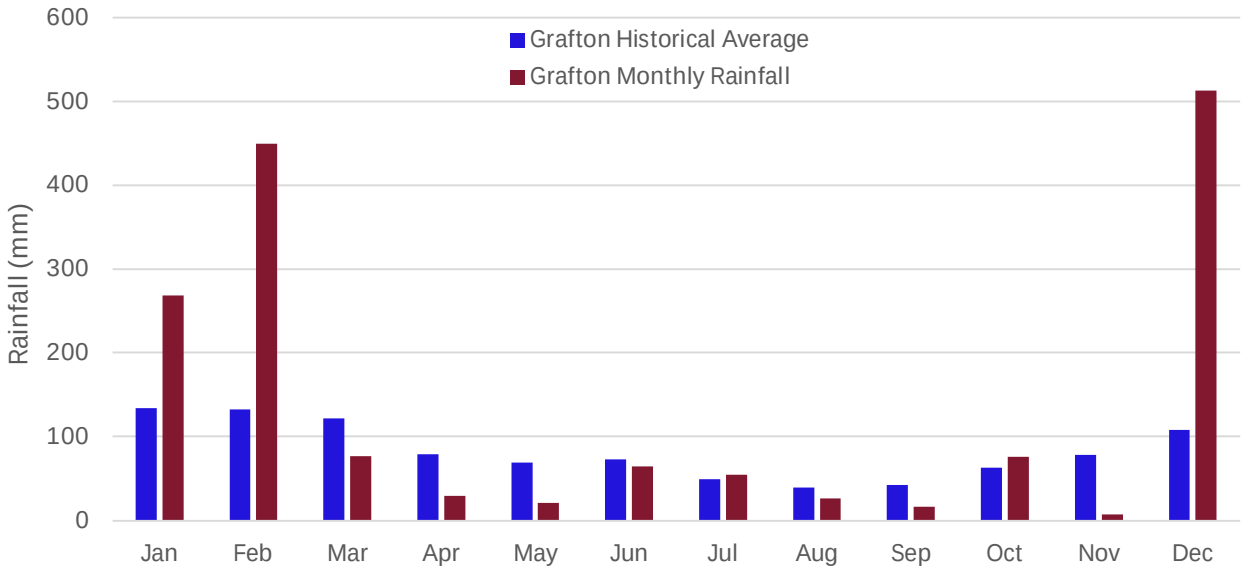

Figure 2-2 Monthly rainfall data and monthly historical average from Grafton Research Station (058077) for 2020

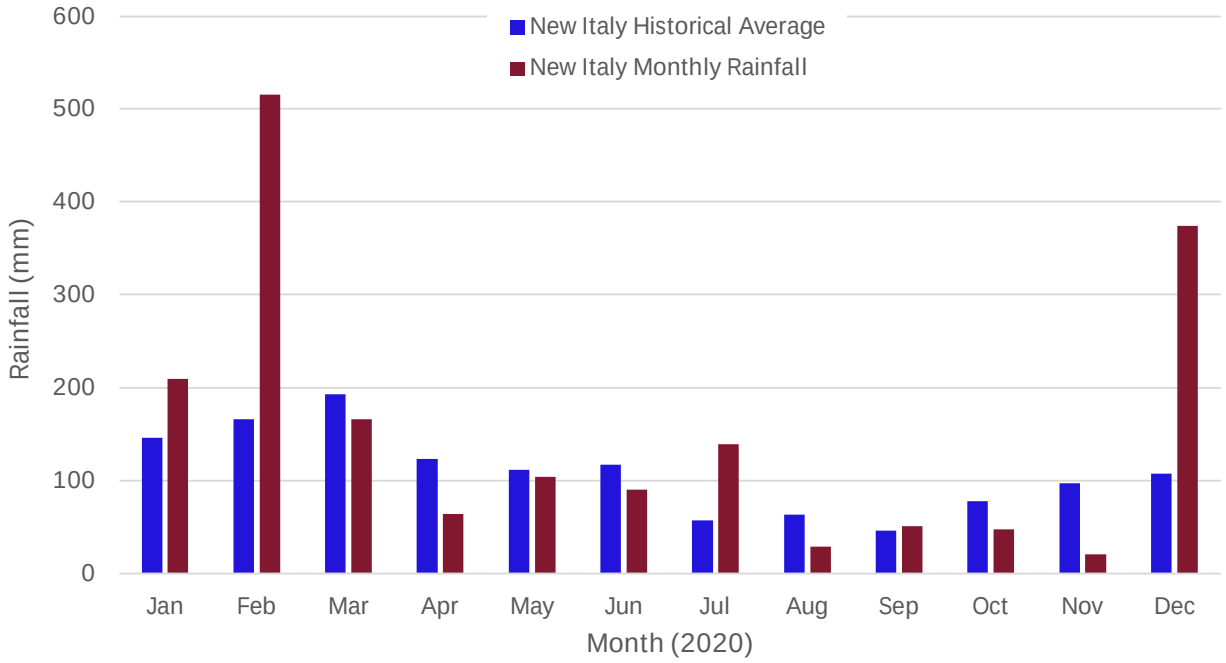

Figure 2-3 Monthly rainfall data and monthly historical average from New Italy (058097) for 2020

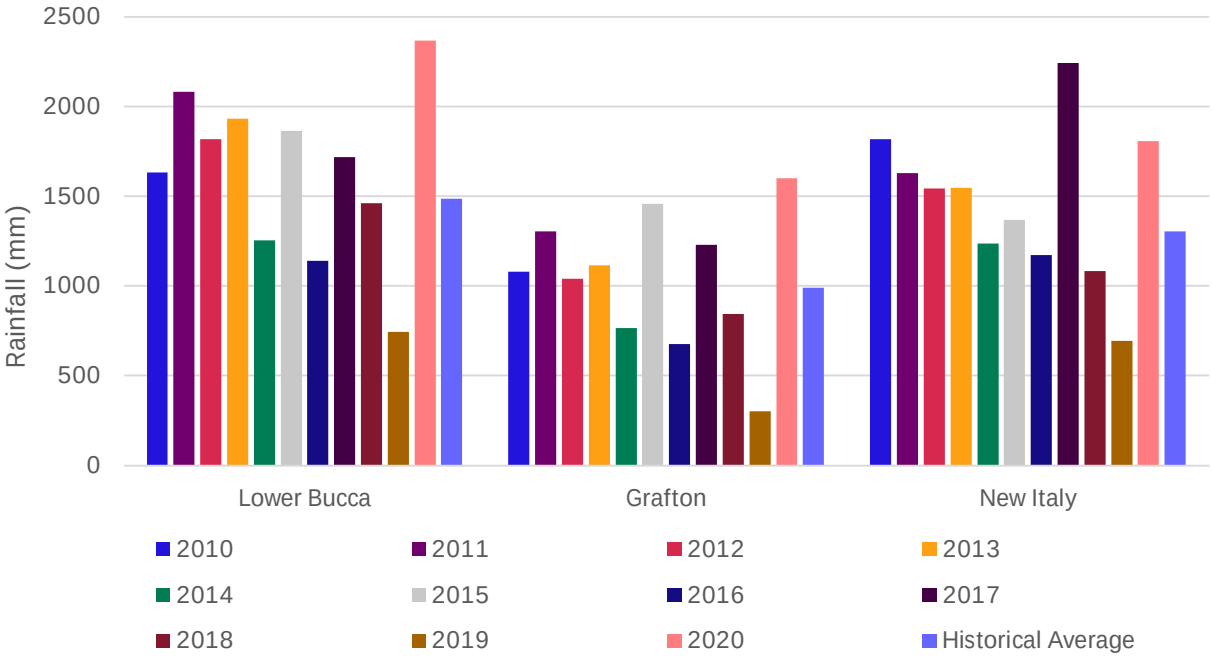

Figure 2-4 Annual and historical rainfall data from the Lower Bucca (059006), Grafton (058077) and New Italy (058097) weather stations (missing annual data was complemented with data from nearby stations)

2.2 Monitoring sites

The pre-construction baseline surveys undertaken by Jacobs (2014) identified 93 threatened flora species occurrences (sites) as the basis of the in-situ monitoring program. This comprised 69 impact monitoring sites and 24 control sites (outside of the impact area). Two or three threatened flora species sites may occur in the same plot location. All sites monitored for pre-construction were established during the development of the project concept design.

During the 2020 construction/operation monitoring period some of the same sites could not be accessed from the first year of monitoring period due to continued landowner restrictions. The new control and impacts sites (added/replaced) established in 2017 were able to be accessed in 2020. This allowed for threatened species monitoring to continue. An additional site La-1.3a was established in 2018 to replace La-1.3 which hasn't been accessed since pre-construction. This was a result of new *Lindernia alsinoides* plants observed growing along the road verge adjacent to La-1.3. New *L. alsinoides* plants were also found in Elt-2.1, and a second site La-2.2 was established in 2018 to monitor these plants adjacent to the constructed highway.

A total of 79 sites are now monitored in the program comprising 60 impact and 19 control sites. Site locations are illustrated in Appendix A. Refer to the Construction Monitoring of In-situ Threatened Flora (non-rainforest flora) Annual Report 2017 for a description of replaced, removed, or added sites from 2017.

2.2.1 Decommissioned monitoring sites

A total of 25 sites have been removed from the monitoring program due to continued access restrictions at 10 sites, loss of 10 sites impacted within the detailed design construction footprint and other reasons for five other sites. Some sites have been replaced or duplicated where possible and are referenced in the annual report 2017 (Jacobs). The list of sites removed is shown in

Table 2-2.

Table 2-2 Sites removed from monitoring program

Site	Chainage	Reason/status	Site	Chainage	Reason/status
Elt-1.1	5700	Impact	Ar-3.10	66500	Impact
Elt-1.2	6200	Impact	Ar-3.11	67700	Impact
Elt-C1.1	6400	No access	Pe-4.2	80600	Impact
Elt-C1.2	6400	No access	Pe-5.1	83400	Impact
Elt-1.4	6700	No access	Emb-4.2	80700	Inadvertent impact
La-1.1	6200	Impact	Sp-4.1	80700	Not listed as threatened
La-C1.1	6400	No access	Sp-8.1	134900	Not listed as threatened
La-C1.2	6400	No access	Pc-6.2	101700	Impact
La-1.3	6700	No access	Pc-6.2a	101700	Monitored in translocation program
La-C1.3	6400	No access	Pc-C6.1	101700	Replaced with in-situ site
Mt-C1.1	4900	No access	Oc-8.1	132200	Impact
Mt-1.2	5700	Impact	Pa-9.1	144400	*Calanthe triplicata* - not listed as threatened
Mt-3.3	64300	No access	Ah-10.5	157600	Impact

2.3 Sampling methods

2.3.1 Targeted surveys and species detection

The long-term monitoring program (pre, during and post construction) is designed to ensure that different plant life stages and climatic conditions are targeted over multiple monitoring events and years. Surveys focus on monitoring the health and condition of known individuals as well as investigating plant recruitment. Detection of cryptic threatened flora was reliant on suitable climatic and seasonal conditions, particularly for *Cyperus aquatilis* and *Rotala tripartita*. Climate variability also has an effect on *Lindernia alsinoides*, *Lindsaea incisa* and *Maundia triglochinoides,* which rely on moist conditions. *Persicaria elatior* and *Arthraxon hispidus* have an annual life cycle and were only detectable at certain times of the year. *Persicaria elatior* would generally show signs of natural dieback in late autumn with few plants remaining in winter and seedlings would appear in late spring, depending on rainfall conditions. *Arthraxon hispidus* would dieback in winter and seedlings would appear in spring and begin to set seed in late autumn. *Cyperus aquatilis* and *Rotala tripartita* are also short-lived annuals and rely on wet summer periods.

The below average rainfall for several months preceding the 2020 surveys resulted in very dry conditions, particularly compared with 2017-2019. These conditions greatly impacted some of these species, particularly *Lindernia alsinoides* and *Persicaria elatior*, which were absent from many sites, including both impact and control sites.

2.3.2 Sampling technique

A 20 x 20 metre plot with a central 20 metre transect was used at each site following the same techniques carried out in previous years and in line with the TFMP. Where possible, transects were aligned from north to south. At each monitoring event a photograph was taken at the northern end of the transect looking along the transect. Additional photographs were taken of the general habitat condition, individual plants and/or clusters of plants, and where insect attack and plant dieback were noted.

A tape measure was laid along the plot midline to record habitat condition (vegetation cover and structure) and used as a reference for plant locations. Vegetation condition was recorded along the transect with the canopy and midstorey (greater than one-metre high) cover recorded as percentage foliage cover every five metres (four points) along the transect and groundcover attributes were recorded at every metre (20 points) as either forb, grass, shrub (less than one-metre high), bare/water, litter or exotic. The central transect was also used to describe the distribution of threatened flora within the plot. Weed species and their cover abundance was recorded within the whole plot.

Habitat condition parameters and plant health indicators were recorded within the plot and the transect and associated with individuals in relation to threatened plants. This included but was not limited to:

- Genus, species, and subspecies.
- Identifier – unique plant number.
- Location – location; easting, northing & description.
- General condition – score on a scale of 0 to 5, where 0 is dead and 5 is excellent.
- Leaf condition – healthy/unhealthy, colour, vigour.
- Flower/fruit – flower/fruit presence.
- Length of new shoots – average length of new shoots (estimate) and abundance of new shoots (counts or basic scale).
- Disease symptoms – evidence of disease (including presence / absence of Myrtle Rust, Cinnamon Fungus).
- Recruitment.

- Evidence of any other damage or disturbance.
- Plant community type.
- Canopy cover.
- Mid-storey cover.
- Ground-layer cover and composition.
- Weed cover of abundance and weed ground cover percentage.
- Recruitment of canopy and mid-storey species.
- Climatic events (e.g. drought, flood, unusually cold winter temperatures etc.).
- Maintenance carried out – when and what kind of maintenance carried out at the site since the last monitoring.
- Any other ecological impacts.

A quantitative measure of a subject plant's abundance and distribution within a plot was used for groundcover plants (and annuals) that are difficult to count and/or grow in large clusters. This method was adopted for *C. aquatilis* and *R. tripartita*. *L. alsinoides, L. incisa* and *M. triglochinoides.*

The technique involved the measurement of an area of occupancy (AoO) of subject plant's distribution within the plot and a series of 1x1 metre quadrats randomly placed within the AoO to either estimate percentage ground cover or count number of stems. Any plots with continual low abundances of individuals were directly counted. A measure of percentage cover was only used for *M. triglochinoides*. For *A. hispidus, C. aquatilis, R. tripartita*. *L. alsinoides and L. incisa,* stems (where present) and were directly counted within specified patches or mean number of stems determined in 1 x 1m quadrats for larger occurrences.

To account for consistent temporal changes in site abundance and occupancy (i.e. increase/decline), a standard method of recording cover/abundance was applied across the entire plot for each monitoring event. This was calculated by multiplying the mean percentage ground cover, or mean number of stems, by the division of the AoO over the plot size, i.e. ((AoO / 400m^2) x mean cover or stem count).

The remaining species of shrubs, trees and orchids were directly counted as per the TFMP. A summary of plant health and habitat condition factors was recorded based on observing leaf condition, any notable dieback or insect attack, plant height, width, diameter at breast height (DBH) for tree species, number of trunks and habitat conditions.

Weed cover was measured using a modified Braun-Blanquet cover abundance score (Braun Blanquet, 1928; Poore 1955), refer Table 2-3.

Table 2-3 Cover abundance score used for measuring weeds

Score	Description
1	Rare, few individuals present (three or less) and Cover <5%;
2	Common and cover <5%;
3	Very Abundant and Cover nearing 5% OR Cover from 5% to <25%;
4	Cover from 25% to less than 50%;
5	Cover from 50% to less than 75%;
6	Cover 75% or more

Other general information recorded at each plot included observations of the dominant flora species in each structural layer, prevailing site conditions (i.e. soil moisture, surface water levels and observed flow velocity for macrophyte species) and landscape parameters (i.e. landform, drainage, slope, and aspect).

2.4 Performance thresholds and corrective actions

The TFMP details an adaptive management approach to achieve management goals and mitigate impacts to in-situ threatened flora. The 2020 data is now relevant to the operational phase of the project has been analysed and interpreted to evaluate any impacts and the effectiveness of any management measures used. This is assessed in the context of the performance measures identified in the plan (refer to Error! Reference source not found. and Table 4-3).

Specific goals for mitigating impacts using performance thresholds and corrective actions during the operational phase for in-situ threatened plants are outlined in Error! Reference source not found. summarised from the TFMP.

Table 2-4 Mitigation measures and corrective actions for threatened flora during operation

Performance goals	Proposed mitigation measure	Monitoring/timing frequency	Trigger for corrective actions	Corrective actions
Zero mortality of retained in-situ threatened plant populations during construction and for three consecutive monitoring periods post-construction. Post the above period 80 per cent survival of tree, shrub, and herbaceous perennials after three years.	Clearly identify in-situ populations and exclusion zones. Implementation of weed management measures throughout operational period.	Threatened plant health monitoring and weed monitoring to occur as per Sections 8. Monitoring to occur annually of in-situ monitoring sites and control sites. Monitoring will occur for a minimum of three years post-construction (subject to achieving three consecutive monitoring periods as per MCoA D8 (k)).	Any mortality of in-situ threatened plants for the first three consecutive monitoring periods post construction. Post the above timeframe more than a 20 per cent decline for an in-situ threatened plant population over one monitoring event from the baseline (depending on species specific seasonal fluctuations).	Commence assessment of potential reasons for mortality, including natural events such as drought and fire within one month of trigger being identified. Review weed maintenance schedule within one month of trigger being identified. Identify potential threats, implement corrective actions, and modify monitoring as necessary. Offset any additional threatened plant impacts that have occurred as a result of the Project.

Performance goals	Proposed mitigation measure	Monitoring/timing frequency	Trigger for corrective actions	Corrective actions
At least 90 per cent of the plants planted as part of the revegetated areas have survived after the first year and 80 per cent after three consecutive monitoring events.	Regular maintenance activities such as watering, mulching, weed control and supplementary plantings as required as per the landscape design.	For the first twelve months monitoring will be monthly. It will then go to every 6 months for two years. Monitoring will occur in Spring/Summer to evaluate the success of revegetation against performance objectives.	Monitoring and maintenance activities not being undertaken. More than 10 per cent of plants have died after year one, and more than 20% have died after three consecutive monitoring events.	Within one month of the trigger review and update maintenance methods as required. Identify any other potential threats and implement corrective actions as required. Any failed areas to be reseeded within 6 weeks of trigger. Ongoing monitoring and maintenance undertaken until plant health and/or ecological condition of habitat has been maintained at 80% survival after three consecutive monitoring events.
Less than five per cent weed cover at retained in-situ threatened flora sites (end of monitoring program).	Implementation of weed management measures throughout operational period.	Threatened plant health monitoring and weed monitoring to occur as per Sections 8. Weeds will be monitored in proximity to in-situ flora populations annually. Monitoring will occur for a minimum of three years post-construction (subject to achieving three consecutive monitoring periods as per MCoA D8 (k)).	Weed cover increases by 10% from the baseline cover in areas surrounding in-situ populations. More than 30% weed coverage in revegetation areas.	Review weed maintenance program within one month of trigger being identified and update as required.

3. Results and discussion

3.1 Operational Year 3 monitoring (Section 1 and 2)

3.1.1 Square-stemmed Spike-rush (*Eleocharis tetraquetra*)

Searches for *E. tetraquetra* at sites Elt-1.1a (chainage: 5700), Elt-1.3 (chainage: 6600) and Elt-2.1 (chainage:14700) were undertaken on 13 and 14 October 2020. No plants were identified at any of the three plots in the 2019 survey and again in spring 2020. Refer to

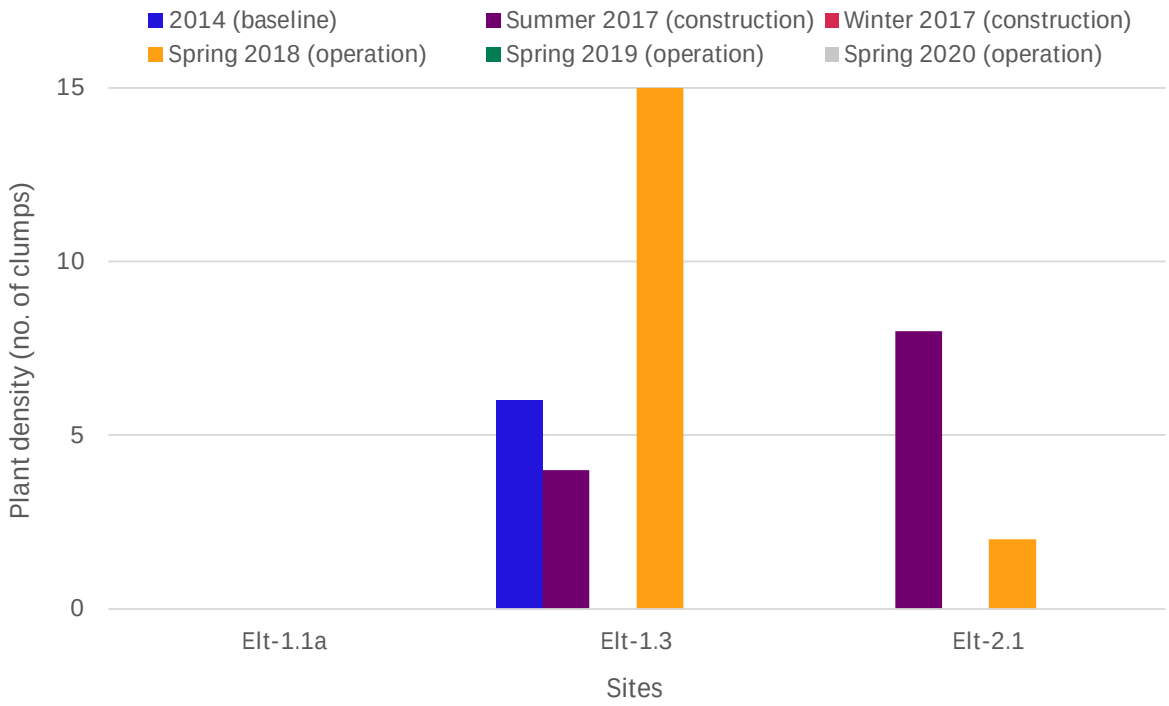

Figure 3-1.

The number of plants observed at these sites over the monitoring years has varied considerably in response to preceding rainfall and subsequent surface water levels. The apparent absence of *E. tetraquetra* in 2019 and the end of 2020 is likely to be directly related to the proceeding and persistent drought conditions and below average rainfall (approx. 50 percent of annual average) experienced in the region particularly in the seven months prior to the survey, resulting in the absence of surface water at each site.

