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Big Swamp Vegetation Monitoring Report 2024



Prepared for: Barwon Water

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Summary

In October 2024, Barwon Water commissioned Ecology Australia to conduct the fourth round of vegetation monitoring at the Big Swamp wetland. Monitoring involved repeat surveys of those initially undertaken by Eco Logical in 2019, 2020 and 2022. Both transect and quadrat monitoring were conducted to assess the vegetation condition, distribution and diversity within Big Swamp. Monitoring data collected will be used by Barwon Water to gauge how the swamp is responding to remedial actions implemented as part of Barwon Water's Remediation and Environmental Protection Plan (REPP) to address the impacts caused by Barwon Water's historic groundwater pumping activities at the Barwon Downs borefield.

Five different Ecological Vegetation Classes (EVCs) within the study area were observed and described and two threatened flora species were identified along transects and within quadrats across the swamp. Recruitment of soft tree-fern *Dicksonia antarctica* was apparent within some areas of the swamp, reflecting the observed groundwater level recovery and increase in moisture within the swamp.

Seven new quadrats were established within the inundation area of the swamp and four new quadrats were established outside of the inundation area to better represent and more accurately monitor the diversity of vegetation types found across the swamp. Quadrats established within the inundation area generally had a higher proportion of terrestrial damp and amphibious species compared with those located outside of it.

Terrestrial species dominant within quadrats located in the inundation area, including prickly tea-tree *Leptospermum continentale* and swamp gum *Eucalyptus ovata*, likely encroached into these areas as a result of the drying of the swamp. Canopy gaps in thickets of prickly tea-tree appear to be forming in some inundated areas, likely caused by root destabilisation due to prolonged periods of inundation. Recolonisation by sedges and rushes typical of the EVC Wet Verge Sedgeland, which was likely once more prevalent across the swamp, has occurred in these areas of up-rooted prickly-tea tree.

Overall trends in species compositions along transects between years of monitoring was limited. As this method was established to provide insight into the encroachment of dry vegetation classes, rather than monitoring the vegetation condition, distribution and diversity within Big Swamp, the transect data no longer aligns with the objectives of the REPP. Data collected through increasing the sampling effort of quadrats across the swamp as done during the 2024 monitoring event will more appropriately inform progress towards meeting the targets and objectives outlined in the REPP going forward.

The higher proportions of amphibious and terrestrial damp species within quadrats surveyed in the inundation area of the Big Swamp suggest that the current conditions within the inundation area are likely conducive to supporting the vegetation types that are thought to have once been more prevalent across the swamp plain.

1 Introduction

1.1 Background

Between 2018 and 2020 Barwon Water developed a Remediation and Environmental Protection Plan in consultation with Southern Rural Water and a community and stakeholder working group, to address the impacts caused by the historic management of groundwater pumping activities at the Barwon Downs borefield. Whilst the REPP was initially accepted by Southern Rural Water in February 2020, this was subsequently amended in October 2024 to account for the additional knowledge and understanding gained since February 2020, and address feedback from Barwon Water's Remediation Reference Group, as well as Southern Rural Water and their Independent Technical Review Panel (ITRP).

The REPP is underpinned by an ongoing monitoring and assessment program to evaluate how the system is responding to the controls and actions outlined in the REPP and help determine when successful remediation has been achieved.

In October 2024, Barwon Water commissioned Ecology Australia to conduct the fourth round of vegetation monitoring at the Big Swamp site and review the methodology to ensure this remains fit for purpose and can successfully measure progress towards updated targets outlined in the REPP.

1.2 Project objectives

The objectives of the project are to assess the vegetation condition, distribution and diversity within Big Swamp and determine:

- How the vegetation communities are responding to the remediation actions adopted as part of the Boundary Creek and Big Swamp Remediation Plan and other factors such as climate and land use changes within the catchment
- Whether the inundation areas within Big Swamp have or have the potential to develop aquatic flora and fauna, or
- Whether the Tier 1 or Tier 2 contingency measures outlined in the REPP (Barwon Water, 2024) are required to be implemented

1.3 Study area

The study area encompasses the Big Swamp wetland and surrounds and is situated on private land in Yeodene, south-east of Colac (Figure 1). The study area falls within the Otway Plain Bioregion.