Sediment transport through the adjacent culvert has ceased considerably at site Elt-2.1 since 2017 and numerous native shrubs have established. The mean mid-storey cover declined in 2020 compared with 2018/19 although weed cover has remained similar. The basin within site Elt-1.3 continues to hold sediment run-off from exposed soils, however the flow of sediment did not appear to be transported into habitat for threatened plants. Native macrophyte vegetation has re-established at the site and is capable of filtering sediment deposition. Weed cover abundance continues to remain similar over the monitoring years and is generally low.

No plants have been observed at Elt-1.1a since its establishment in 2017 due to the original Elt-1.1 being set up during baseline monitoring within the approved clearing boundary. An increase in grass cover (40 percent) and decrease in reed cover (30 percent) since 2017 was observed at site Elt-1.1a, possibly due to lower water levels. Sitting water was a grey colour, possibly leached from introduced rock situated around adjacent basin.

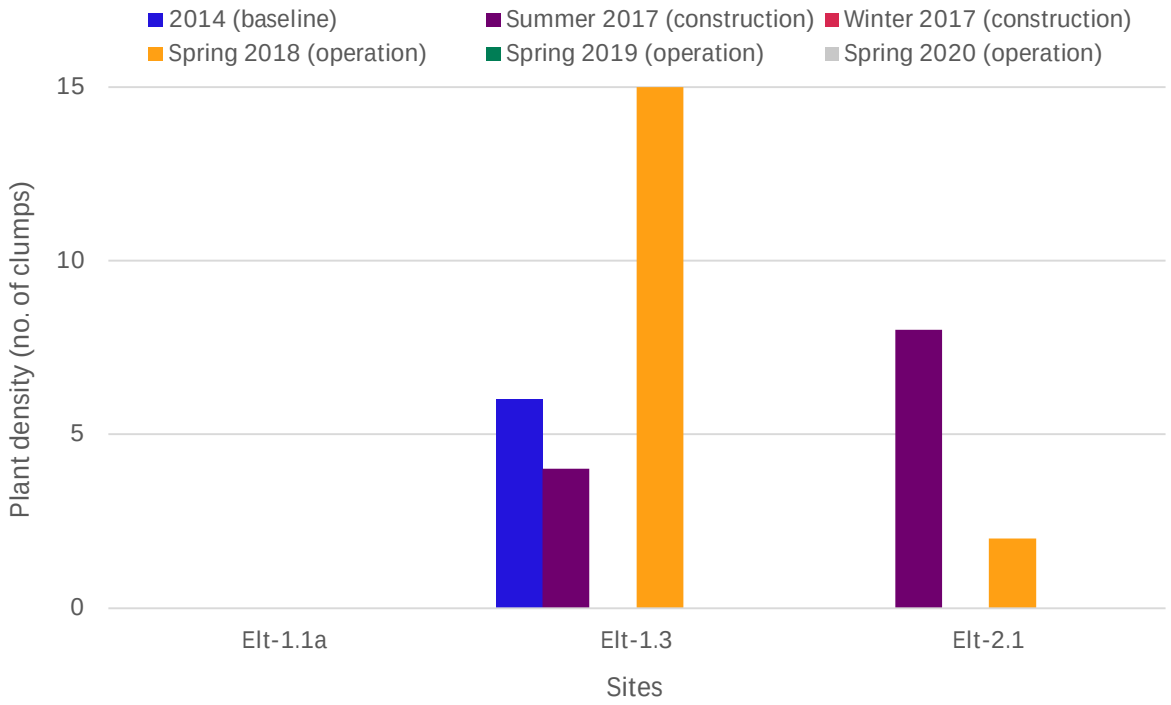

Figure 3-1 Number of clumps *Eleocharis tetraquetra* observed over six survey periods at three active in-situ monitoring sites (Elt-1.1a, Elt-1.3 and Elt-2.1). No baseline data exists for Elt-1.1a as the original site (Elt-1.1) was located within the approved construction boundary.

3.1.2 Square fruited Ironbark (*Eucalyptus tetrapleura*)

All sites were searched on 15 October 2020 except for Et-1.1. All sites (chainage: 9200-28400) demonstrated minimal to no change from 2019. The results recorded during the 2020 surveys identified an increase in 5 trees for Et-2.1, and an increase in 6 trees and decline in 3 seedlings for Et-2.2 in comparison to the 2019 data. Additionally, control site Et-C2.1 and in-situ site Et-2.3 remained the same. Refer to Figure 3-2 for changes in tree and seedling abundance over eight monitoring events.

Run-off is affecting site Et-2.3 (also observed during construction phase) and continues to wash away topsoil within the plot. The drainage pipe initially diverting water to site during construction has been removed, however flow of water from the constructed embankment adjacent to the site is evident during high rainfall. The loss of topsoil may impact on the success of seedlings to establish.

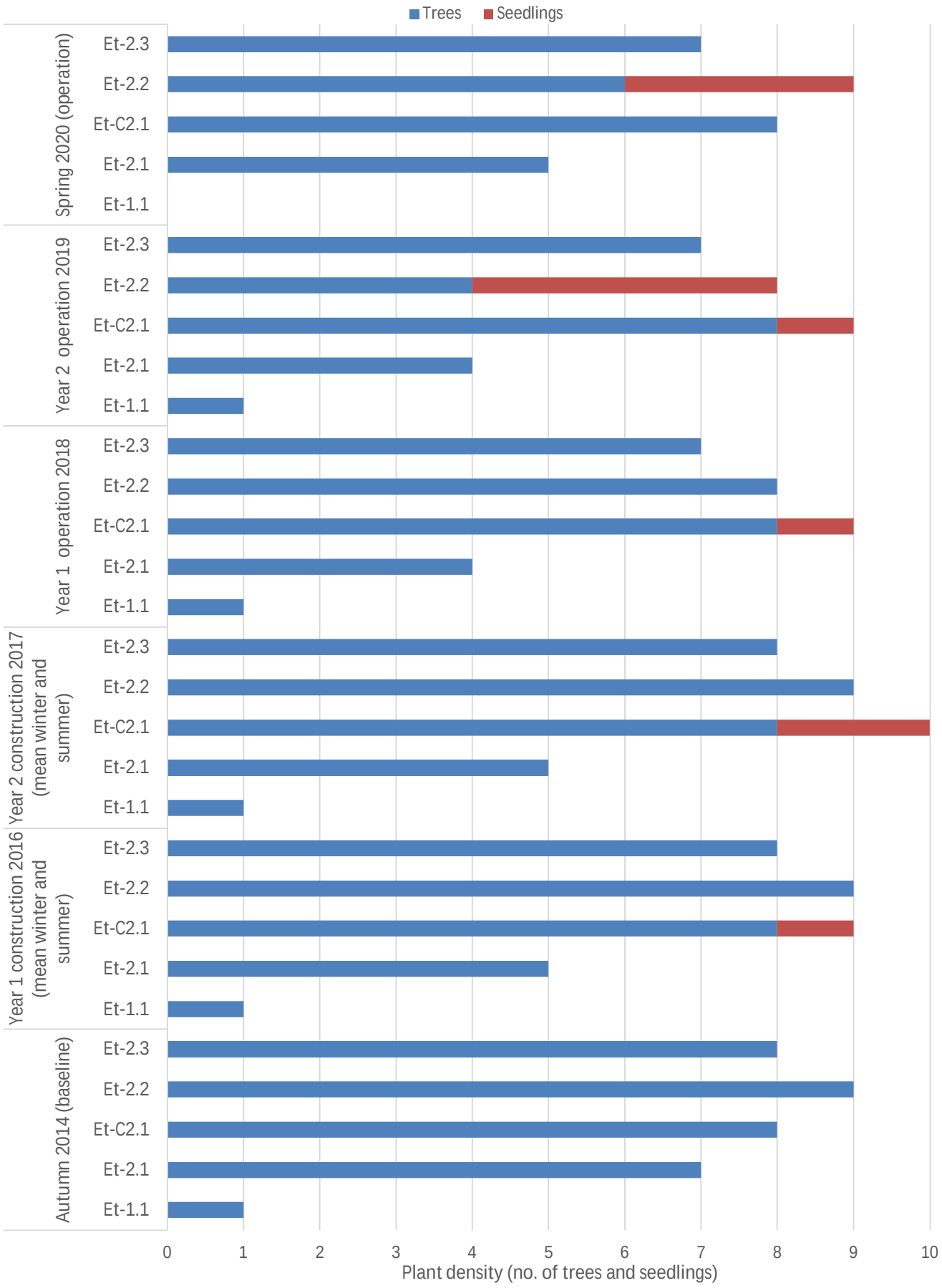

Figure 3-2 Number of *Eucalyptus tetrapleura* trees and seedlings observed over eight monitoring events in S.1 and 2. (mean results for 2016 (n=2) and 2017 (n=2)) at four in-situ sites and one control site.

3.1.3 Noah's False Chickweed (*Lindernia alsinoides*)

All accessible *Lindernia alsinoides* sites; La-1.2 (chainage:6600), La-2.1 (chainage:22400), La-C1.3a, La-1.3a (chainage:6700) and La-2.2 (chainage:14700) were searched on 13, 14 and 15 October 2020. Plants were not recorded at La-1.2, La-2.1 or La-C1.3a with no significant changes in plant density when compared with the results of 2019, except for the reduction in La-2.1 in 2020 (see Figure 3-3).

The two sites added in 2018, La-1.3a and La-2.2, also did not have any plants during 2020 surveys. These monitoring sites were added in 2018 in response to opportunistic observations of plants that may have grown in response to rain. The persistent dry conditions experienced in 2020 due to infrequent and lower than average monthly rainfall across several month prior to the survey (in contrast to historical average rainfall) is considered to be the likely cause of the absence of these species at all of these sites where previous detected. No impacts from construction or operational activities were identified.

Refer to

Figure 3-3 for changes in plant density over six monitoring events.

Figure 3-3 Density (mean no. of plants / m^2) of *Lindernia alsinoides* observed over six monitoring events at four in-situ sites and one control site. Data only exists for La-1.3a and La-2.2 from 2018 onwards when these sites were established.

3.1.4 Slender Screw fern (*Lindsaea incisa*)

All active *Lindsaea incisa* sites; Li-1.1, Li-2.1, Li-2.2 and Li-C2.1 in Sections 1 and 2 (chainage: 5000-17500) were surveyed during the operational phase on 14 and 15 October 2020. There was a slight increase in *L. incisa* mean cover at site Li-1.1 and a substantial increase at sites Li-2.1, Li-2.2 and Li-C2.1. All fern fronds were in mostly good health showing new growth, particularly at site Li-1.1, Li-2.1 and Li-C2.1.

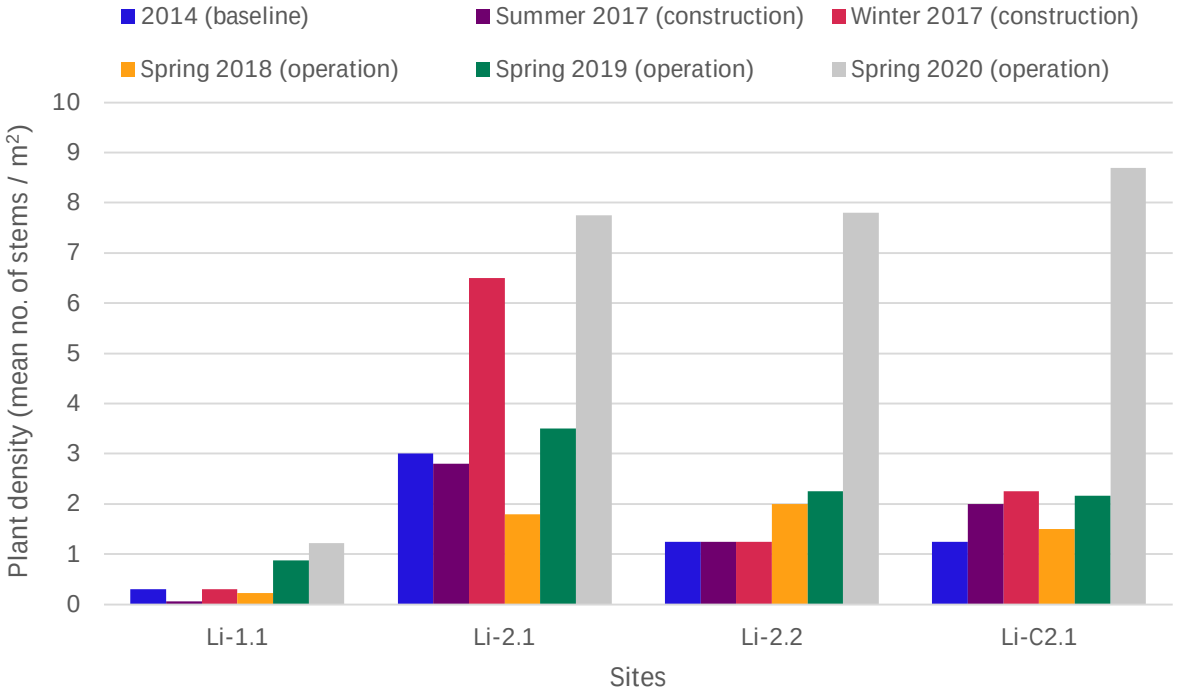

Figure 3-4 shows changes in plant density (mean percent cover) over the six monitoring events. There was an increase in density at the three impact and control sites compared with previous years. This could be attributed to reduced competition from grasses and understorey plants due to drier conditions.

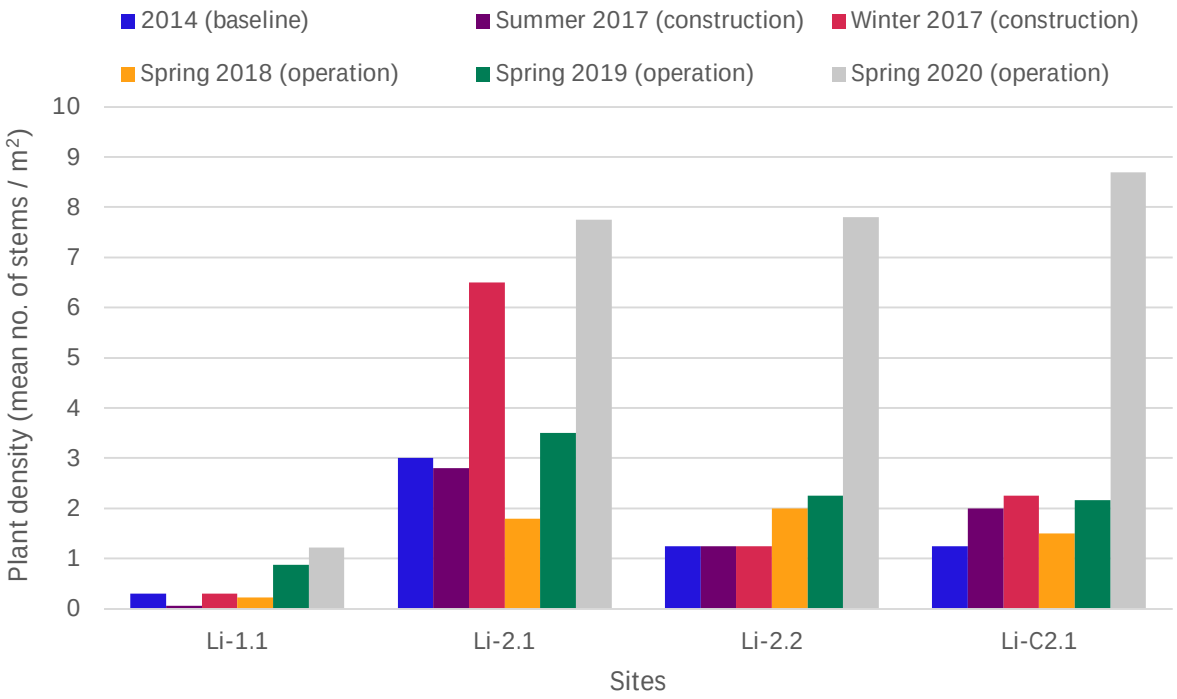

Figure 3-4 Density (mean no. of stems / m^2) of *Lindsaea incisa* observed over six monitoring events at three in-situ sites and one control site.

Photograph 3: *Lindsaea incisa* at Li-1.1

Photograph 4: High cover of *Lindsaea incisa* observed at site Li-2.1

3.1.5 *Maundia triglochinoides*

All active *Maundia triglochinoides* sites; Mt-1.1, Mt-1.2a, Mt-C1.2a, Mt-2.1, Mt-C2.1, Mt-2.2, Mt-C2.2, Mt-2.3 and Mt-2.4 in Sections 1 and 2 (chainage: 4900-22400) were surveyed during the operational phase on 13, 14 and 15 October 2020. Rainfall was below average in most months preceding survey in 2020 that caused a reduction in water levels though all sites maintained at least low-moderate water levels.

Plants were identified at all sites except Mt-1.1 (as per previous years), Mt-2.1 and Mt-2.3. Site Mt-1.1 continues to have no evidence of *M. triglochinoides*, even with broader searches beyond plot site. Cover of plants at Mt-2.1 was very low in 2018 (10 stems) with remaining plants growing on the outer edges of the creek. With dropping water levels this habitat has become unsuitable and the above-ground plant parts have died back. Presumably these plants continue to exist only as tubers in the soil and were not observed here in 2019 or 2020.

Cover of *M. triglochinoides* at Mt-2.3 was very low in 2019, with just one plant identified and has now completely disappeared during the 2020 surveys and the cover of surface water was very low. The largest decrease in cover was recorded at Mt-2.4, which doubled in cover between 2017 and 2018, though has now reduced by >80 percent and showed further decline in 2020. Despite this, new young shoots were noted, and the species is persisting at this location. This is likely in response to dropping water levels associated with the drought.

Overall, mean cover at most sites changed little from 2019. Where plants persisted, health was generally very good and new shoots noted. Some small increases in cover were recorded at Mt-1.2a, Mt-C2.1 and Mt-2.2.

Summary of mean percentage cover of *M. triglochinoides* is shown in

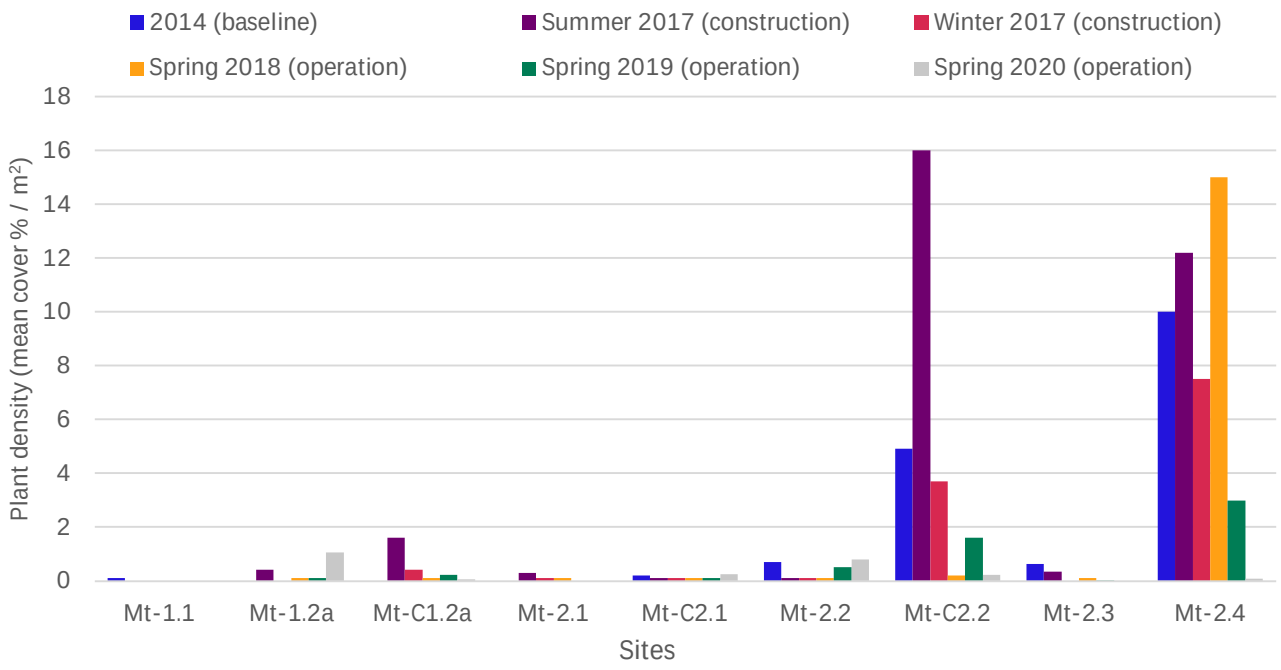

Figure 3-5.

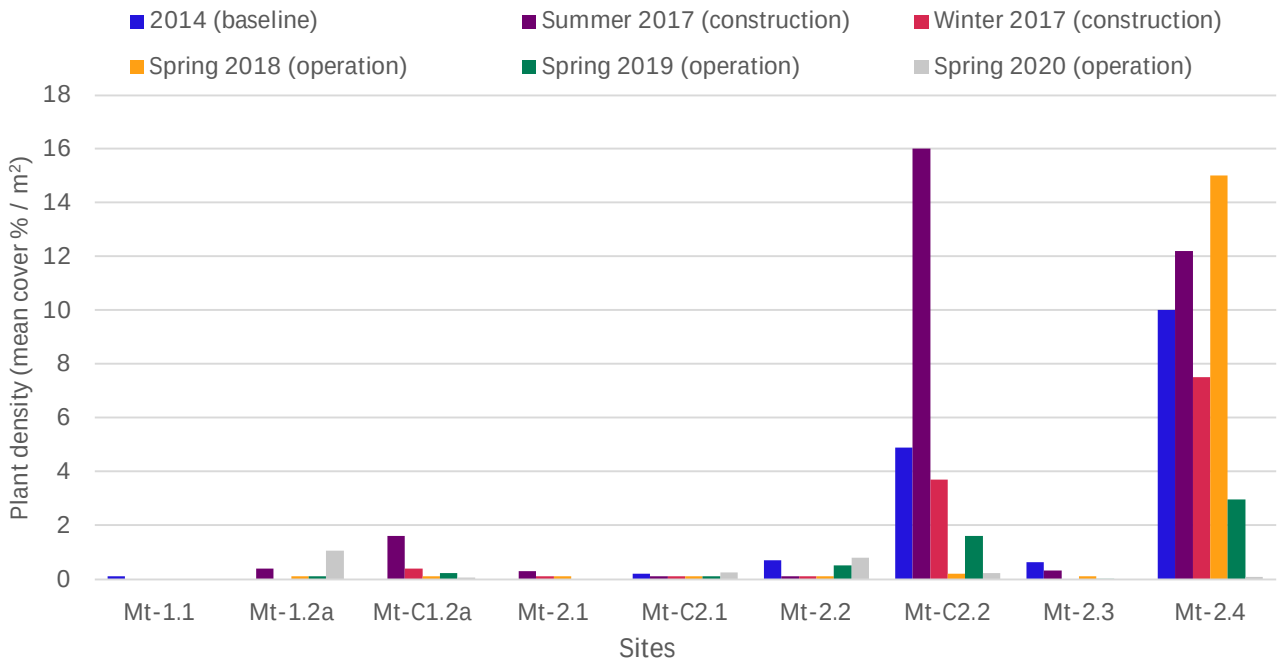

Figure 3-5 Density (mean cover % / m^2) of *Maundia triglochinoides* observed over six monitoring events at six in-situ sites and three control sites

3.1.6 Moonee Quassia (*Quassia* sp. Moonee Creek)

The two in-situ sites (Qm-2.1-Qm-2.2) and two control sites (Qm-C2.1-Qm-C2.2) (chainage:8000-8300) were surveyed on 14 October 2020.