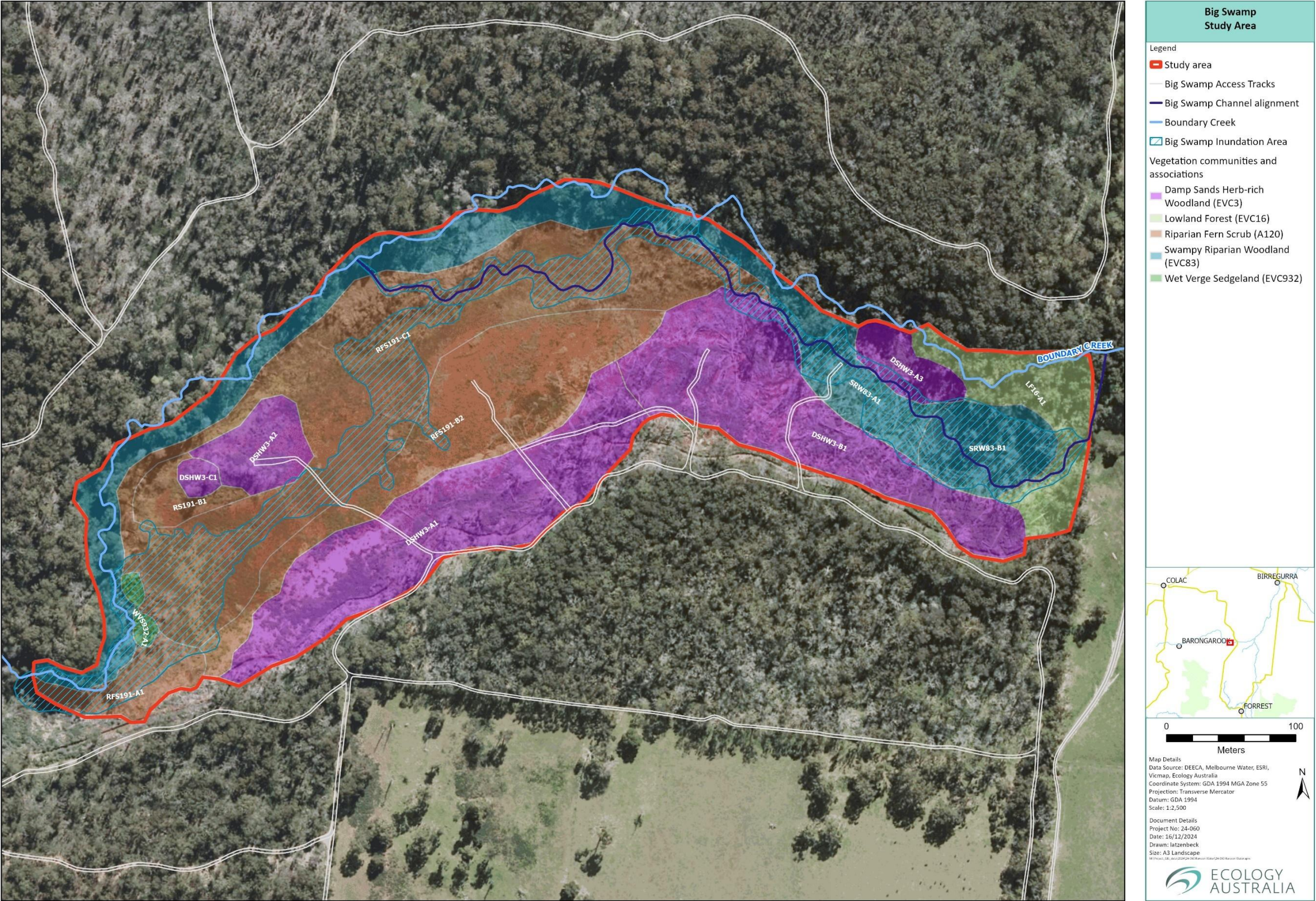


Figure 1 Big Swamp study area location. Note the various vegetation communities presented here were mapped by (Eco Logical Australia 2019). A description of each of the vegetation types is presented in the (Eco Logical Australia 2019) report.