The abundance of *Quassia* stems in the 2020 plots increased notably for both the in-situ impact sites Qm-2.1, Qm-2.2 and the control site Qm-C2.2, particularly in contrast to the 2018 and 2019 monitoring results. This increase was associated with evidence of recruitment through the presence of small juvenile individuals and new shorts on former dead stems. Most plants are in good health, and although insect browsing damage were

observed at some sites (Qm-1.1, Qm-2.1 and Qm-C2.1). New basal shoots were observed on several former dead stems at Qm1.1, which had previously been reported in 2018 and 2019 as dieback, subject to an unknown white substance obvious on the stems.

Leaf dieback was reportedly high at Qm-1.1 in 2019, with plants exhibiting missing leaves, insect damage and a white coverage on the stems of some plants, possibly a fungus. These conditions appeared less obvious in 2020, and several plants had new basal shoots from dead steams, indicating plant recovery (see Photo 5 and 6). Refer to Figure 3-6 for changes in tree abundance over seven monitoring events.

Photograph 5: *Quassia* sp. Moonee plant at Qm-1.1 showing basal shoots / recovery of plants after dieback in 2019

Photograph 6: *Quassia* at Qm-1.1 with new basal shoots from base of older dead stem

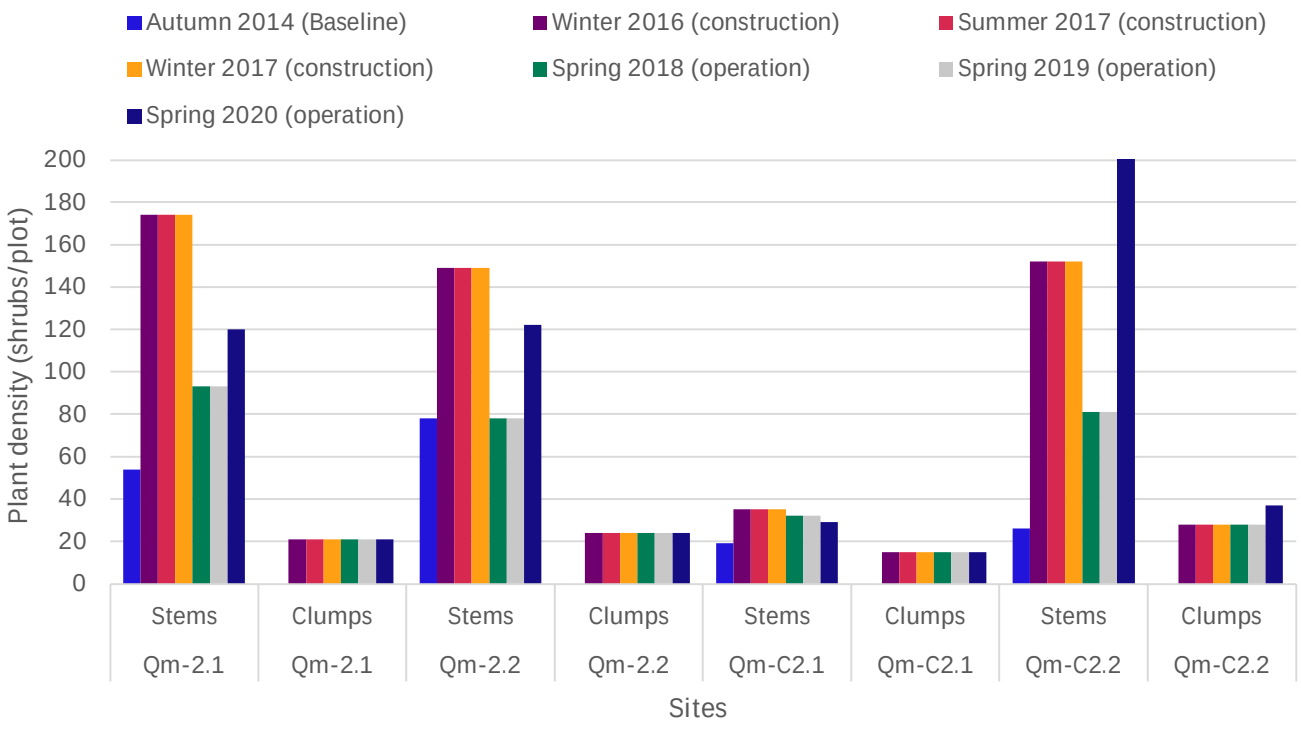

Figure 3-6 Clumps and stems counts of *Quassia* sp. Moonee Creek over seven monitoring events (baseline,

construction and operation) at two in-situ sites and two control sites. Only stem data was collected during baseline surveys.

3.2 Operational Year 1 monitoring (Sections 3-10)

3.2.1 Sandstone Rough-barked Apple (*Angophora robur*)

All thirteen *Angophora robur* sites (in-situ and control) (chainage:44600-67700) were surveyed on 15 and 16 October 2020, and on 4-6 November 2020.

The data from the Year 1 operation monitoring of *A. robur* recorded an increase in the number of plants across several sites, especially in relation to evidence of recruitment /new seedlings despite the previous drought conditions. The most notable changes in tree abundance from the 2020 surveys were at sites Ar-3.1, Ar-3.4, Ar-3.5 and Ar-3.6. Likewise, the most notable changes in seedling abundance from the 2020 surveys were at sites Ar-3.1, Ar-C3.1, Ar-C3.2, Ar-3.3, Ar-3.5 and Ar-3.6 (refer to Figure 3-7).

As noted from previous monitoring general plant dieback continues to be evident (since Year 1 construction monitoring) at sites Ar-3.4 and Ar-3.7 and associated with heat stress and / or caused by the epidemic infection of the root-rot fungus Cinnamon Fungus (*Phytophthora cinnamomic*), but this would need to be confirmed (refer to Photograph 7). Low average annual rainfall in the region has resulted in very dry conditions effecting many species including *A.robur* and evidence of controlled groundcover fires was noted (occurring around 2 months prior to the monitoring) at sites Ar3.3 and Ar3.4. these fires had cause minor impacts to smaller trees.

No baseline data exists for sites Ar-3.10a and Ar-3.11a that were established in 2017. Site Ar-3.10a was not surveyed in 2019 due to access restrictions (high fencing) and construction activities. This site was surveyed in 2020 and *A.robur* found to be in good to very good condition in a range of size classes with multiple recruits of small trees 15-30cm in height.

A summary of all in-situ and control A. robur sites is presented in Figure 3-7.

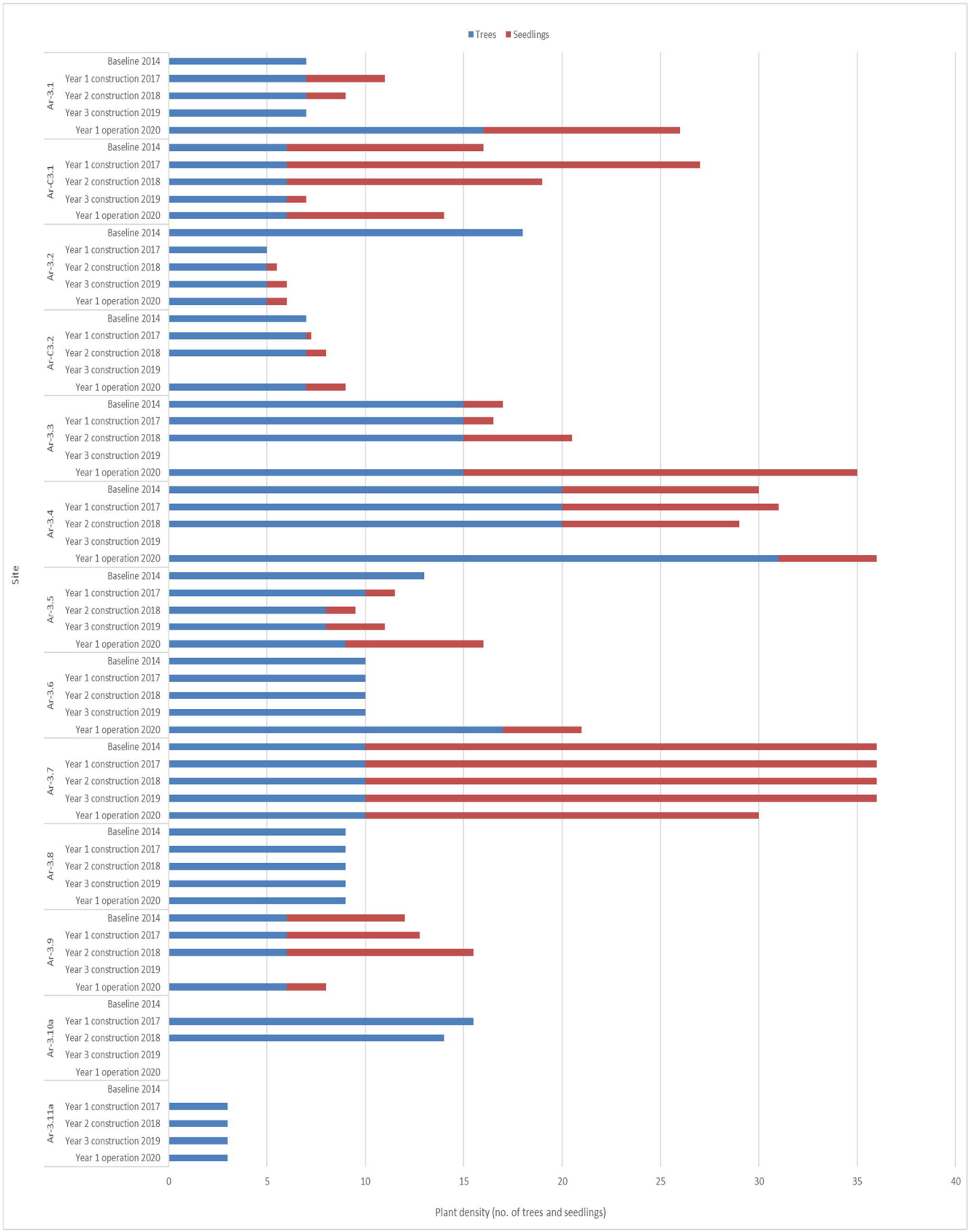

Figure 3-7 Number of *A. robur* trees and seedlings observed over eight monitoring events (2014 [n=1], mean results for 2017 [n=4], mean results for 2018 [n=2], annual results for 2019 and 2020, at eleven in-situ sites and two control sites).

3.2.2 Hairy-joint Grass (*Arthraxon hispidus*)

All six *Arthraxon hispidus* in-situ sites (chainage:129300-157900) and two control sites (chainage:157200-157500) were surveyed on 8 and 9 November 2020. This considers the removal of Ah-10.5 from the monitoring program as it was located within the detailed design boundary.

A. hispidus was detected at two sites (Ah-8.1 and Ah-10.1) and absent from six (Ah-10.2, Ah-10.3, Ah-10.4, Ah-10.6, Ah-C10.1, Ah-C10.2) from the 2020 surveys. This is consistent with the 2019 monitoring data. The average number of stems per square metre where *A.hispidus* was present was slightly higher for both these plots. Plants observed in Ah-8.1 were up to 30 cm in height and all in good condition. Additionally, plants observed in Ah-10.1 were up to 10 cm in height and all in good condition. No flowering plants were observed at either of these sites. *A. hispidus* is an annual species that naturally dies back each year and the abundance of plants observed at the sites surveyed as part of this monitoring program have fluctuated since baseline surveys (referError! Reference source not found.). These observations in 2020 are considered primarily the result of below average rainfall and dry conditions experienced in preceding months leading up to the 2020 surveys (refer Figure 2-3). This would account for the absence of plants from Ah-10.1 and Ah-10.2 where plants where present in 2019.

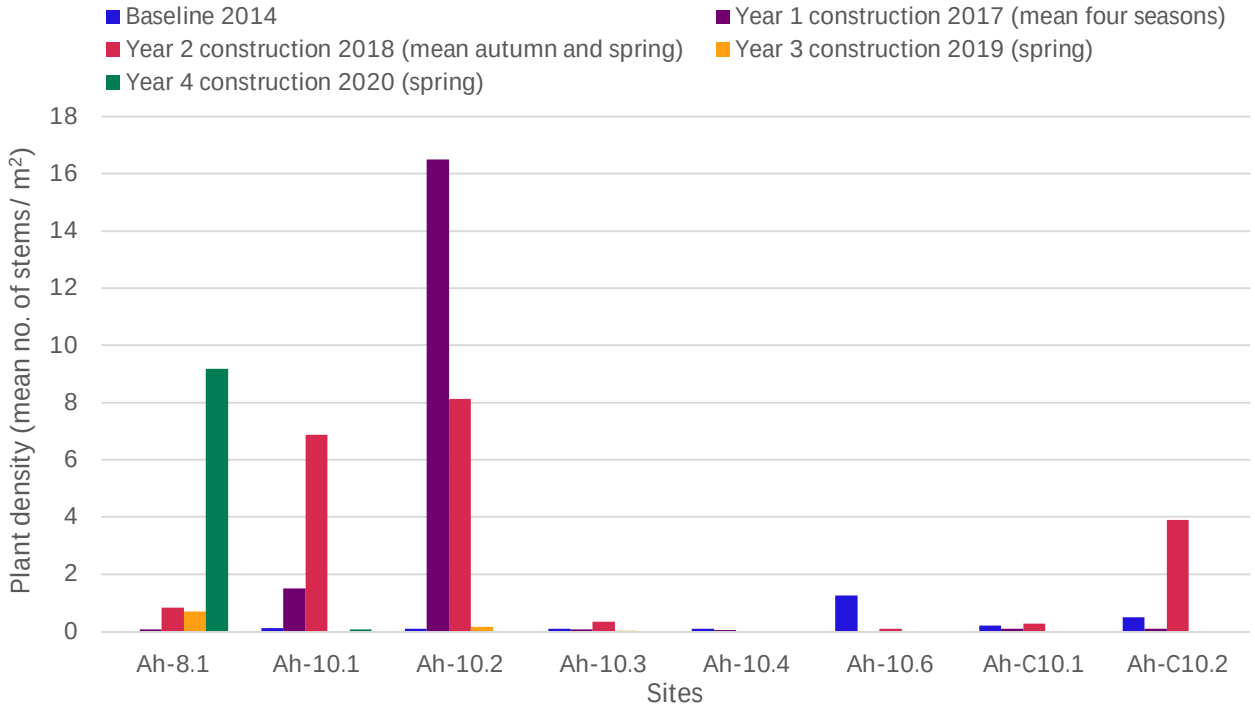

Figure 3-8 Density (mean no. of stems / m^2) of *Arthraxon hispidus* in each plot observed over eight monitoring events at six in-situ sites and two control sites

Competition with other plants continues to be a threat to *Arthraxon hispidus*. This is primarily by exotic species such as *Ageratum houstonianum* and *Commelina benghalensis* forming dense groundcover. This is particularly evident at sites Ah-C10.2 and Ah-10.4, where it appears *Arthraxon hispidus* plants are being out-competed. Similarly, this is also happening at Ah-C10.1 with the native grass *Leersia hexandra*. This is most likely occurring as the wetland around the upper reaches of Saltwater Creek is slowly drying out, a product of drought conditions in 2018-2020. Though this problem may also be exacerbated by the removal of cattle from these properties, which have been previously managed through grazing. Cattle removal has occurred in some locations during the construction period. Table 3-1 shows the change in weed cover and number of weed species for all sites over all monitoring periods. This impact is not project related.

Table 3-1 Comparison of weed abundance ground cover and species richness) at Arthraxon hispidus monitoring plots (pre-construction, construction, and operational periods)

Site	Mean weed ground cover (%) / weed richness (No. spp.)						Change (%) in mean weed ground cover (baseline vs construction) / baseline vs operation (+/-)	Difference in no. of weed species (cons / oper (+/-)	Detailed design impact
	Pre-construction	Construction Year 1	Construction Year 2	Construction Year 3	Construction mean	Operation Year 1			
Ah-8.1	100/1	67.5/8	82.5/8	100/8	83.3	80/5	-16.7 / -20.0	+7 / +4	No
Ah-10.1	100/2	99/10	100/10	100/11	99.7	100/10	-0.3 / 0.0	+4 / +8	No
Ah-C10.1	20/1	31.5/4	15/4	0/4	15.5	19/3	-4.5 / -1.0	+3 / +2	No
Ah-10.2	85/3	75/3	57.5/10	80/10	70.8	100/3	-14.2 / +15.0	+7 / +0.	No
Ah-C10.2	20/3	35/8	40/8	95/8	56.7	100/8	+36.7 / +80.0	+5 / +5	No
Ah-10.3	65/3	82.5/11	77.5/11	80/11	80	75/5	+15 / +10.0	+8 / +2	No
Ah-10.4	75/6	64/9	65/5	65/9	64.7	65/5	-10.3 / -10.0	+3 / -1	No
Ah-10.6	65/2	96/9	100/9	100/9	98.7	100/5	+33.7 / +35.0	+7 / +3	No

Photo 7: Plot Ah10.3 Exotic species (*Commelina benghalensis*) dominating the plot and outcompeting Arthraxon hispidus.

Photo 8: Dense matting of exotic and native perennial grasses plants outcompeting Arthraxon hispidus. This is Ah-C10.1, and this situation was observed at a number of impact and control sites.

3.2.3 Water Nutgrass (*Cyperus aquatilis*)

No *Cyperus aquatilis* individuals were recorded from the monitoring plot in the spring 2020 survey, and this is consistent with previous years. This species is best detected during summer and autumn where climatic conditions are most suitable. Rainfall in the region was below the annual average (refer to Figure 2-3) and this is likely to have contributed to this species' absence from the site. Although individuals have not been detected since the baseline surveys, and its absence from the site is not considered to be related to the project, but rather

a change in conditions associated with surface hydrology and weed abundance, which occurred prior to construction. Furthermore, exotic groundcover decreased from 80 percent in 2019 to 14 percent in 2020 which is due to the new location of the transect occurring south to north ending at the creek enabling data to be captured for this species.

3.2.4 Green-leaved Rose Walnut (*Endiandra muelleri* subsp. *bracteata*)

Site Emb-4.2 consisted of one mature *Endiandra muelleri* subsp. *bracteata* shrub, which was inadvertently removed by a construction contractor in January 2019. The contractor is required to implement a Remediation Plan to address corrective actions. Site Emb-4.2 has now been removed from the monitoring program.

Emb-4.1 (chainage: 81700) was surveyed on 4 November 2020. The single individual *E. muelleri* subsp. *bracteata* at site Emb-4.1 is in good health with new growth observed. Insect activity and browsing on leaves continues to be observed including caterpillar, moth, ant, and aphids. Leaf insect damage has been noted since the start of the program but hasn't caused detrimental harm to plant. The *E. muelleri* shrub was observed in 2018 being smothered by Dutchmen's Pipe (*Aristolochia elegans*) climber weed, however weeds works have been undertaken and flagging has been re-established around the shrub. The amount of sunlight entering this site has increased from vegetation clearing during construction to the south (inside the project boundary) and dieback of Flooded Gum (*Eucalyptus grandis*) tree canopy, suspected to be caused by irregular roosting of Flying Foxes. The increased sunlight to the groundcover was potentially the cause of increases in weed cover. No recruitment of *E. muelleri* subsp. *bracteata* was observed.

Photo 9: E. muelleri subsp. bracteata at in-situ site Emb-4.1 showing insect browsing on older leaves

Photo 10: New growth on E.muelleri subsp bracteata.

3.2.5 Four-tailed Grevillea (*Grevillea quadricauda*)

Both in-situ site Gq-3.1 (chainage:59300) and control site Gq-C3.1 (chainage:59500) were surveyed on 4 November 2020.

In-situ site Gq-3.1 sits on the edge of the forest, and much of the plot is exposed to increased sunlight from clearing for the project. This has resulted in good recruitment of new individuals. The plot had seven adult *G. quadricauda* plants and seven juvenile plants in 2020. Observations of plant recruitment, seed dispersal and seedling mortality have varied over the years of monitoring. There were 24 seedlings counted in autumn 2018, 21 seedlings in November 2018, 20 in October 2019 and 7 in November 2020. Some recruits from this period have now been counted as adult plants and there are now 7 adult plants recorded in 2020. Some mature plants on the edge of the plot showed dieback in leaves, perhaps because of dry conditions and competition. The old track is becoming overgrown with Broad-leaved Paspalum (*Paspalum mandiocanum*) and native shrubs and Monterey Pine (*Pinus radiata*) have continued to increase the mid-storey and canopy cover on site.

Gq-C3.1 increased from seven individuals in 2019 to 12 individuals in 2020 surveys, this accounted for 5 juveniles. Plant height ranged from 30 cm to 2 m with occurrence of flowering and new shoots. Overall plants were in excellent condition.

A summary of *G. quadricauda* plant numbers at monitoring sites is presented in Figure 3-8.

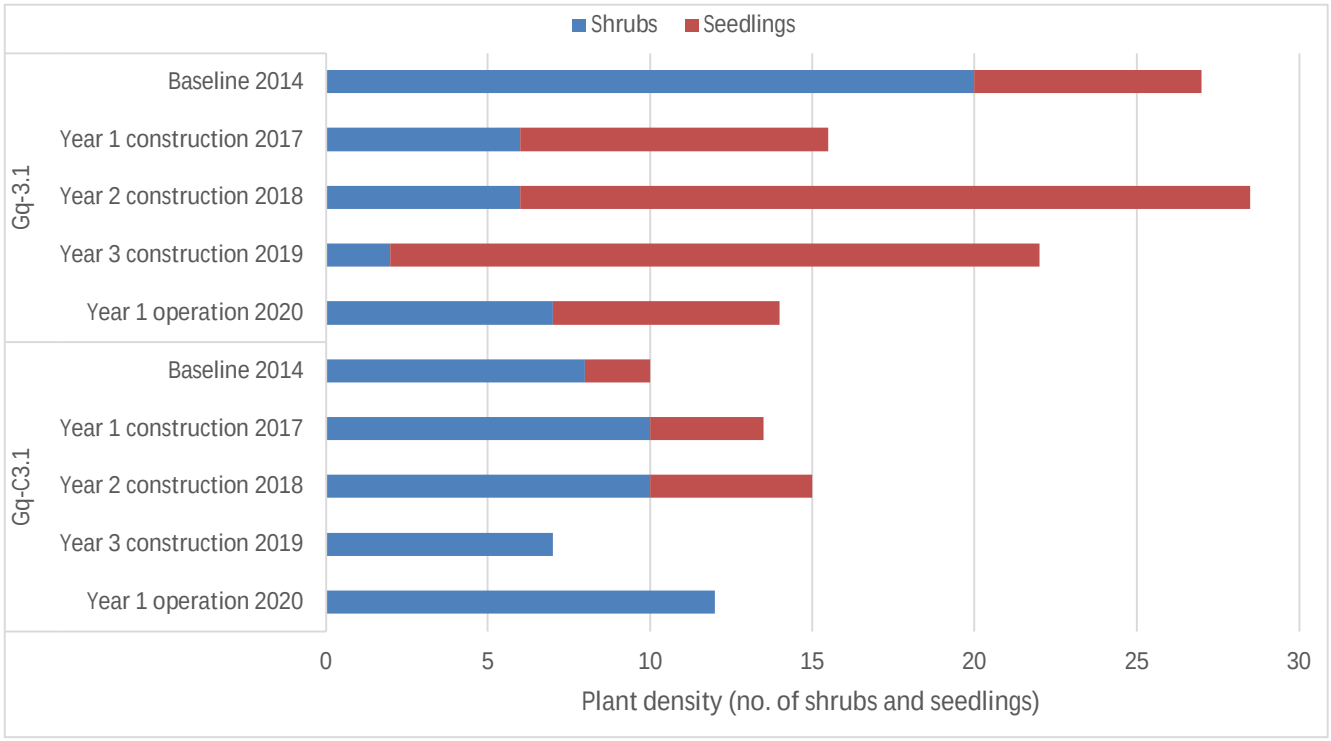

Figure 3-8 Number of *G. quadricauda* shrubs and seedlings observed over nine monitoring events (2014 [n=1], mean results for 2017 [n=4], mean results for 2018 [n=2], 2019 [n=1] and 2020 [n=1] at in-situ and control site).

3.2.6 Slender Screw Fern (*Lindsaea incisa*)

Year 4 construction monitoring was conducted between 3-7 November 2020 for in-situ sites Li-3.1, Li-3.2 (chainage:55800-60200), Li-6.1, Li-6.2 and, control site Li-C6.1 (chainage:98600-99300).

In-situ site Li-3.1 has exhibited a large increase in area of occupancy over the plot in 2020 compared with 2018 and 2019 surveys. This site was directly impacted by the approved detailed design work prior to autumn 2018 survey with the construction of a man-made drainage line in the middle of the site, which resulted in some loss of ferns. The decrease in areas of occupancy to just 0.5 m^2 observed during 2019 surveys is possibly a result of a combination of this impact plus the dry conditions. Since this impact, there has been strong recovery of plants observed in spring 2020 and there are no further construction impacts occurring at the site.

In-situ site Li-3.2 has also substantially increased across all sites in the area of occupancy of *L. incisa* from 10 m^2 in 2019 to 113 m^2 in 2020, though the number of stems counted was higher which resulted in an increase in estimated cover within the plot from November 2020. *L. incisa* ferns were in excellent health during Year 1 operation.

Mororo State Forest had experienced a very hot fire in November 2019, subsequently no plants were observed at monitoring locations Li-6.1 and Li-6.2 within the State Forest in Section 6 during the 2020 surveys and there was no post-fire recovery here. Prior to this no plants were recorded in 2019 prior to the fire, during a drought phase and the environmental conditions at these sites are thought to have led to the decline rather than clearing for the project. Indeed, these observations are expected to be a result of lower than average rainfall in the region in both 2018 and 2019, followed by the hot fire in late 2019. This species is likely to be sensitive to the very low rainfall trends and these observations are unlikely to be a project-related impact.

In contrast however, plants at the control plot to the south (Li-C6.1) had recovered following the fire. No plants were recorded at the plot in 2018 and 2019, although and area of 30 m^2 of the plot contained young plants that were recorded in November 2020, 12 months after fire. It is unsure why plants have re-appeared at the control plot compared with the two nearby impact plots.

Summary of mean percent cover for all *L. incisa* sites is presented in Figure 3-9.

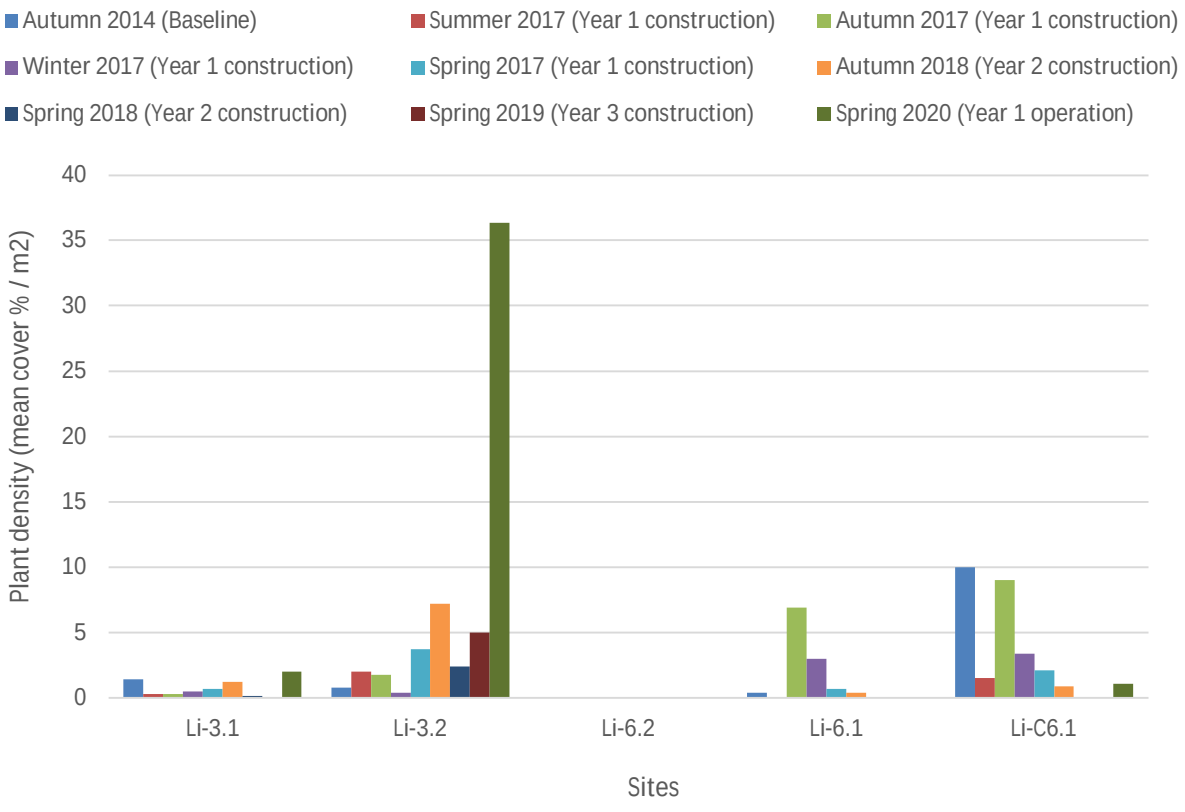

Figure 3-9 Density (mean no. of stems / m^2) of *Lindsaea incisa* observed over nine monitoring events at four in-situ sites and one control site.

3.2.7 Rough-shelled Bush Nut (*Macadamia tetraphylla*)

There was no notable change in health of the *Macadamia tetraphylla* tree or change in weed cover over the first year of operational monitoring at Site Mac-8.1 (chainage: 134700). As per monitoring in 2019, the tree was not flowering or fruiting at the time of the survey and there was no evidence of old fruit around base of tree. Weed cover remains high with 70% mean cover in the plot and a total of 13 weed species. Four weeds species have a high cover of abundance including *Senecio madagascariensis*, *Cenchrus clandestinus*, *Bromus catharticus*, *Cirsium vulgare* and *Bidens pilosa*.

3.2.8 *Maundia triglochinoides*

Monitoring was conducted on 15 and 16 October 2020 for in-situ sites Mt-3.1, Mt-3.2 and control site Mt-C3.1, and on 8 November 2020 for in-situ sites Mt-7.1, Mt-7.2 and Mt-7.3.

Changes in mean cover and area of occupancy of *M. triglochinoides* occurred at all impact and control sites compared with the final year of construction (2019), and these annual fluctuations are likely associated with changing hydroperiods of ponds and creeks where the species is found. In particular, while below average rainfall conditions were experienced between November 2019 and November 2020, a large rainfall event occurred in February 2020 which only lasted a few days. For species such as Maundia, these rapid high rainfall events may dislodge plants and account for changes in areas of occupancy at monitoring sites. The depth of water will change the micro-habitat conditions for the species, which prefers shallow ponded environments and edges of pools and dams.

For example, no plants were found at the control site Mt-C3.1 during 2020 surveys. Control site Mt-C3.1 had a large decrease in cover of *M. triglochinoides* from 150 m^2 area of occupancy in 2018 to 0.5 m^2 in 2019 and plants appeared absent in 2020. The species was observed around 50 metres from the plot persisting in a ponded section of the creek. As above-ground plant parts of have dieback, presumably *M. triglochinoides* continue to exist only as tubers in the soil until sufficient water returns.

In contrast, plants at the in-situ site Mt-3.2 exhibited a small increase in mean percent cover during 2020 surveys compared with 2019, covering 1.4 % of the plot.

The cover of Maundia at the in-situ site Mt-7.1 decreased by around 30 % mean percent cover from 2019 to 2020. This may be related to a large hot fire which passed through the habitat in November 2019 plants being dislodged. There was evidence of plants at the edge of the pond being burnt.

The recovery of the *M. triglochinoides* population at in-situ site Mt-7.2 from inadvertent indirect impacts during Year 1 construction in 2017 has increased from 2018. Surveys in 2020 recorded an area of occupancy of 28 m^2 which is very similar to 2018 and a large improvement from early 2018 being over three times the area of occupancy from early 2018 period with the mean percentage cover of plants across the plot continuing to increase over the last 3 years within the plot of 1.9 percent. The plants observed at Mt-7.2 in 2020 were healthy and in flower.

There was a continued decrease in mean percent cover of *M. triglochinoides* at in-situ site Mt-7.3 during Year 1 operational monitoring as was noted in 2019 and compared with the baseline and early construction phase monitoring. The area of occupancy has decreased by 75% since 2018 and related to construction impacts associated with increased shading from the new bridge. As a result, the *M. triglochinoides* area of occupancy within the plot has decreased by almost 75 percent from November 2018. With dropping water levels, plants along the edges are susceptible to dieback. Most of the remaining population is healthy and a moderate proportion of plants were in flower in 2020, indicting the plants are persisting in the area and may expand into other areas of the waterway away from the shaded bridge. These plants are located in the approved construction corridor.

Summary of mean percent cover for all *M. triglochinoides* sites is presented in

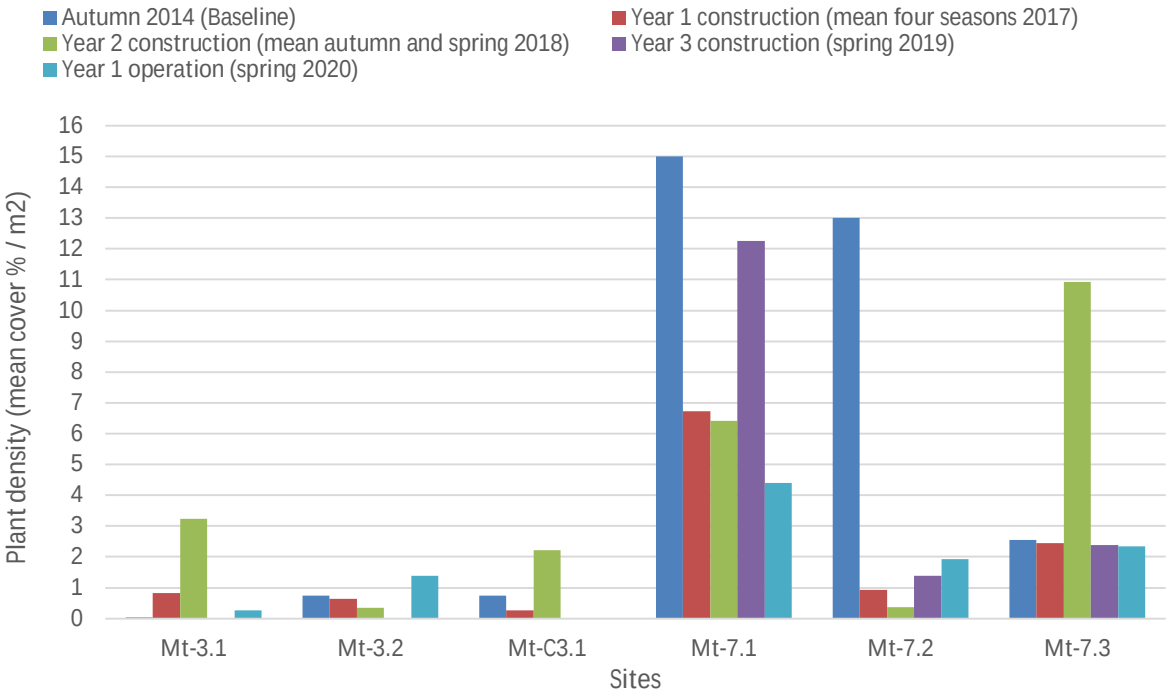

Figure 3-10.

Photograph 11: Pre-construction phase at in-situ site Mt-7.2 showing healthy population of *M. triglochinoides* (May 2014)

Photograph 12: Year 1 operational phase at in-situ site Mt-7.2 showing gradual recovery of *M. triglochinoides* core population (November 2020)

Photograph 13: Year 1 operational phase at in-situ site Mt-7.1 showing good recover following hot fire in November 2019 which burnt through Tabbimoble State Forest.

Photograph 14: Year 1 operational phase at in-situ site Mt-7.3 showing population has contracted from the bridge footprint in rear of the photo

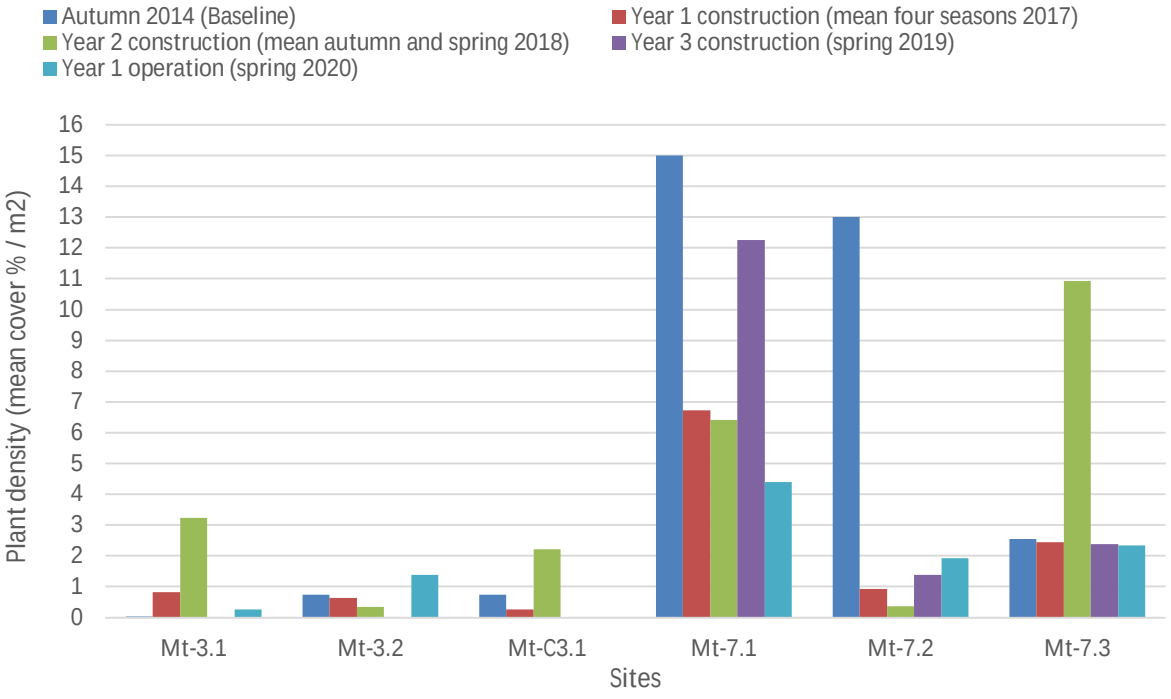

Figure 3-10 Density (mean cover % / m^2) of *Maundia triglochinoides* observed over nine monitoring events at five in-situ sites and one control site

3.2.9 Swamp Tea-tree (*Melaleuca irbyana*)

All active sites for *Melaleuca irbyana* were surveyed on 9 November 2020. All impact and control plots had severely burned from a large wildfire in November 2019. Very few trees were actually killed from the fire and the species was showing good signs of post-fire recovery such as basal resprouting, coppice growth and new germination of plants that had spread seed post-fire, demonstrating the species resilience to fire. The abundance of *M. irbyana* during the 2020 surveys increased at in-situ site Mi-7.1 (chainage: 120800) by 16 trees and Mi-7.2 (chainage: 120900) increased by one tree each in contrast to 2019 surveys. Plants damaged by falling trees during construction activities at in-situ sites Mi-7.1 and Mi-7.2 in April 2018 continue to recover with new growth. The control site Mi-C7.1 (chainage: 120800) increased by 15 trees during the 2020 surveys in comparison to 2019.

Photo 15: Melaleuca irbyana observed in year 1 operational phase survey (November 2020) at in-situ site Mi-7.1. Smaller individuals like this were killed in the 2019 fire

Photo 16: Good post-fire recruitment of M. irbyana was noted in impact and control plots demonstrating the species resilience to fire.

3.2.10 King of Fairies (*Oberonia titania*)

Both in-situ site Ot-10.1 and control site Ot-C10.1 (chainage:152300) were surveyed on 9 November 2020. The in-situ site (Ot-10.1) occurs on the edge of the forest clearing adjacent the highway. The plot is in an area close the edge of the cleared project corridor and there is increased light and solar exposure, and conditions were drier than the internal forest where the control plot is located (Ot- C10.1).

There has been a slight decrease in *O. titania* plant numbers and plant condition at the impact site. While it is difficult to quantify there appear around 7-10 less individuals than previous construction surveys and some of the remaining plants appear in poor condition due to desiccation, with some plants yellowing and others having dead plant material (see photo 17). This impact may be related to the dry conditions in proceeding months, however plants at the control site are located >100 m further east away from the forest edge and are in healthy condition, where no desiccation was noted, and this suggests that the edge effect along forest clearing has indirectly contributed to the noted impacts. Plants at the control site were in very healthy condition, and several

noted in seed having recently completed flowering. A count of plants at the control showed two clumps less than the 2019 survey, although recruitment was also noted in some clumps.

Photo 17: Oberonia titania on edge of forest clearing at in-situ site Ot-10.1 showing desiccation, likely from greater exposure to increased sunlight ad dry conditions

3.2.11 Tall Knotweed (*Persicaria elatior*)

Data was collected for *Persicaria elatior* on 5 November 2020 for in-situ sites Pe-4.1, Pe-4.2a and Pe-5.1, and control site Pe-C4.1.

P. elatior was not recorded at any of the impact and control sites during the November 2020 (Year 1 operational monitoring). And this is consistent with the absence of plants in November 2019. The abundance of plants at all sites has been in a general trend of decline over the monitoring program and the drought conditions has indirectly impacted species presence and abundance over this time, as well as grazing impacts at some sites. The highest number of plants recorded at each site was during baseline surveys. Further to this, all sites exhibited an increase in exotic species cover.

These changes are most likely directly related to the lower-than-average annual rainfall the region has experienced in four of the last six years, as opposed to above average annual rainfall in the four years prior to baseline surveys (refer Figure 2-4). Particularly low rainfall in Year 3 construction monitoring (Grafton Research Station received 31 percent of the historical annual average in 2019 – refer Error! Reference source not found.) resulted in the eventual drying out of standing water at all four monitoring sites.

These declines are not project related. Refer to Figure 3-11 for a summary of results.

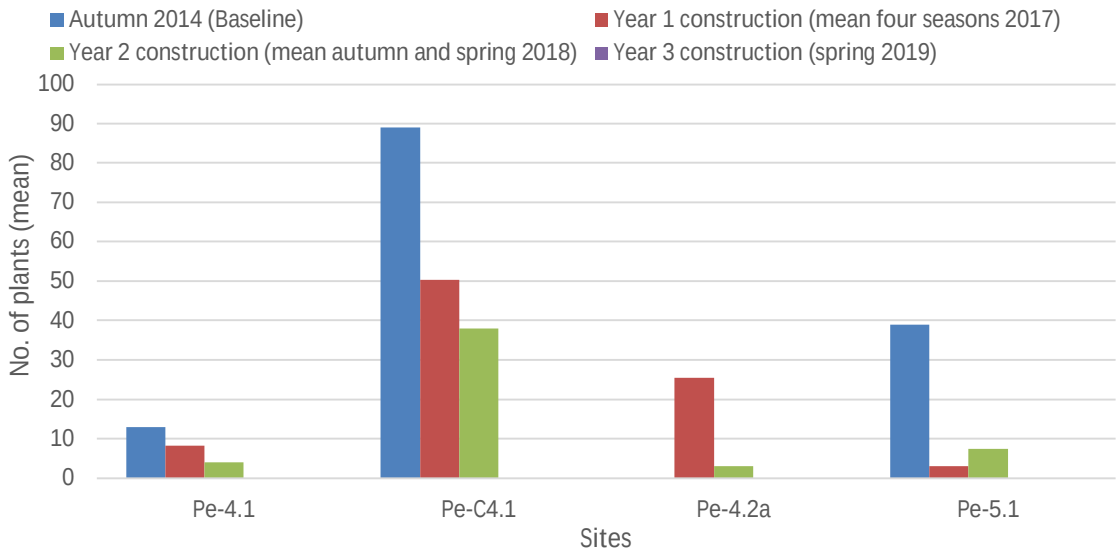

Figure 3-11 Mean number of *Persicaria elatior* plants over nine monitoring events (baseline and construction) at three in-situ sites and one control site. No baseline data exists for site Pe-4.2a as it was added in 2017.