2 Methods

2.1 Database review

Prior to undertaking the field assessment, Ecology Australia undertook a review of online databases and previous reports. The following resources were accessed during the desktop assessment:

- Flora and fauna records within 5 km of the study site held in DEECA's Victorian Biodiversity Atlas (VBA) online database (DEECA 2024b).
- Records of ecological communities and flora and fauna species listed under the EPBC Act (1999) within a 5 km radius of the study area using the EPBC Protected Matters Search Tool (DCCEEW 2024)
- Ecological Vegetation Class (EVC) mapping/modelling of the area (both extant and pre-1750) from DEECA's NatureKit interactive map (DEECA 2024a).
- Relevant GIS data and aerial photography.
- Previous relevant reports and plans as follows:
 - Assessment of historical and current vegetation diversity and condition within Big Swamp (Eco Logical Australia 2019)
 - Big Swamp Vegetation Monitoring Report 2020 (Eco Logical Australia 2021)
 - Big Swamp Vegetation Monitoring Report 2022 (Eco Logical Australia 2023)
 - Boundary Creek, Big Swamp and Surrounding Environment Remediation and Environmental Protection Plan (Barwon Water 2024)
 - Ecological Risk Assessment: Boundary Creek, Big Swamp and the Barwon River (Nation Partners 2025)
 - Big Swamp Paleoenvironmental Study (La Trobe University 2023)

2.2 Methodology review

Prior to undertaking field assessments, a review of the current vegetation monitoring methodology was conducted to assess whether it remained fit for purpose for evaluating how the system is responding to the controls and actions outlined in the REPP and successfully measure progress towards the accepted remediation success targets.

This review highlighted that the methodology that had been employed to date was primarily focused on monitoring the encroachment of dryland species into Big Swamp, meaning the resulting data is too coarse to capture fine-scale changes within and across the different vegetation communities.

As such, it was determined that increasing the number of replicates across the vegetation communities identified within Big Swamp would better represent the diversity of the vegetation present and would allow for more accurate monitoring of any changes that occur.

The finalised methodology, established in consultation with Barwon Water and relevant technical advisors, involved establishing 11 new 8 x 8 m quadrats (in addition to the 5 pre-existing quadrats). The

sampling effort was concentrated within the inundation areas to aid in determining whether these areas have or have the potential to develop aquatic flora and fauna, which is one of the success targets outlined in the REPP. Furthermore, it was decided that assigning the species present within these quadrats to a functional group (Casanova 2011) would also help to determine whether the composition of species present is shifting to a more aquatic or terrestrial-dominated community.

2.3 Field Assessments

Field assessments were conducted between the 2nd and 5th of December by a team of two botanists. The monitoring methodology involved a combination of survey techniques, including the use of transects and quadrats. The location of quadrats and transects are presented in Figure 2 and Appendix 2–3. The approach involved with each monitoring technique is described below.

2.3.1 Transect methodology

Vegetation transect monitoring involved sampling 7 permanent 50 metre-long transects (one of the transects established in 2019 was not resurveyed in 2024 due to access/safety issues) initially established by Eco Logical Australia in 2019 and 2020 to monitor the boundaries of different vegetation communities or ‘ecohydrological zones’ (Eco Logical Australia, 2019 and Eco Logical Australia, 2020). These included the Main Channel, Swamp Plain, Damp Woodlands, Wet Verge Sedgeland and Lowland Forest.

Point intercept measurements were taken at 25cm intervals along the entire transect, for a total of 200 points per transect. Every flora species that intercepted the point was recorded, in addition to a ground parameter including bare ground, bryophytes, litter, water or log. A photo was taken at each transect from a permanent photopoint established at the start of each transect with a metal star picket.

2.3.2 Quadrat methodology

Quadrat monitoring involved assessing 5 pre-existing and 11 new 8 x 8 metre floristic quadrats within the Big Swamp study area and the surrounding vegetation. A full inventory of all flora species observed within the quadrat was recorded. Each species and ground parameter (bare ground, bryophytes, litter, water, log) identified within the quadrat was assigned a percentage cover value (projected foliage cover). Each species was then allocated a functional group based on the categories listed in Table 1. The classification of plant species into these groups was based largely on (Brock and Casanova 1997; Reid and Quinn 2004), and species not classified in either of these studies were assigned to functional groups based on field observations and information available in (VicFlora 2024).

Table 1 Flora functional group (FG) categories assigned to plant species recorded in quadrats

FG	Description
S	Aquatic submerged species (established plants that do not tolerate drying).
F	Aquatic floating, unattached species (established plants that do not tolerate drying).
Arf	Amphibious, fluctuation-responder, floating species which have floating leaves in their aquatic phases and also grow stranded on damp ground.

FG	Description
Arp	Amphibious, fluctuation-responder, floating species, with various growth characteristics, that feature morphological plasticity in response to water level fluctuations.
Atl	Amphibious, fluctuation-tolerant, emergent species which are dicotyledons and require damp conditions (low growing plants that tolerate wetting and drying).
Ate	Amphibious, fluctuation-tolerant, emergent species which are mostly monocotyledons (emergent plants that tolerate wetting and drying).
Atw	Amphibious, fluctuation-tolerant, emergent plants which are woody (trees and shrubs that tolerate wetting and drying).
Tda	Terrestrial species that typically occur in damp habitats.
Tdr	Terrestrial species that typically occur in dry habitats.

2.4 Plant names

Plant names in this report follow those names published in the VBA database (DEECA 2024b). An asterisk (*) denotes species that are exotic to Victoria.

2.5 Limitations

Fieldwork was conducted in early December 2024. Early summer is an ideal time to survey, with most vascular plant species being readily identifiable due to the presence of above-ground vegetative growth, fruits or flowers. Nonetheless, some species may not have been detectable at the time of surveys, and as such, species lists compiled per quadrat/transect should not be considered as an exhaustive inventory. Floristic surveys are also influenced by project constraints (e.g. differences in survey times each year) and environmental conditions (e.g. climatic conditions, wetland wetting and drying cycles, etc.) which will further influence species which are present and detectable at the time of surveys.

It was noted that the stake marking the location of Q5 could not be located by Eco Logical Australia in 2022 and this was reestablished using GPS coordinates (Eco Logical Australia, 2023). Review of the site photos and species provided by Eco Logical Australia show the species composition between the 2020 and 2022 location were not consistent between years. During 2024 surveys, Ecology Australia botanists were able to relocate and assess all quadrat locations assessed during the 2022 surveys. Inconsistencies in quadrat placement can limit the ability to draw meaningful conclusions regarding changes in vegetation structure and condition across years.

Transect 7 was not monitored during the 2024 survey period. This transect could not be safely accessed due to dense regrowth of vegetation and deep inundation levels surrounding the transect.