3.2.12 Singleton Mintbush (*Prostanthera cineolifera*)

Both the in-situ (Pc-6.1) and control (Pc-C6.1a) (chainage: 101700) were surveyed on 8 November 2020. These sites were impacted by a hot fire 12 months prior (November 2019) and were in state of recovery with recruitment of new plants evident across both plots. The number of adult plants at Site Pc-6.1 has decreased by around 60 % from the 2019 count, and this is associated with mortality from the fire. Of the count of 21 plants in the plot, over 50 % were vigorous juveniles germinated post-fire demonstrating the species resilience to fire and the resulting stimulation of seed and germination success.

Similarly, twelve months after the fire, the control site Pc-C6.1a exhibited a reduction in plant numbers and cover by around 75 % compared to the 2019 survey. However, greater than 50 % of the plants that were present were healthy juveniles that had established post-fire, and this compared with the previous count of juveniles being <1 % of total plants in 2019.

Wilting of the leaves of some mature *P. cineolifera* plants was observed at both sites and this is likely a short-term response to the hot and dry conditions and lack of rain prior to the survey.

Lantana camara cover and abundance remains low at both sites. Cover of exotic species is generally low at both sites.

No construction-related impacts affecting *P. cineolifera* were identified.

3.2.13 *Rotala tripartita*

Both *Rotala tripartita* in-situ sites Rt-6.1 and Rt-6.2 were surveyed on 8 November 2020. No plants were recorded at either site. The drainage line at in-situ site Rt-6.2 was completely dry, and most wetland species had been replaced by pasture species due to cattle grazing. Plants have not been recorded since April 2018, when the last of the small population were observed at Rt-6.2. It is understood that individuals of this population were removed in 2017 as part of the project translocation program (Benwell 2019). This population likely exists most of the time in the soil seedbank, only growing plant parts during periods of suitable rainfall. In contrast, the climatic conditions at in-situ site Rt-6.1 were very damp and the water levels were 1 metre deep in the creek. Weed groundcover remained moderate to high (40 percent at RT-6.1 and 90 percent at Rt-6.2). There has been no evidence of inadvertent construction-related impacts.

4. Evaluation of performance criteria, mitigation measures and impact thresholds

4.1 Amendments to the program and assessing impacts

As outlined in section 4.1 of the TFMP further pre-clearing flora surveys were undertaken by suitably qualified ecologists to reconfirm the distribution and abundance of threatened flora populations in proximity to the project prior to clearing for construction. Where additional populations of threatened flora were identified these were quantified and could be managed and translocated prior to clearing. This has resulted in a revised baseline threatened flora layer and shown in the Appendix B as "*Additional finds & GIS consolidation".*

Through the detailed design process, the project construction footprint was reduced. This resulted in a significant reduction to the overall impacts to threatened flora in-situ compared to quantities reported in the approved EIS/SPIR. Where there was an increase this was contained within the project approval boundary and where feasible additional translocation efforts were undertaken.

The minor changes to the construction footprint affected the previous placement of some impact monitoring plots established in the early pre-construction phase. Replacement sites were established where there was opportunity to do this, which allowed for threatened species adjacent to the project boundary to be continually monitored and addressed the refinements of detailed design. Additionally, it was agreed with Transport for NSW to establish new control sites to allow for additional data to be collected where sites were on private land with access restrictions.

The updated clearing boundary as a result of the Detailed Design has changed the total number of threatened flora species and individuals expected to be impacted during construction and has reset the total remaining in-situ populations for following monitoring years.

Appendix B presents the final threatened flora impact as of April 2021 for the project, outlining the following:

1. *EIS/SPIR boundary/impact* – Expected impact on threatened flora based off the concept design boundary/EIS and outlined in the Threatened Flora Management Plan.

2. *EIS/SPIR boundary/impact + Additional finds and GIS consolidation* - Expected impact on threatened flora based off the Concept Design/EIS boundary using the revised threatened flora layer.

3. *Current M-Class boundary/impact + Additional finds and GIS consolidation* - Expected impact on threatened flora based off the current Detailed Design boundary using the revised threatened flora layer.

4. *Net change* – Comparison between the Concept Design EIS/SPIR boundary and the Detailed Design Clearing boundary using the revised threatened flora layer.

As noted in Section 2.3.2, the baseline methods for determining the abundance of threatened groundcover species was coarse and a percentage of mean cover over an area of occupancy for each relevant species was subsequently introduced into the method during the construction monitoring surveys to improve the detection of change. This allowed for an effective measure of change to be monitored over each season and identified typical trends in plant dieback in response to rainfall and other climatic factors. A percentage mean cover for relevant species from baseline data was estimated to provide indicative comparisons for measuring performance criteria. Therefore, this information has been viewed with consideration of other site observations and evidence when scrutinising data after each sampling event prior to making and assessment of impact.

4.2 Discussion of observed impacts and threats to threatened flora

A total of 81 sites were monitored in 2020 as part of the revised program comprising 62 impact and 19 control sites. All 37 threatened flora species sites in Section 1 and 2 were surveyed during spring 2020 for the final year of operational monitoring. The remaining 44 sites in Sections 3-10 were surveyed during spring 2020 for the first time since the commencement of operation of the highway, referred to as Year 1 operational monitoring.

No major changes or notable impacts were observed from the 2020 operational monitoring in Section 1 and 2 and most sites only experienced slight decreases in plant abundance considered a result of the low annual rainfall in the seven months prior to the monitoring compared to previous years. For example, aquatic species reliant on persistent surface water such as *Eleocharis tetraquetra* and *Maundia triglochinoides* were absent at some sites where water has completely dried up. Similarly, the dry conditions had resulted in an absence of *Lindernia alsinoides (*sections 1-3*)* and *Persicaria elatior* (sections 4-5) from the 2020 monitoring, these species typically occurs in swampy sites, moist and riparian areas, and plants were absent from both impact and control sites. These changes are considered natural variation and in response to climatic conditions and not a result of construction or operational activities.

The *Oberonia titania* in-situ site (Ot-10.1) (section 10) reported a reduction in number of plants and plant health from the 2020 monitoring, probably associated with indirect impacts from increased exposure to light, heat and wind (edge effects) given its position directly adjacent to the cleared road corridor.

4.3 Measuring performance criteria

The TFMP provides indicative thresholds for measuring the performance of mitigation measures applied during the project construction. It is noted that some of the performance goals do not relate to the in-situ threatened flora species and monitoring program, such as plant translocation (examined in the translocation monitoring program) and dust monitoring. The relevant construction performance criteria and thresholds (refer to Section 2.4) that trigger corrective actions for this program is presented in Table 4-1 and only relate to those sites situated outside of the updated clearing boundary.

Goals supporting the management of dust, translocation and habitat revegetation is not covered in the construction monitoring program. No dust was observed affecting in-situ sites.

The 2020 monitoring period represents the first full operational phase of the project (Year 3 for sections 1-3; and Year 1 for sections 3-11). The relevant goals for mitigating impacts from operation of the project are addressed by the monitoring program as outlined in section 2.4, include:

- Zero mortality of retained in-situ threatened plant populations during construction and for three consecutive monitoring periods post-construction.
- Post the above period 80 per cent survival of tree, shrub, and herbaceous perennials after three years
- Less than five per cent weed cover at retained in-situ threatened flora sites (end of monitoring program).

4.4 Effectiveness of mitigation measures implemented during construction

4.4.1 Method of mitigation and discussion of impacts

Where mitigation measures have been applied during construction, the effectiveness of these were previously assessed in relation to impacts on in-situ threatened plants at the monitoring sites. The mitigation measures applied to protect threatened plants include:

- Identification of exclusion zones and clearing limits prior to clearing.
- Identification of exclusion zones informed by targeted surveys.
- Exclusion zones fenced off to protect in-situ threatened plants.

- Monitor in-situ plants at established monitoring sites during construction.
- Salvage and planting of identified plants for translocation undertaken prior to clearing, into suitable habitat, and using appropriate methods that maximise the chance of plant survival.
- Adequate soil and water quality controls installed surrounding retained threatened plants.
- Procedures for maintenance and monitoring of erosion and sediment controls included in the CEMP.
- Restrict the availability of information identifying where orchids occur within the project area, and in close proximity to the project area.
- Limit site access to areas where orchids naturally occur and may be being managed in-situ.

Examples of impacts observed during construction within and outside the project boundary are described below, with reference to whether these are project-related and therefore an assessment of the effectiveness of the mitigation applied.

Table 4-1 Corrective actions applied during construction

Species	Impact and status	Corrective actions applied
Endiandra muelleri subsp. *bracteata*	As mentioned above, the single mature Endiandra muelleri subsp. bracteata shrub at site Emb-4.2 was inadvertently removed by a construction contractor in January 2019. This site was located within the approved clearing boundary; therefore, it is not an additional impact, however the plant was proposed to be retained for translocation. Pacific Complete have advised that the construction contractor (BGC Contracting) has developed and is implementing the Green-leaved Rose Walnut Rehabilitation Plan – W2B Section 4 Major Civil Works (Geolink 2019) to address corrective actions. The Rehabilitation Plan includes collaboration with local expert Dr Andrew Benwell (ECOS Environmental Pty Ltd) and contains four specific actions:	i. Targeted Green-leaved Rose Walnut Surveys - Identify additional occurrences of Green-leaved Rose Walnut in the Maclean area. ii. Collect and Propagate Seeds/ Cuttings - Collect and propagate at least 20 Green-leaved Rose Walnut seeds/ cuttings sourced from trees in the Maclean area or W2B Section 10. iii. Vegetation Regeneration and Green-leaved Rose Walnut Plantings (Management Zone 1) - Plant at least 10 propagated Green-leaved Rose Walnut trees as part of a vegetation regeneration area (Management Zone 1). iv. Vegetation Regeneration (Management Zone 2) - Manage weeds within Management Zone 2 around the retained in-situ Green-leaved Rose Walnut at approximate chainage 81700.
	Major increases in the abundance and number of weed species was noted in 2018 at sites Emb-4.1 and Emb-4.2 within the project boundary. Although sites had existing weeds, long-term monitoring results and site observation of construction works indicated notable weed problems exacerbated by the project.	Weed management actions were undertaken at site Emb-4.1 on 11 April 2019, with all actions completed. Ongoing weed maintenance is to continue as per BGC contract requirement. Surveys in spring 2019 confirmed that weed management actions had been effective in removing the weeds impacting this site.
Angophora robur	Suspected root-rot fungus at site Ar-3.7. Surveys in 2019 saw continued mortality of native plants *Xanthorrhoea* sp. and *B. oblongifolia*.	Pacific Complete engaged a consultant in 2018 to undertake sampling for *Phytophthora cinnamomi* along the entire project alignment, which found the fungus to be widespread. Management

		specification since the commencement of the project has included requirements for construction equipment wash downs before entering the project area. It is difficult to confirm if construction activities have contributed to the spread and prevalence of *Phytophthora cinnamomi*.
Maundia triglochinoides	Population of *Maundia triglochinoides* monitored at in-situ sites Mt-7.2 and Mt-7.3 was inadvertently impacted by the sediment run-off from the March 2017 storm event.	Not required. Continued monitoring in 2018-2020 has showed that the populations are slowly recovering from this flood event.

4.5 Thresholds triggering corrective actions during operation

The examples above describe where suitable corrective actions were applied to identified impacts during construction and identifies recovery or affected plants in-situ. All stages of the project are no in full operation, and the 2020 spring monitoring was the third event covering operation of Section 1 and 2 and the first event covering operation of Section 3-10.

The TFMP identifies the parameters for monitoring performance of in-situ populations during construction and operation. These are described as performance measures and set a threshold whereby if impacts occur and exceed this threshold, specific corrective actions are required. The set of threshold triggers and corresponding corrective actions from the TFMP are outlined in Table 4-2Error! Reference source not found..

Table 4-2 Corrective actions relating to triggered performance thresholds during operation phase

Threshold triggers	Corrective actions
▪ Any loss of retained in-situ threatened plants for the first three consecutive monitoring periods post-construction.	▪ Commence assessment of potential reasons for mortality, including seasonal fluctuations, natural events such as drought and fire within one month of trigger being identified. ▪ Review weed maintenance schedule within one month of tigger being implemented ▪ Identify potential threats, implement corrective actions, and modify monitoring s necessary ▪ Offset any additional threatened plant impacts that have occurred as a result of the project.
▪ Weed cover increases by 10% from the baseline cover in areas surrounding in-situ populations ▪ More than 30% weed coverage in revegetation areas	▪ Review weed maintenance program within one month of trigger being identified and update as required.

Error! Reference source not found. summarises the results of the 2020 operational monitoring species and assesses any impacts against the triggers for corrective actions.

Table 4-3 Assessment of thresholds triggering corrective actions for threatened flora during operational monitoring

Species	Thresholds (triggers for corrective actions)		Impacts within approved project boundary.	Requires corrective actions (inadvertent construction impact
	Any loss of retained in-situ threatened plant populations for three consecutive monitoring periods post-construction.	Less than five per cent weed cover at retained in-situ threatened flora sites (end of monitoring program).		
Year 3 operation (Section 1 and 2)				
Eleocharis tetraquetra	2020 is 3rd operational monitoring period (s.1&2). Plants were absent at Elt-1.3, Elt-2.1, that were present during Year 1 and 2 operational monitoring.	2020 is end of monitoring program for s.1,2. Up to 10% exotic groundcover recorded at Elt-2.1 in 2020, mostly Paspalum and Whiskey Grass. These invasive grasses have increased due to low hydroperiod associated with drought and would be expected to decrease after increased hydroperiods and therefore cover not associated with the project.	Impacts expected to be associated with the drought and resulting dry conditions at both monitoring sites in the months leading to the spring monitoring. Absence of other aquatic species was also noted	No
Eucalyptus tetrapleura	Yes – loss of 1 tree at one site Et-2.1 and Et-2.3, reported in 2019 but not project related. No further losses reported in 2020	2020 is end of monitoring program for s.1,2. No exotic cover recorded in 2020.	No	No
Lindernia alsinoides	2020 is 3rd operational monitoring period (s.1&2). Plants were absent at La-1.2, La-1.3, La-2.2, and also absent at the control site LaC1.3, that were present during Year 1 operational monitoring	2020 is end of monitoring program for s.1,2. Range of common exotic species recorded over the monitoring surveys Up to 15% exotic groundcover recorded at La-1.3 in 2020, mostly Paspalum and Whiskey Grass. These invasive grasses have increased due to low hydroperiod associated with drought and would be expected to decrease after increased hydroperiods and therefore cover not associated with the project	Impacts expected to be associated with the drought and resulting dry conditions and were observed at impact and control monitoring sites. Absence of other aquatic species was also noted	No
Lindsaea incisa	2020 is 3rd operational monitoring period (s.1&2). Plants present at all impact and control sites in s.1,2 with density and cover of plants slightly greater than 2019.	2020 is end of monitoring program for s.1,2. Range of common exotic species recorded over the monitoring surveys at low cover.	No	No

Species	Thresholds (triggers for corrective actions)		Impacts within approved project boundary.	Requires corrective actions (inadvertent construction impact
	Any loss of retained in-situ threatened plant populations for three consecutive monitoring periods post-construction.	Less than five per cent weed cover at retained in-situ threatened flora sites (end of monitoring program).		
Maundia triglochinoides	2020 is 3rd operational monitoring period (s.1&2). Declines in numbers of plants have been observed during the 2020 monitoring and associated with the drought and decreased hydroperiod of ponds / streams. Plants were absent at Mt-1.1 and Mt-C1.1 (absent 2017-2020), Mt-2.1 (also absent in 2019) and Mt-2.3 (very low numbers reported here 2017-2018 and 1 plant in 2019)	2020 is end of monitoring program for s.1,2. Range of common exotic species recorded over the monitoring surveys at low cover.	Impacts expected to be associated with the drought and resulting dry conditions and were observed at impact and control monitoring sites. Absence of other aquatic species was also noted	No
Quassia sp. Moonee Creek	2020 is 3rd operational monitoring period (s.1&2). All impact and control sites have seen either stable or increased plant numbers. No decline in health or abundance observed	Weed cover remains low and not increasing	No	No
Year 1 operation (Section 3-11)				
Angophora robur	No loss of tree in first phase of operational monitoring. All impact and control sites have been either stable or increased plant numbers. No decline in health or abundance noted.	2020 is first year of monitoring. Weed cover varies, and there is a moderate proportion of Lantana and exotic grasses at some sites, that is consistent with the baseline	No	No
Arthraxon hispidus	No apparent loss of plants in first phase of operational monitoring. All impact and control sites have been either stable or increased plant numbers. No decline in health or abundance noted.	Presence and abundance of weeds varies each year, although has always been above 5% during pre-construction and construction. There has been a reduction in cover from 2019 for some impact sites and increase for others. This is consistent with the control sites. Importantly there has been no declines in plant numbers	No	No
Cyperus aquatilis	N/A – no individuals identified, and absent from site from pre-construction period	2020 is first year of monitoring. Weed cover is currently low and consistent with baseline at this site	No	No

Species	Thresholds (triggers for corrective actions)		Impacts within approved project boundary.	Requires corrective actions (inadvertent construction impact
	Any loss of retained in-situ threatened plant populations for three consecutive monitoring periods post-construction.	Less than five per cent weed cover at retained in-situ threatened flora sites (end of monitoring program).		
Endiandra muelleri subsp. *bracteata*	There were no losses during Year 1 operation. Some insect browsing noted, although overall plant health good	2020 is first year of monitoring. Weed cover is currently low and reflects the weed control that was done in 2019	No	No
Grevillea quadricauda	No apparent loss of plants in first phase of operational monitoring. All impact and control sites have been either stable or increased plant numbers. No decline in health or abundance noted.	2020 is first year of monitoring. Weed cover is currently at around 10% but has decreased from 40% since initial construction phase	No	No
Lindsaea incisa	Improved condition since 2019. No apparent loss of plants in first phase of operational monitoring. All impact and control sites have been either stable or increased plant numbers. No decline in health or abundance noted.	2020 is first year of monitoring. Weed cover is currently low 5% and has been aided by bushfire.	No	No
Macadamia tetraphylla	No loss of tree in first phase of operational monitoring. All impact and control sites have been either stable or increased plant numbers. No decline in health or abundance noted.	2020 is first year of monitoring. Weed cover is consistent with baseline and reflects the grazed habitat the tree is located in	No	No
Maundia triglochinoides	Declines noted in 2019 and have continued at some sies in 2020 due to continued dry conditions and the associated decreasing area and condition of habitat available	2020 is the first year of operational monitoring. Weed cover has declined from 2019 at all sites, and currently less than 5%.	No	No
Melaleuca irbyana	Some losses of mature plants due to a wildfire in November 2019, independent from highway operation. Good recovery through abundant germination and presence of new immature plants and new growth on mature trees.	2020 is first year of monitoring. Weed cover is currently low post-fire, and lower that previous years	No	No
Oberonia titania	Less numbers than 2018 and 2019, difficult to quantify, possibly 7-10 plants. Desiccation / wilting of some remaining plants due to increased sunlight. No flowers present, but	2020 is first year of monitoring. Weed cover is currently consistent with previous years, and no notable increase	Impacts expected to be associated with the natural dry conditions and exacerbated by increased exposure to light along the cleared	No, monitoring to continue

Species	Thresholds (triggers for corrective actions)		Impacts within approved project boundary.	Requires corrective actions (inadvertent construction impact
	Any loss of retained in-situ threatened plant populations for three consecutive monitoring periods post-construction.	Less than five per cent weed cover at retained in-situ threatened flora sites (end of monitoring program).		
	signs that plants had recently finishing flowering		project edge. This was noted in 209, and further monitoring required	
Persicaria elatior	No further project related loss of plants in first phase of operational monitoring. All impact and control sites have showed decline or absence of plants related to changed hydrology and drought conditions.	2020 is first year of monitoring. Weed cover is currently low	No	No
Prostanthera cineolifera	Some losses of mature plants due to a wildfire in November 2019, independent from highway operation. Good recovery through abundant germination and presence of new immature plants.	2020 is first year of monitoring. Weed cover very low post-fire	No	No
Rotala tripartita	Plants were not present in 2020, and had dieback previously	2020 is first year of monitoring. Weed cover low	No	No

5. Correction actions and recommendations

5.1 Assessing mitigation performance

The current 2020 monitoring represents the last phase of operational monitoring for in-situ threatened plants in Section 1 and 2. The TFMP measures performance of mitigation measures during the operational phase as zero mortality occurring over three consecutive monitoring periods post-construction. Achieving low weed cover at the in-situ site (<5%) is also a measure of achieving mitigation success. As there have been no project related impacts to in-situ plants in Section 1 and 2 for 3 post-construction monitoring periods (i.e., 2018-2020) this performance criterion has been met. While weeds continue to be present at some sites, there is no evidence that weeds have substantially increased from the baseline, and where this has occurred, follow-up weed control has been successful.

For Sections 3-10, 2020 represents the first year of operational monitoring and further annual monitoring is planned in 2021 and 2022. There have been reported losses of plants that are associated with the prolonged dry conditions experienced during much of 2019 and 2020, as the impact has been largely observed for aquatic and semi-aquatic plant species where declines in surface water were also noted to occur and therefore habitat availability and condition was lower. The losses at this stage are not deemed to be project related.

The *Oberonia titania* site is a difficult one to monitor, as plants are small and some high in the canopy, making direct counts each year difficult to compare accurately. It is evident that the number of plants observed has declined by a few individuals from previous monitoring in 2018 and 2019 and that plant health was lower than plants at the control site. Drier climatic conditions have prevailed at both impact and control sites, although the effects of these may be more pronounced at the impact site which is on the edge of the cleared project corridor compared to the control which is in the forest interior. Weed removal at this location is unlikely to influence the condition of the plants, which are adjusting to the edge environment.

5.2 Recommendations

Operational corrective actions follow the same actions if thresholds are triggered for any loss of plants or increases in weeds. No notable impacts to threatened flora and/or sites have been reported in Section 1 and 2, therefore no corrective actions are required for these sites. These results have been obtained for three consecutive operational monitoring events, and no further mitigation and monitoring is required.

As stated above, the operational monitoring in Sections 3-10 has identified plant mortality at only one site, associated with Oberonia titania at the in-situ population, compared with control population. This is inconsistent with the goals of the TFMP, which aim to achieve zero mortality and therefore has triggered the need for corrective actions. The current TFMP sets out prescribed corrective actions for all threatened flora species that have in part been addressed in this report by the assessment of site observations and reasons for impact. Some corrective actions are time bound and require immediate implementation that are not achievable prior to reporting and permanent loss of threatened flora may result.

As this is first year of operational monitoring in Section 8, and the given the prolonged dry conditions that occurred at this stage of the monitoring, further monitoring in 2021 will be important to see if plants have recovered, particularly as more favourable wetter conditions have prevailed and vegetation along the edge would have increased in density. There are no recommendations at this stage, other than compare results for 2021 and assess at the end of year 2. If further declines continue, this will be an opportunity to consider mitigation. The percentage of weeds at the site has not changed, and further weed control is not expected to mitigate the edge effect and is not recommended.

6. References

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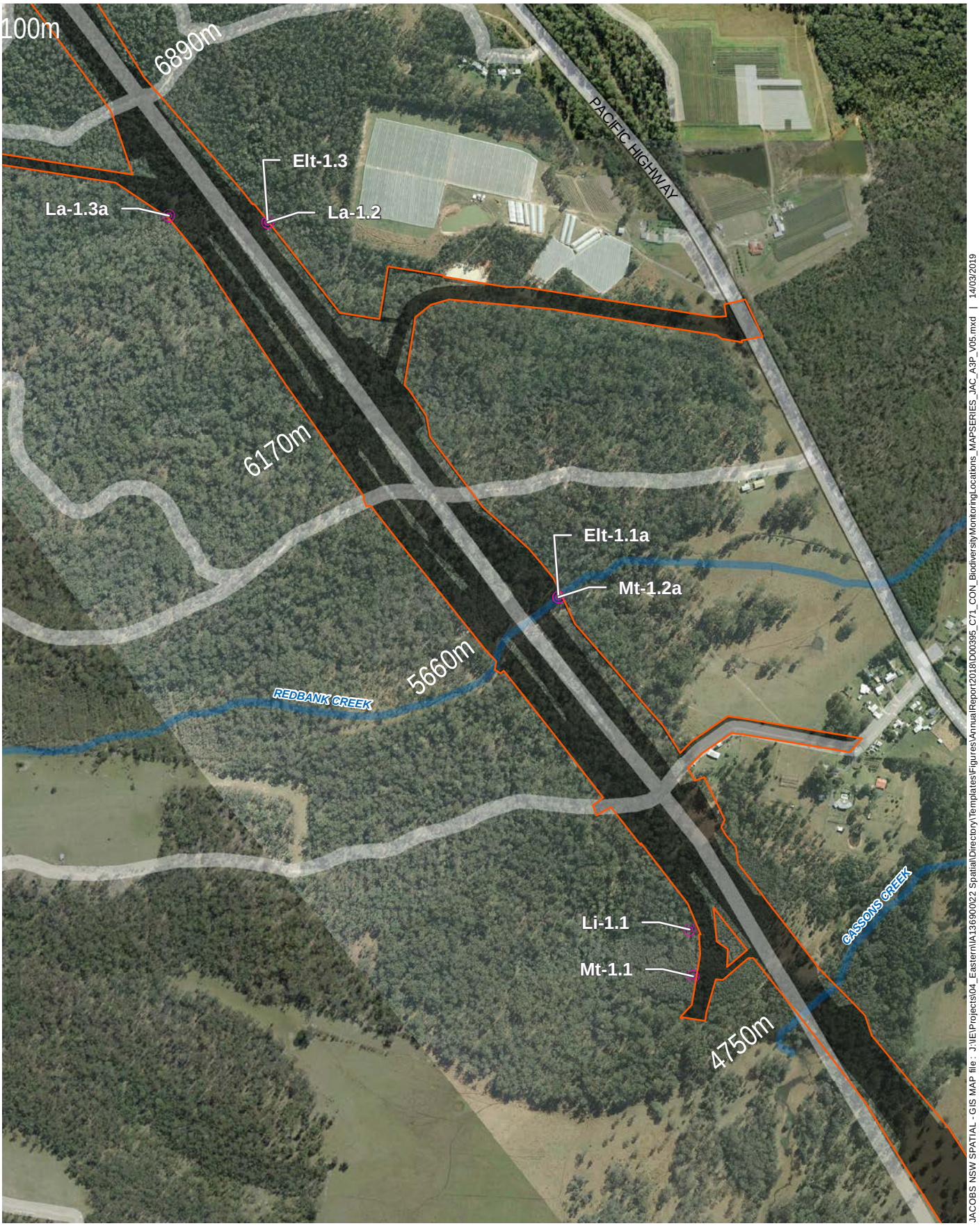
Appendix A. Threatened Flora Monitoring Sites (Figures)



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Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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Figure A-1 | Threatened flora monitoring locations

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Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- State Forest (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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Figure A-2 | Threatened flora monitoring locations

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Legend

- Monitoring location - Control (Jacobs 2018)
- State Forest (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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Figure A-3 | Threatened flora monitoring locations

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Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- State Forest (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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Figure A-4 | Threatened flora monitoring locations

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Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- National Park (DFSI Oct 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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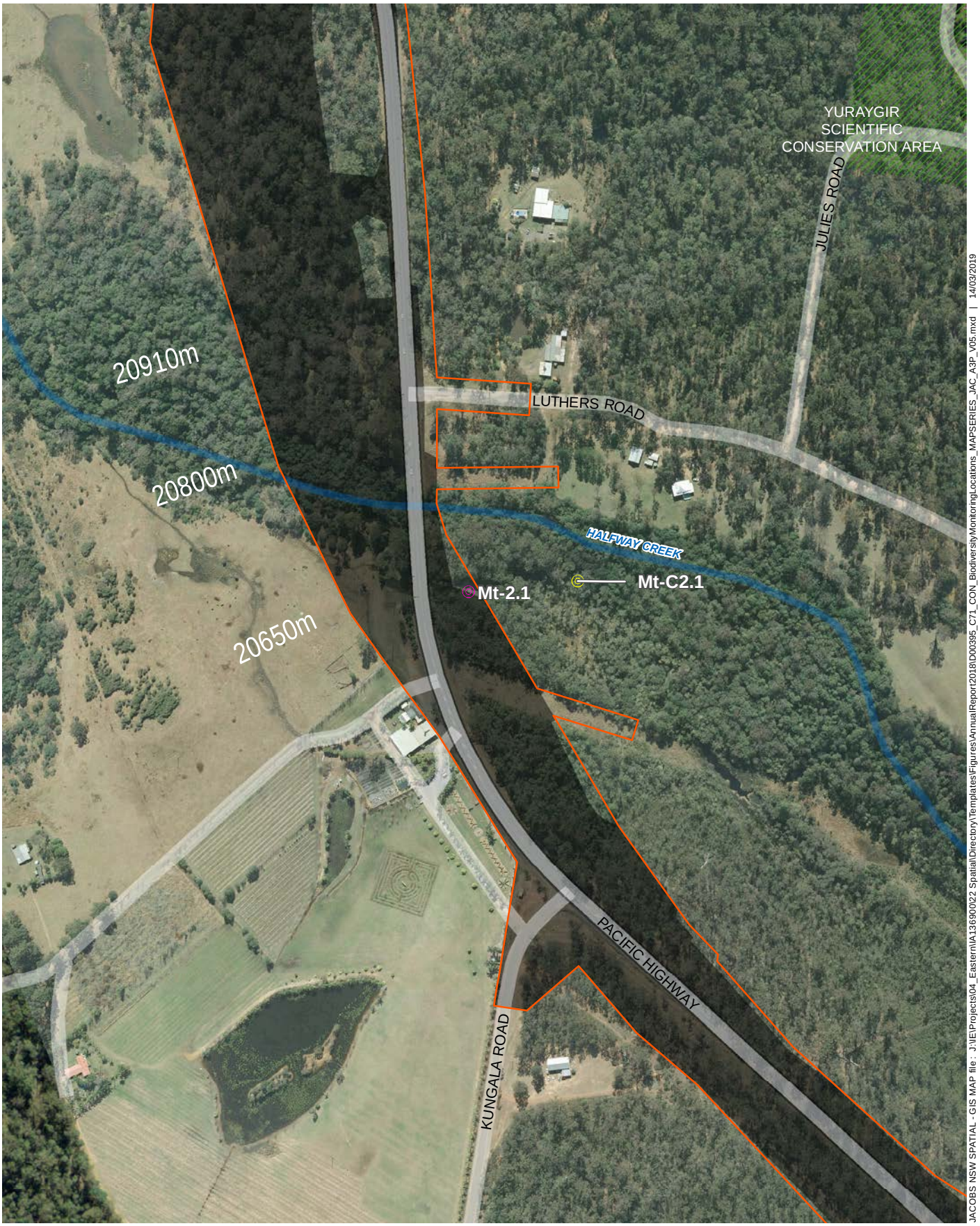
Figure A-5 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

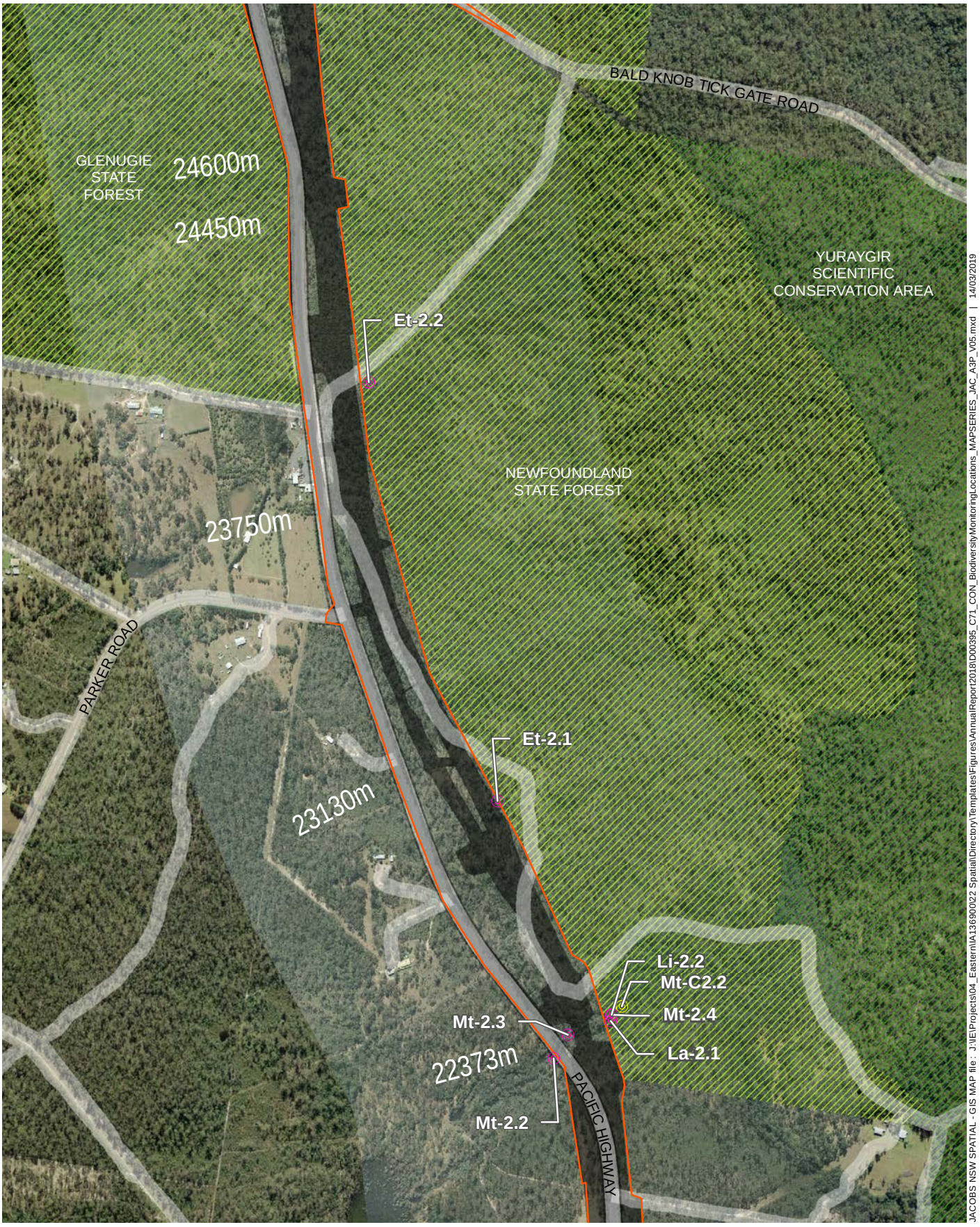
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-6 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- State Forest (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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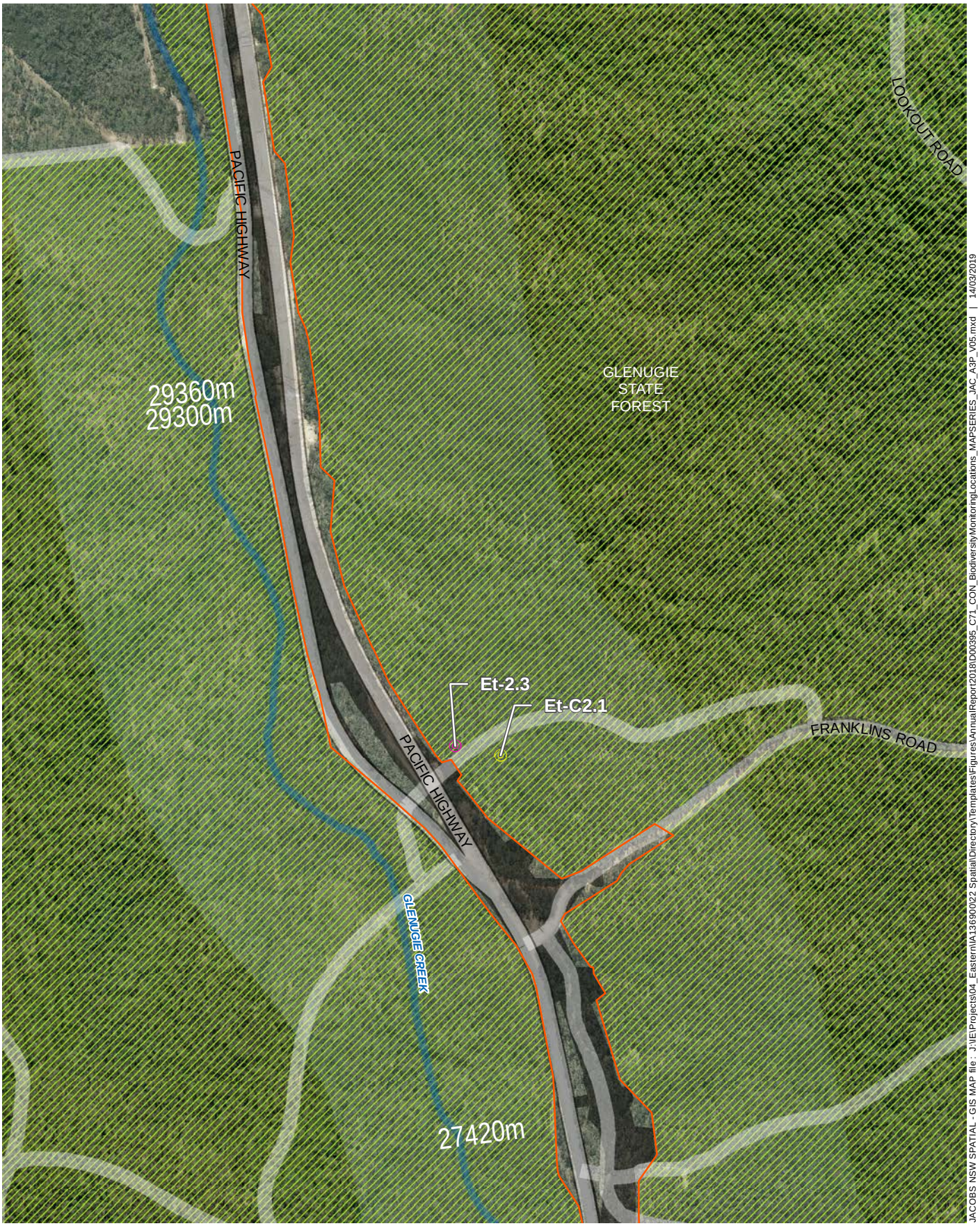
1:12,500 @ A3

0 100 200m

Figure A-7 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\IE\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- State Forest (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:12,500 @ A3

0 100 200m

Figure A-8 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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1:5,000 @ A3

0 100 200m

Figure A-9 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\IE\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:12,500 @ A3

0 100 200m

Figure A-10 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Waterway (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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1:10,000 @ A3

0 100 200m

Figure A-11 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:7,500 @ A3

0 100 200m

Figure A-12 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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1:5,000 @ A3

0 100 200m

Figure A-13 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

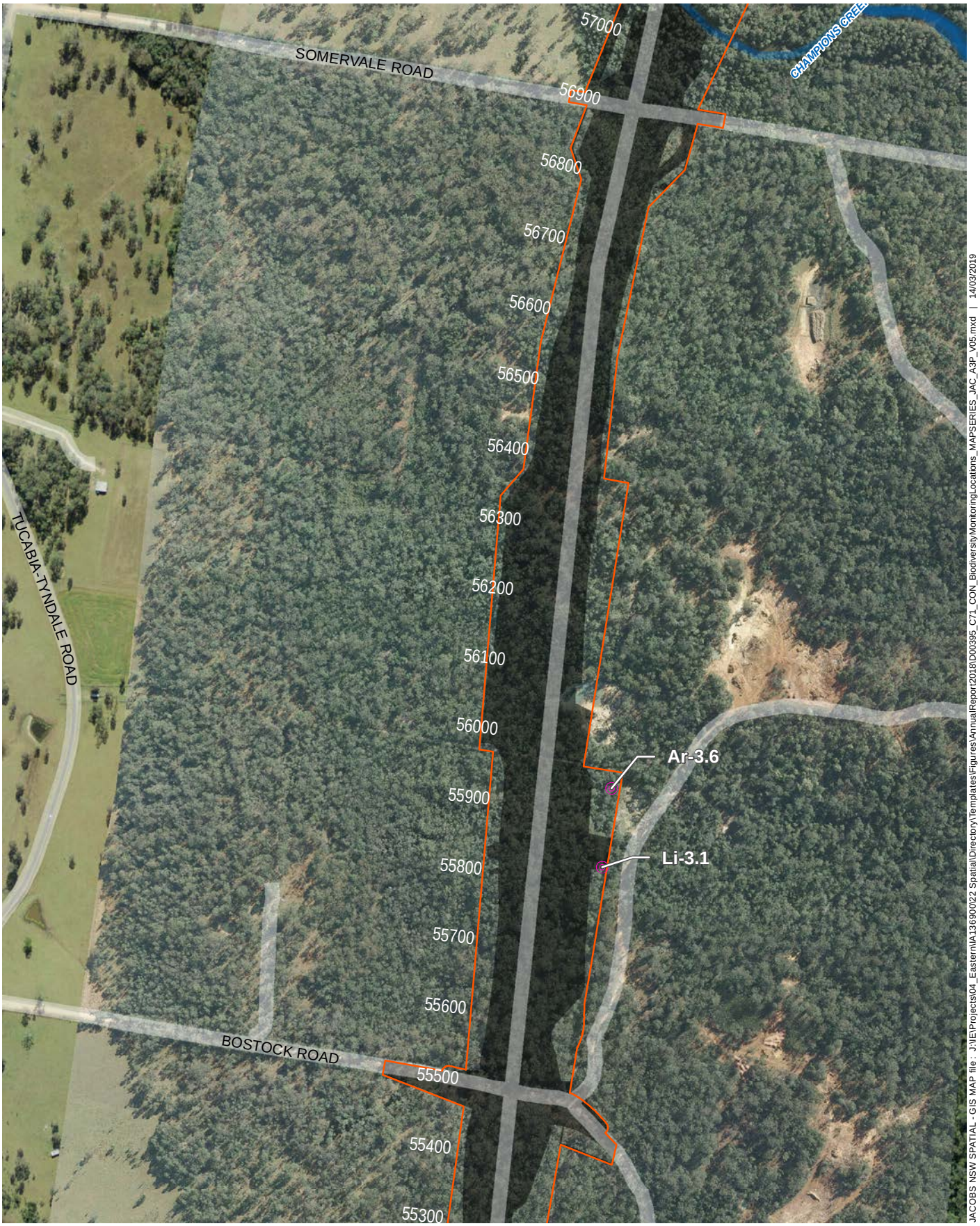
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:7,500 @ A3

0 100 200m

Figure A-14 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

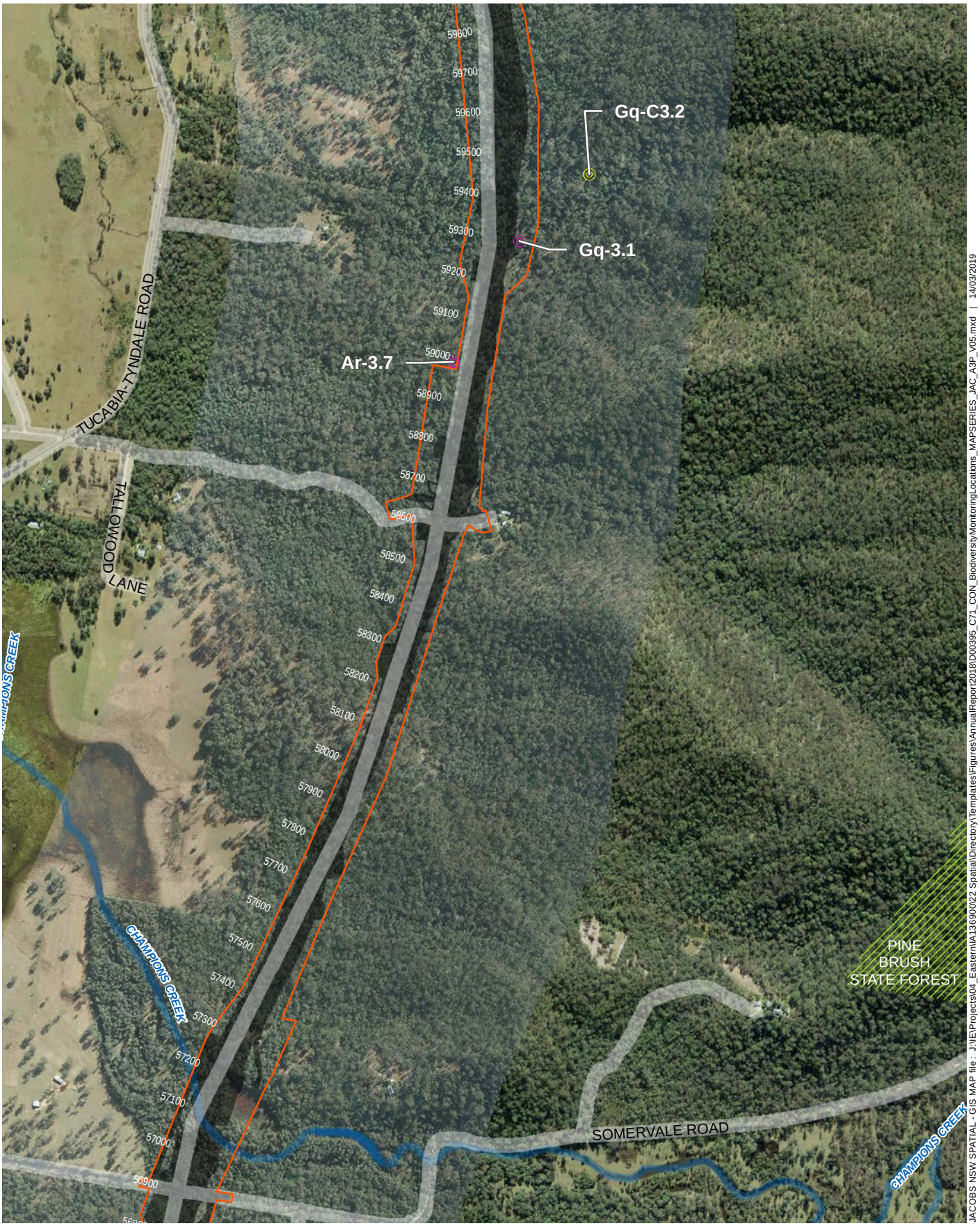
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:7,500 @ A3

0 100 200m

Figure A-15 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- State Forest (DFSI Mar 2018)

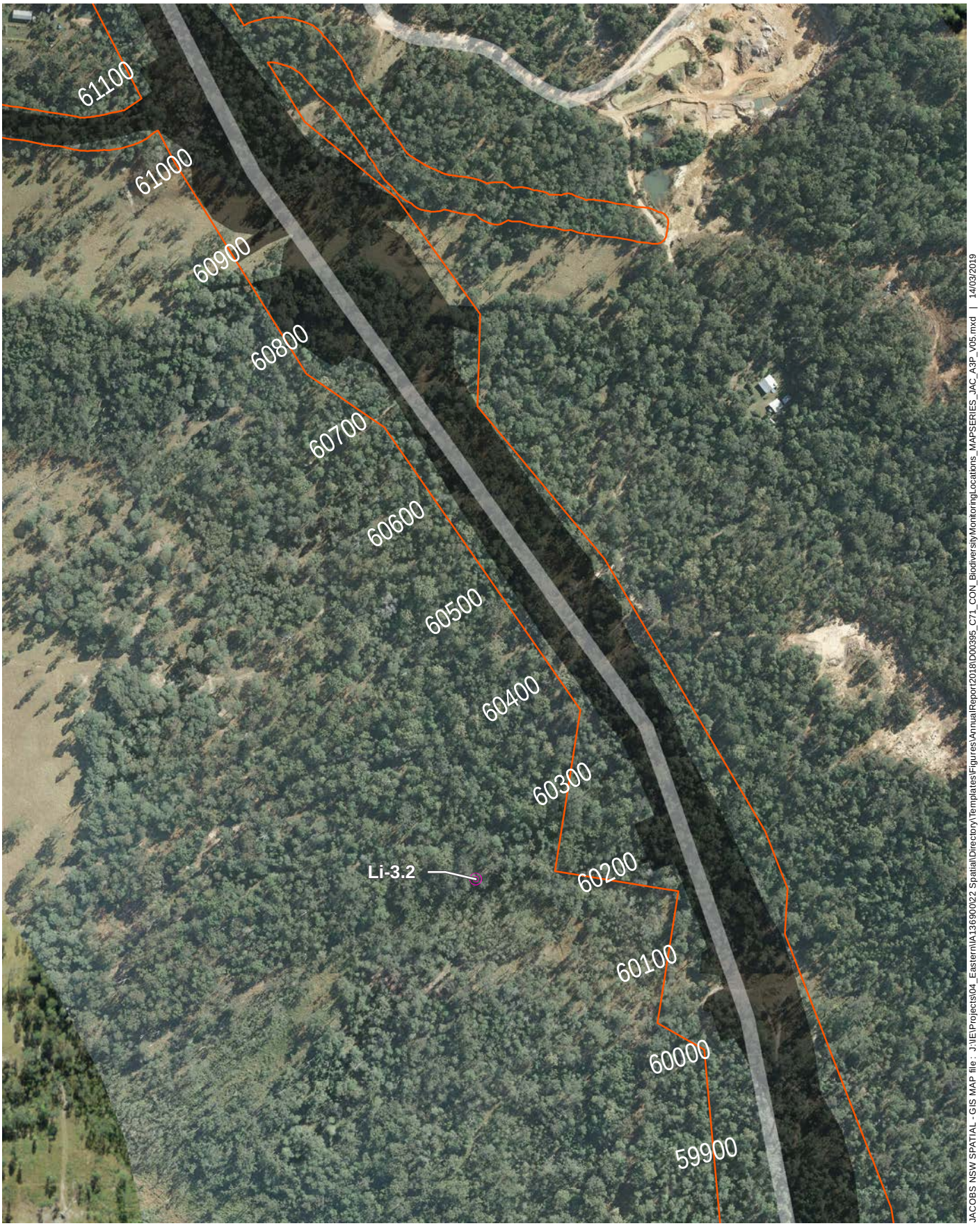
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:12,500 @ A3

0 100 200m

Figure A-16 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

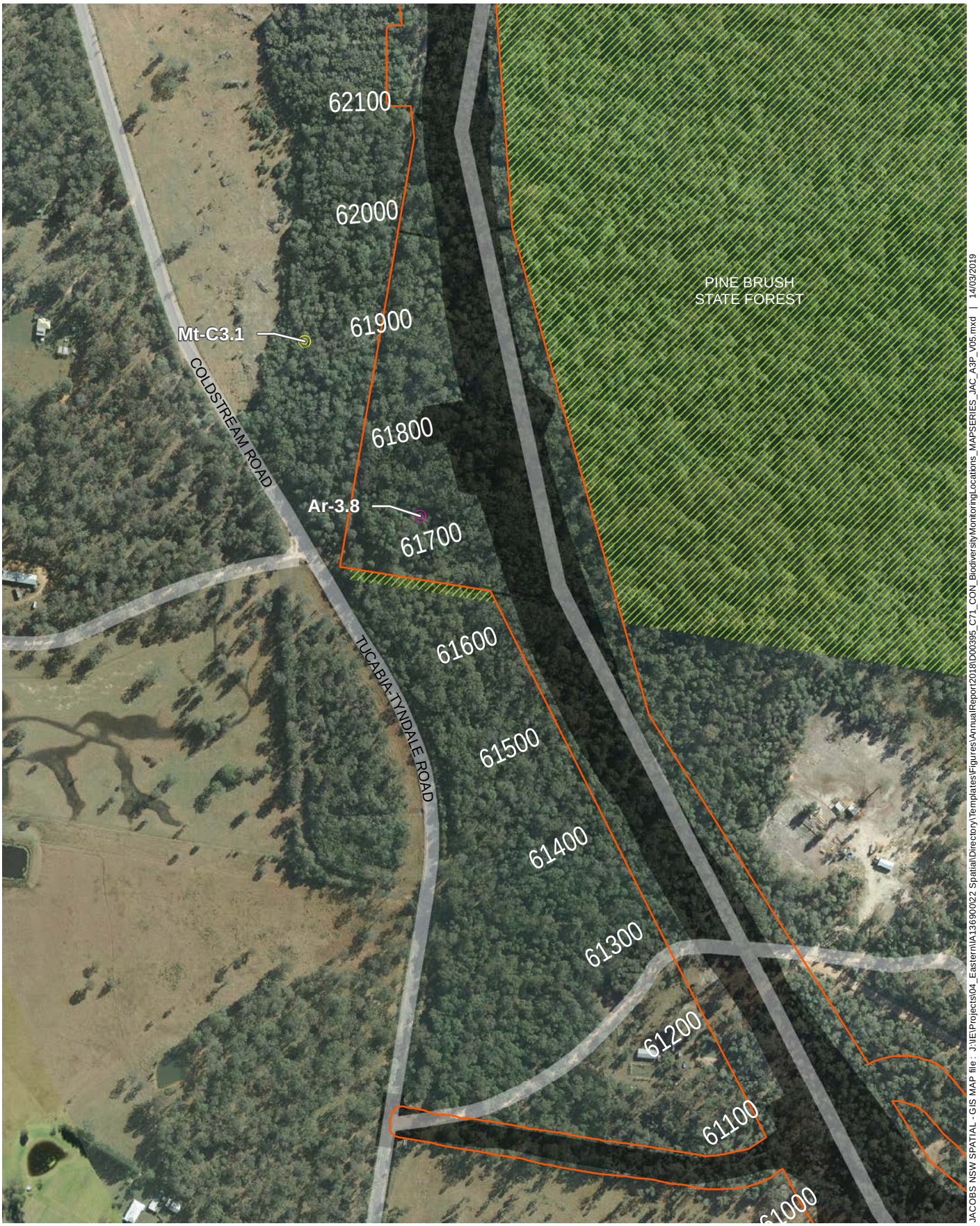
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-17 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- State Forest (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-18 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- State Forest (DFSI Mar 2018)

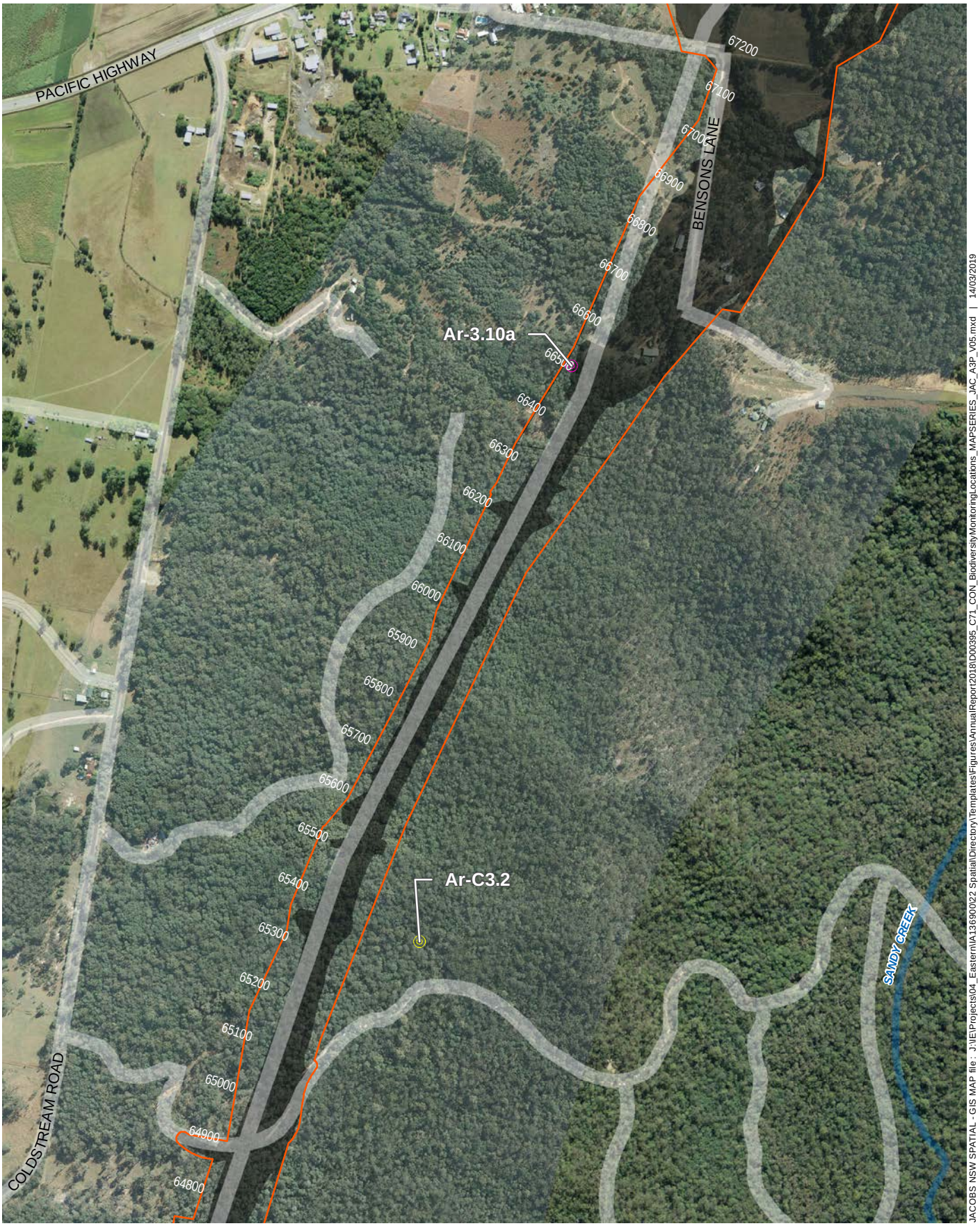
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:10,000 @ A3

0 100 200m

Figure A-19 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)

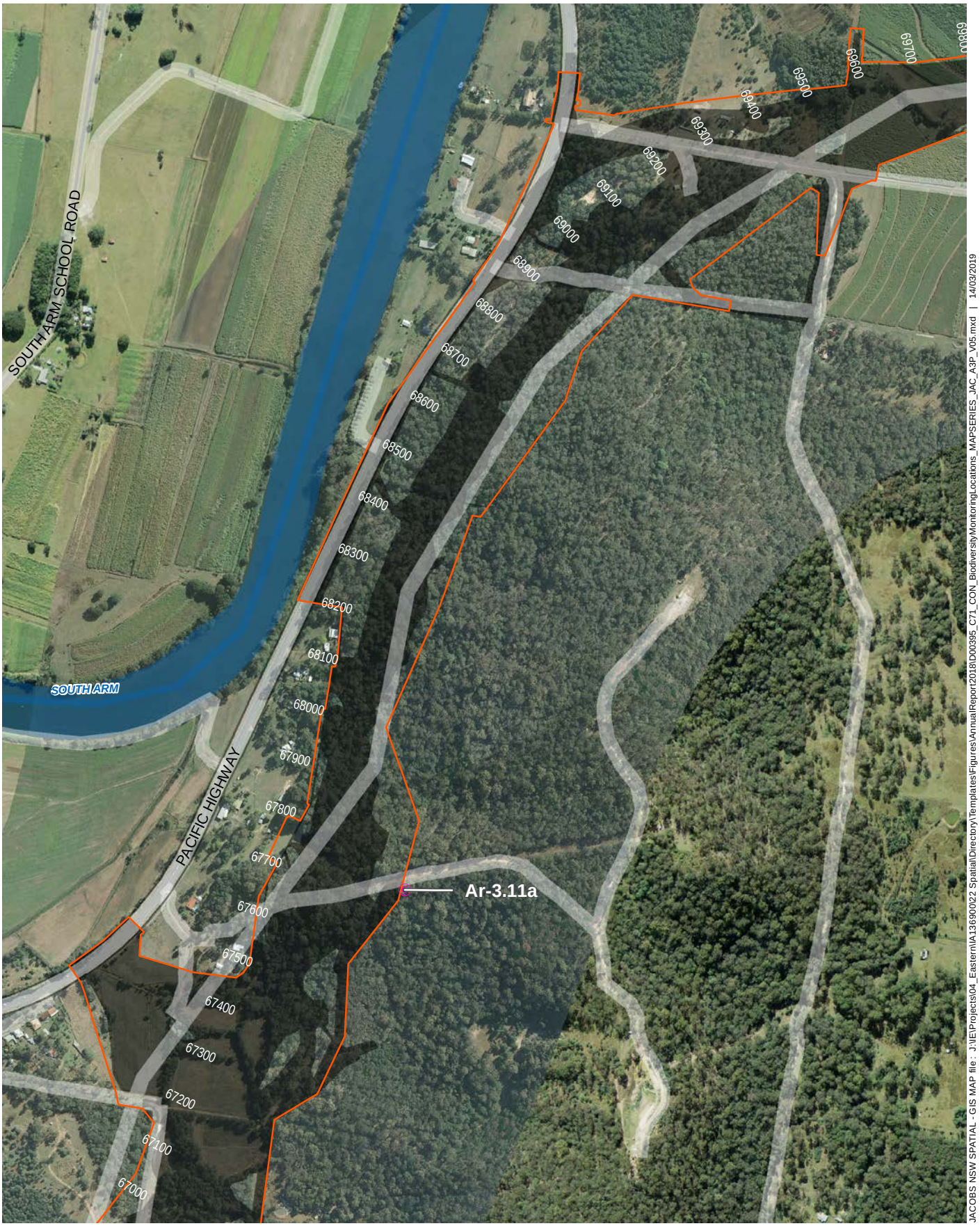
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:10,000 @ A3

0 100 200m

Figure A-20 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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1:10,000 @ A3

0 100 200m

Figure A-21 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\EI\Projects\04_Eastern\IA136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)

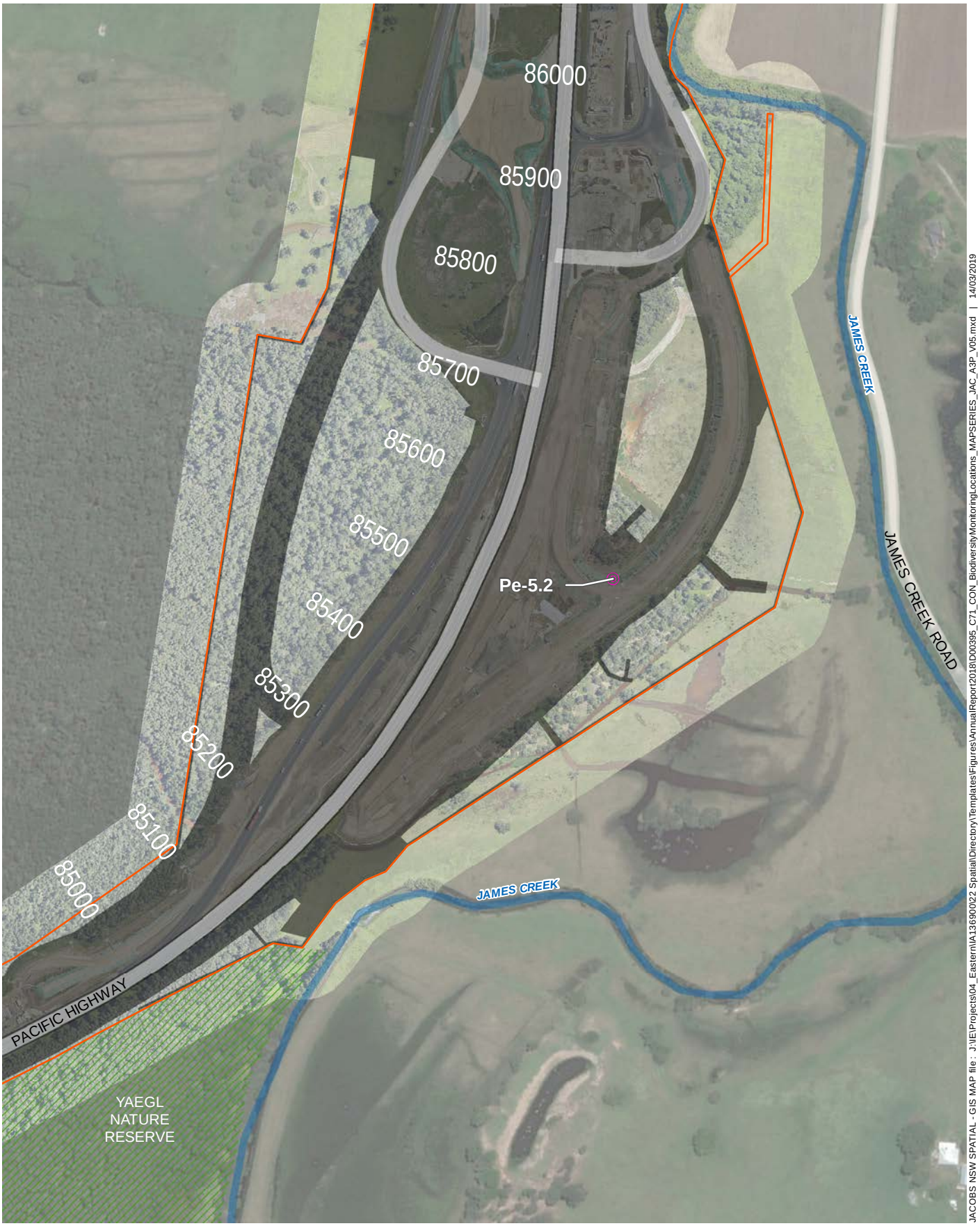
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:12,500 @ A3

0 100 200m

Figure A-22 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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1:5,000 @ A3

0 100 200m

Figure A-23 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- State Forest (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

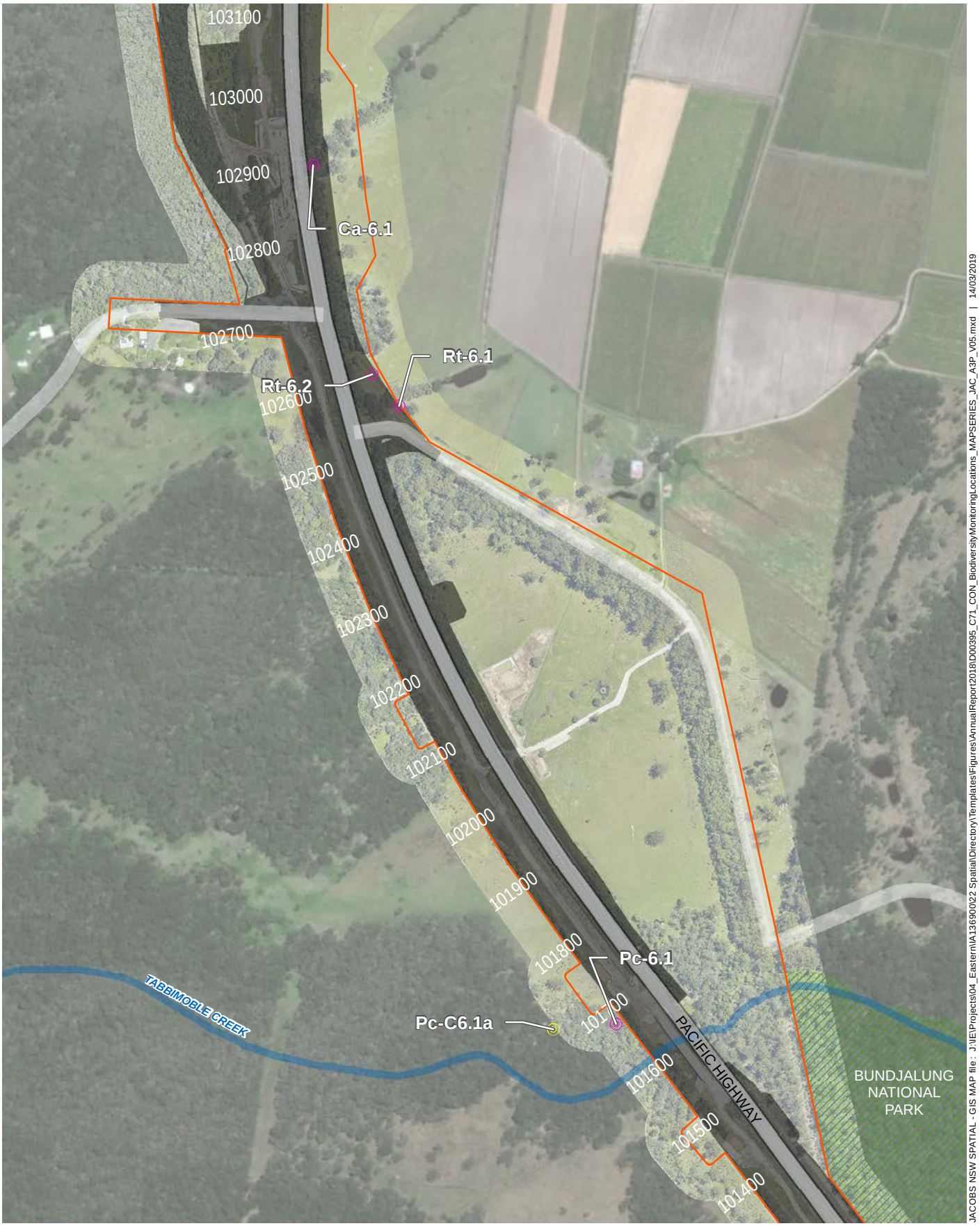
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-24 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:7,000 @ A3

0 100 200m

Figure A-25 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\IE\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- State Forest (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-26 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- State Forest (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-27 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:10,000 @ A3

0 100 200m

Figure A-28 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

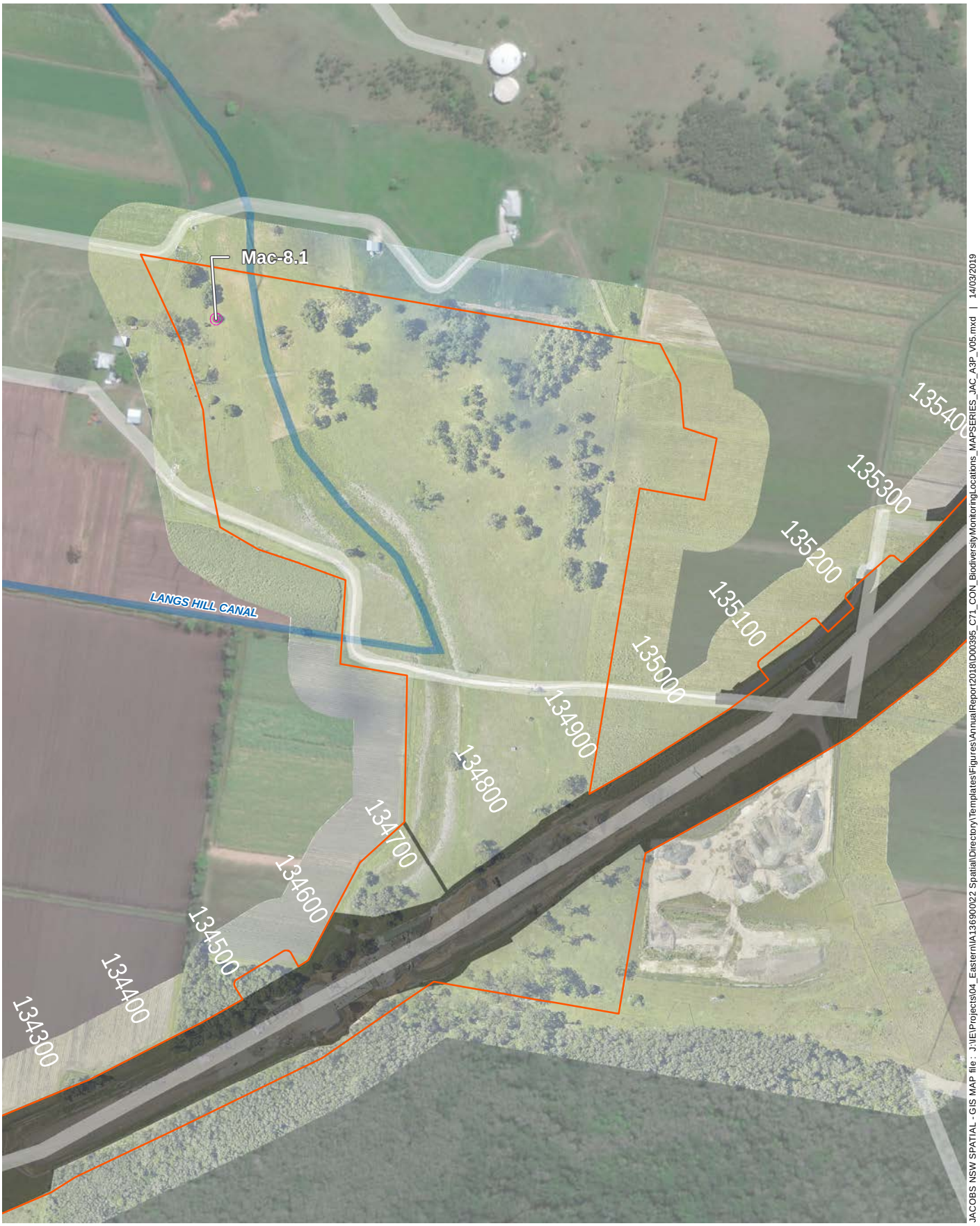
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-29 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-30 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

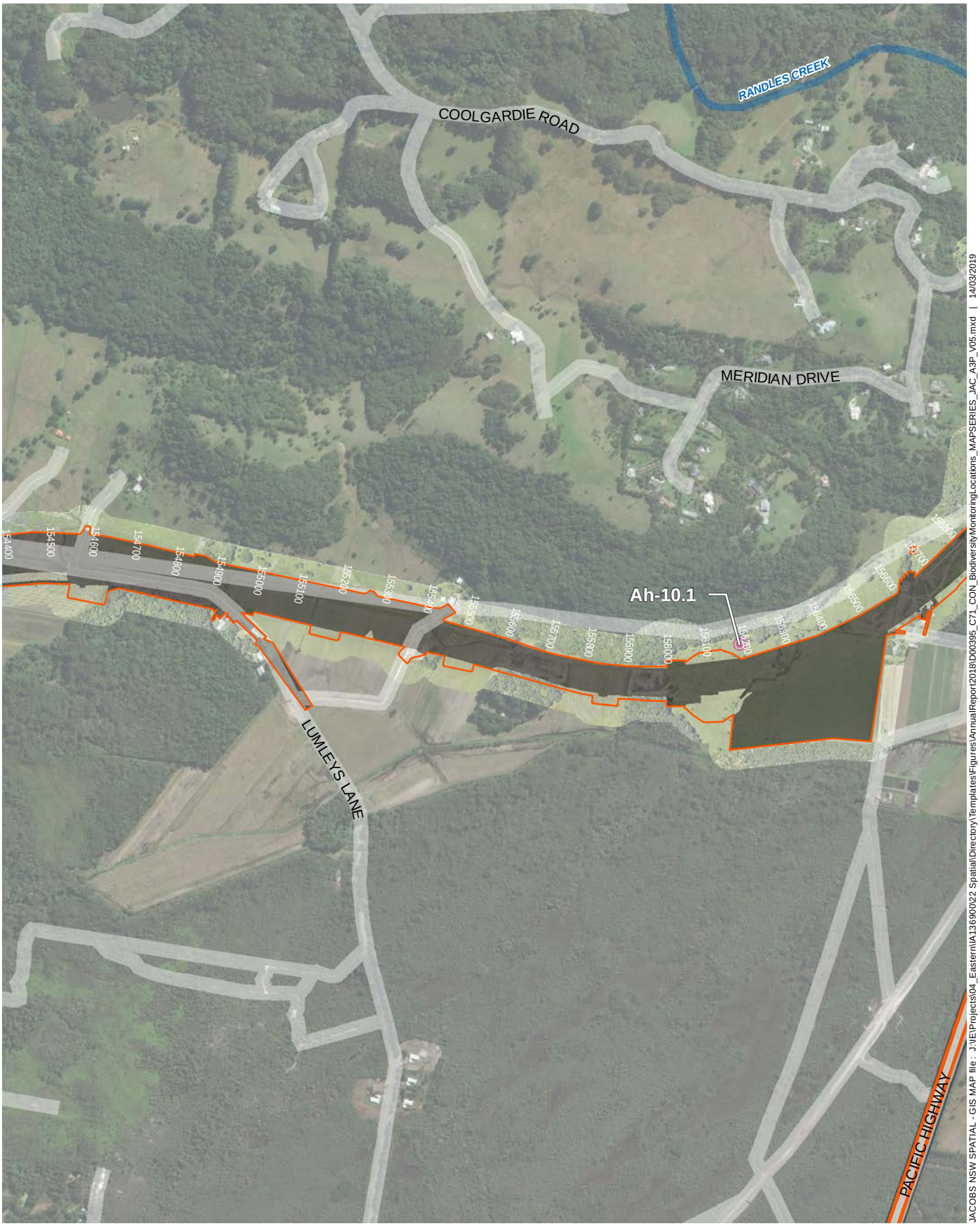
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-31 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
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- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:12,500 @ A3

0 100 200m

Figure A-32 | Threatened flora monitoring locations

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:7,000 @ A3

0 100 200m

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Figure A-33 | Threatened flora monitoring locations

Appendix B. Differences in EIS vs Current Clearing Boundary for Threatened Flora (Year 2 reset)

Common name	Scientific name	Location	Direct								Indirect within 10m								Indirect with 10 to 20m							
			EIS/SPIR boundary/impact (points)	EIS/SPIR boundary/impact + Additional finds & GIS consolidation (points)	Current M-Class boundary/impact + Additional finds & GIS consolidation (points)	Net Change (points)	EIS/SPIR boundary/impact approval (area)	EIS/SPIR boundary/impact + Additional finds & GIS consolidation (area)	Current M-Class boundary/impact + Additional finds & GIS consolidation (area)	Net Change (area)	EIS/SPIR boundary/impact (points)	EIS/SPIR boundary/impact + Additional finds & GIS consolidation (points)	Current M-Class boundary/impact + Additional finds & GIS consolidation (points)	Net Change (points)	EIS/SPIR boundary/impact approval (area)	EIS/SPIR boundary/impact + Additional finds & GIS consolidation (area)	Current M-Class boundary/impact + Additional finds & GIS consolidation (area)	Net Change (area)	EIS/SPIR boundary/impact (points)	EIS/SPIR boundary/impact + Additional finds & GIS consolidation (points)	Current M-Class boundary/impact + Additional finds & GIS consolidation (points)	Net Change (points)	EIS/SPIR boundary/impact approval (area)	EIS/SPIR boundary/impact + Additional finds & GIS consolidation (area)	Current M-Class boundary/impact + Additional finds & GIS consolidation (area)	Net Change (area)
Rough-barked Apple	Angophora robur	S3	6443	6443	5915	-528	87.895	89.115	78.568	-10.547	1146	1146	1512	366	20.691	21.137	25.886	4.748	1208	1208	1092	-116	19.572	21.056	23.565	2.509
		S4	108	108	18	-90	2.618	2.561	0.237	-2.324	3	3	35	32	0.462	0.550	1.147	0.597	8	8	34	26	0.425	0.480	0.986	0.506
		Total	6551	6551	5933	-618	90.513	91.676	78.805158	-12.871	1149	1149	1547	398	21.153	21.687	27.033	5.346	1216	1216	1126	-90	19.997	21.536	24.551	3.015
Broad-leaved Apple	Angophora subvelutina	S1				0		0.290	0.291	0.001			1	1		0.050	0.051	0.001				0		0.054	0.054	0.000
		Total	0	0	0	0	0	0.290	0.291	0.001	0	0	1	1	0	0.050	0.051	0.001	0	0	0	0	0	0.054	0.054	0.000
White laceflower	Archidendron hendersonii	S10	1	3	4	1				0.000	4	8	1	-7				0.000	18	18	17	-1				0.000
		Total	1	3	4	1	0	0.000	0.000	0.000	4	8	1	-7	0	0.000	0.000	0.000	18	18	17	-1	0	0.000	0.000	0.000
Veiny Lace Flower	Archidendron muellerianum	S10			2	2				0.000				0				0.000				0				0.000
		Total	0	0	2	2	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000
	Artanema fimbriatum	S3		5	5	0				0.000				0				0.000				0				0.000
		Total	0	5	5	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000
Hairy-joint grass	Arthraxon hispidus	S1	2	2	2	0				0.000				0				0.000				0				0.000
		S3	1	1	1	0				0.000				0				0.000				0				0.000
		S8	38	38	16	-22	0.238	1.244	0.097	-1.147		2	17	15		0.020	0.115	0.095	8	8	20	12	0.038	0.038	0.101	0.062
		S10	347	347	376	29	1.232	0.256	1.575	1.320	47	47	52	5	0.697	0.697	0.861	0.164	53	53	35	-18	0.846	0.858	0.811	-0.046
		Total	388	388	395	7	1.47	1.500	1.672	0.172	47	49	69	20	0.697	0.717	0.976	0.259	61	61		-6	0.884	0.896	0.912	0.016
Stinking laurel	Cryptocarya foetida	S10	41	51	49	-2				0.000	1	1	7	20				0.000	6	7	3	-4				0.000
		Total	41	51	49	-2	0	0.000	0.000	0.000	1	1	7	20	0	0.000	0.000	0.000	6	7	3	-4	0	0.000	0.000	0.000
Water nutgrass	Cyperus aquatilis	S1	1	1	1	0	0.021	0.021	0.030	0.009				0		0.013	0.004	-0.009				0				0.000
		S2	6	6	6	0	0.003	0.003	0.003	0.000				0				0.000				0				0.000
		S6	113	121	111	-10				0.000				0				0.000			10	10				0.000
		S7	8	3	3	0				0.000	2	1		-1				0.000	1		1	1				0.000
		Total	128	131	121	-10	0.024	0.024	0.000	0.009	2	1	0	-1	0	0.013	0.004	-0.009	1	0	11	11	0	0.000	0.000	0.000
Davidson's Plum	Davidsonia jerseyana	S10				0				0.000			1	1				0.000				0				0.000
		Total	0	0	0	0	0	0.000	0.000	0.000	0	0	1	1	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000
Square-stemmed spike-rush	Eleocharis tetraquetra	S1	253	58	235	177	0.815	0.787	0.889	0.101	43	178	58	-120	0.118	0.135	0.144	0.009	48	44	11	-33	0.12	0.122	0.114	-0.007
		Total	253	58	235	177	0.815	0.787	0.889	0.101	43	178	58	-120	0.118	0.135	0.144	0.009	48	44	11	-33	0.12	0.122	0.114	-0.007
Green-leaved rose walnut	Endiandra muelleri ssp. bracteata	S4			2	2				0.000		1	1	0				0.000	2	1	1	0				0.000
		S10	3	4	4	0				0.000	10	11	2	-9				0.000	3	4	10	6				0.000
		Total	3	4	6	2	0	0.000	0.000	0.000	10	12	3	-9	0	0.000	0.000	0.000	5	5	11	6	0	0.000	0.000	0.000
Square-fruited Ironbark	Eucalyptus tetrapleura	S2	822	868	919	51	20.285	20.990	19.388	-1.602	193	188	181	-7	6.337	7.205	6.090	-1.114	115	102	92	-10	4.87	6.585	5.394	-1.191
		S3				0			0.573	0.573				0		0.743	0.170	-0.573				0		0.720	0.154	-0.566
		Total	822	868	919	51	20.285	20.990	19.960	-1.029	193	188	181	-7	6.337	7.948	6.260	-1.687	115	102	92	-10	4.87	7.305	5.548	-1.757
Four-tailed grevillea	Grevillea quadricauda	S3	3	3	5	2		0.020	0.020	0.000	35	35	34	-1	0.017	0.018	0.018	0.000	14	14	13	-1		0.003	0.003	0.000
		Total	3	3	5	2	0	0.020	19.980	0.000	35	35	34	-1	0.017	0.018	0.018	0.000	14	14	13	-1	0	0.003	0.003	0.000
Noah's false chickweed	Lindernia alsinoides	S1	1811	958	1035	77				0.000	18	72	17	-55				0.000	91	17	31	14				0.000
		S2				0				0.000				0				0.000	4	2		-2				0.000
		Total	1811	958	1035	77	0	0.000	0.000	0.000	18	72	17	-55	0	0.000	0.000	0.000	95	19	31	12	0	0.000	0.000	0.000
Slender screw fern	Lindsaea incisa	S1		1470	1470	0	0.013	0.013	0.013	0.000		250	250	0		0.001	0.001	0.000		330	330	0	0.003	0.003	0.003	0.000
		S2		409	409	0		0.024	0.024	0.000		1	1	0		0.003	0.003	0.000		2	2	0		0.004	0.003	0.000
		S3			1	1			0.005	0.005			2	2			0.007	0.007			1	1		0.001	0.003	0.002
		S6		11437	11927	490	0.37	0.370	0.281	-0.089		1501	3903	2402	0.058	0.058	0.137	0.078		3221	186	-3035	0.148	0.152	0.346	0.194
		Total	0	13316	13807	491	0.383	0.406	0.323	-0.084	0	1752	4156	2404	0.058	0.062	0.148	0.086	0	3553	519	-3034	0.151	0.159	0.356	0.196
Macadamia Nut	Macadamia integrifolia	S10				0				0.000			2	2				0.000			2	2				0.000
		Total	0	0	0	0	0	0.000	0.000	0.000	0	0	2	2	0	0.000	0.000	0.000	0	0	2	2	0	0.000	0.000	0.000
Rough-shelled Bush Nut	Macadamia tetraphylla	S5		3	2	-1				0.000			1	1				0.000				0				0.000
		S8			2	2				0.000	2	2		-2				0.000				0				0.000
		S10	10	10	10	0				0.000				0				0.000	3	3	11	8				0.000
		Total	10	13	14	1	0	0.000	0.000	0.000	2	2	1	-1	0	0.000	0.000	0.000	3	3	11	8	0	0.000	0.000	0.000
Maundia	Maundia triglochinoides	S1	5	4	6	2	0.075	0.103	0.117	0.014	5	1	1	0	0.038	0.044	0.042	-0.001		1	1	0		0.032	0.032	0.000
		S2	34	28	20	-8	0.075	0.069	0.052	-0.017	45	43	39	-4	0.072	0.082	0.054	-0.028	16	6	10	4	0.073	0.065	0.075	0.010
		S3	3	3	1	-2	0.016	0.050	0.020	-0.029			1	1		0.006	0.026	0.020	1	1	2	1		0.034	0.068	0.035
		S7	11	10	8	-2	0.023	0.023	0.018	-0.005	16	18	4	-14		0.008	0.003	-0.005	1	3	1	-2		0.018	0.002	-0.016
		Total	53	45	35	-10	0.189	0.245	0.207	-0.038	66	62	45	-17	0.11	0.140	0.126	-0.014	18	11	14	3	0.073	0.148	0.177	0.029
Weeping paperbark	Melaleuca irbyana	S7	1582	1582	1539	-43	2.761	2.761	2.714	-0.047	132	132	165	33	0.322	0.322	0.413	0.091	41	42	68	26	0.203	0.246	0.250	0.004
		Total	1582	1582	1539	-43	2.761	2.761	2.714	-0.047	132	132	165	33	0.322	0.322	0.413	0.091	41	42	68	26	0.203	0.246	0.250	0.004
Yellow-Flowered King of the Fairies	Oberonia complanata	S8	18	20	20	0	0.033	0.033	0.038	0.005	1	2	8	6	0.013	0.013	0.011	-0.002	6	7	1	-6		0.003	0.000	-0.003
		Total	18	20	20	0	0.033	0.033	0.038	0.005	1	2	8	6	0.013	0.013	0.011	-0.002	6	7	1	-6	0	0.003	0.000	-0.003
	Oberonia titania	S10				0				0.000				0				0.000		13		-13	13			0.000
		Total	0	0	0	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000	0	13	0	-13	13	0.000		0.000
	Olax angulata	S2		1	1	0				0.000				0				0.000				0				0.000
		Total	0	1	1	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000
Birdwing Butterfly Vine	Pararistolochia praevenosa	S10		40	50	10				0.000		10		-10				0.000		1	1	0				0.000
		Total	0	40	50	10	0	0.000	0.000	0.000	0	10	0	-10	0	0.000	0.000	0.000	0	1	1	0	0	0.000	0.000	0.000
Tall knotweed	Persicaria elatior	S4	53	53	98	45	0.153	0.153	0.137	-0.016	3	8	108	100		0.042	0.521	0.479	1	3	64	61	0.006	0.006	0.436	0.430
		S5	23	23	97	74	0.047	0.057	0.154	0.097	25	25	30	5	0.069	0.077	0.060	-0.017	68	68	29	-39	0.084	0.098	0.057	-0.041
		Total	76	76	195	119	0.2	0.210	0.291	0.081	28	33	138	105	0.069	0.120	0.581	0.462	69	71	93	22	0.09	0.104	0.493	0.389
Singleton mint bush	Prostanthera cineolifera	S6	609	616	653	37	0.424	0.424	0.438	0.015	260	258	228	-30	0.188	0.188	0.177	-0.011	106	106	99	-7	0.229	0.229	0.204	-0.026
		Total	609	616	653	37	0.424	0.424	0.438	0.015	260	258	228	-30	0.188	0.188	0.177	-0.011	106	106	99	-7	0.229	0.229	0.204	-0.026
Moonee Quassia	Quassia sp. Moonee Creek	S1	73	133	73	-60	0.08	0.152	0.080	-0.073	137	173	137	-36	0.105	0.091	0.107	0.016	250	185	243	58	0.126	0.106	0.120	0.014
		Total	73	133	73	-60	0.08	0.152	0.080	-0.073	137	173	137	-36	0.105	0.091	0.107	0.016	250	185	243	58	0.126	0.106	0.120	0.014
	Rotala tripartia	S6			2	2				0.000				0				0.000	2	6		-6				0.000
		Total	0	0	2	2	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000	2	6	0	-6	0	0.000	0.000	0.000
	ROTAP Trichosanthes subvelutina	S10				0				0.000		1	1	0				0.000				0				0.000
		Total	0	0	0	0	0	0.000	0.000	0.000	0	1	1	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000
Siah's Backbone	Streblus pendulinus	S10	4	4	3	-1				0.000	1	1	4	3				0.000	2	2	1	-1				0.000
		S4											1	1				0.000	1	1		-1				0.000
		S8												0				0.000		2		-2				0.000
		Total	4	4	3	-1	0	0.000	0.000	0.000	1	1	5	4	0	0.000	0.000	0.000	3	5	1	-4	0	0.000	0.000	0.000
Smooth-bark Rose Apple, Red Lilly Pilly	Syzygium hodgkinsoniae	S10	6	6	2	-4				0.000	4	4		-4				0.000		6	8	2				0.000
		Total	6	6	2	-4	0	0.000	0.000	0.000	4	4	0	-4	0	0.000	0.000	0.000	0	6	8	2	0	0.000	0.000	0.000