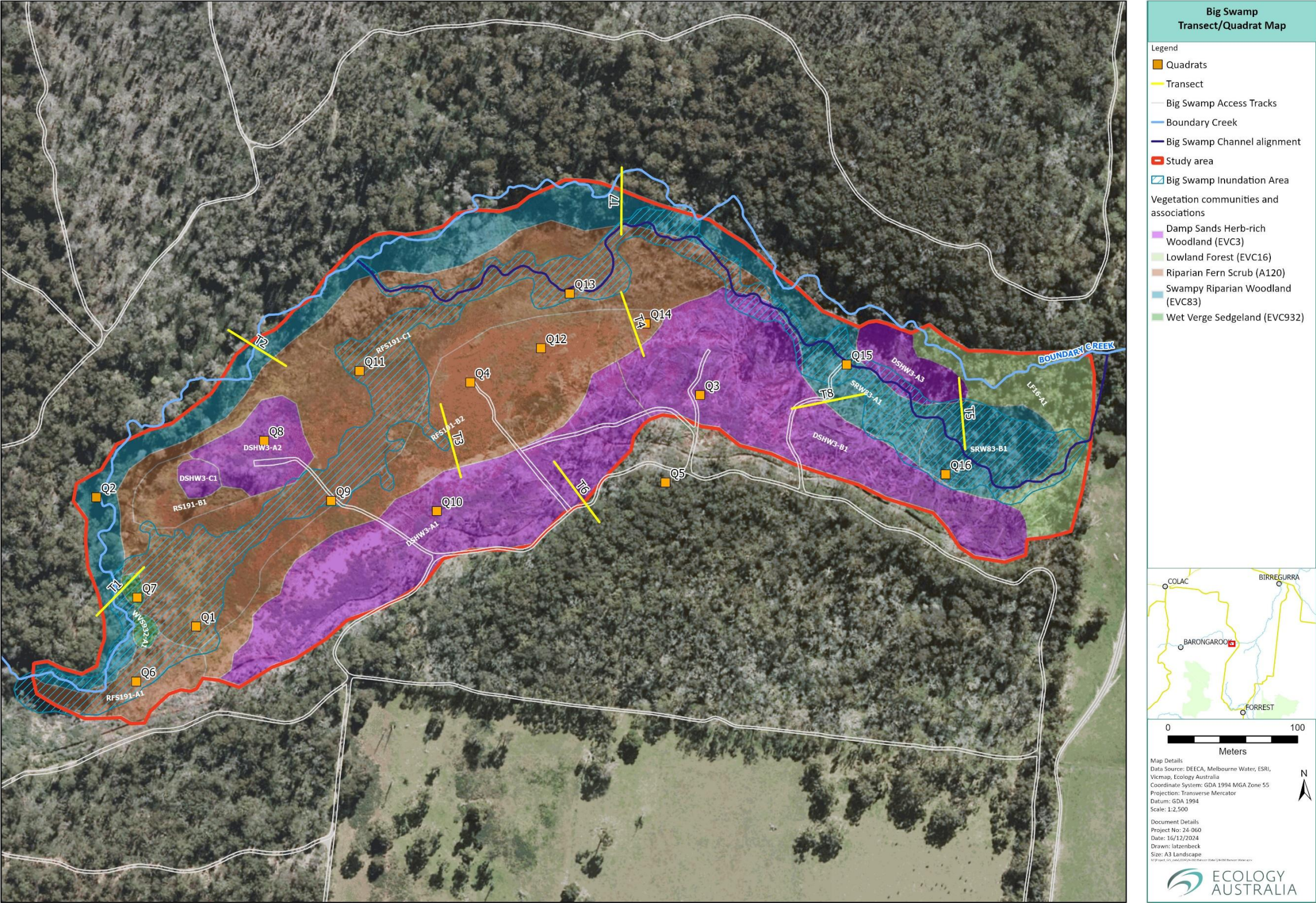


Figure 2 Big Swamp quadrat and transect locations. Quadrats 6 – 16 were established during the 2024 monitoring event.

3 Results

3.1 Ecological Vegetation Classes

Five ecological vegetation classes (EVCs) were previously identified within the study area (mapped by Eco Logical 2019). These included Lowland Forest (EVC 16), Damp Sands Herb-rich Woodland (EVC 3), Swampy Riparian Woodland (EVC 83), Wet Verge Sedgeland (EVC 932) and Riparian Fern Scrub (EVC A120; Figure 2). Both Lowland Forest and Damp Sands Herb-rich Woodland are not considered wetland EVCs. These EVCs are less reliant on surface water availability and are more dependent upon groundwater availability. Therefore, they are more likely to contain a higher proportion of species within the terrestrial dry and terrestrial damp functional groups, rather than species within the amphibious and aquatic functional groups.

EVCs mapped by (Eco Logical Australia 2019) are further broken down into separate vegetation associations according to differences in floristic and structural diversity. These vegetation associations are described in (Eco Logical Australia 2019). A description of EVCs based on the quadrats sampled in 2024 is provided below.

Lowland Forest (EVC 16)

This EVC was mapped in a small section at the eastern end of the study area, in addition to the upper slopes of the swamp beyond the boundary of the study area (Eco Logical Australia 2019). The vegetation within this EVC was generally found to be in good condition, with a high floristic and structural diversity based on the benchmark for this EVC (DSE 2004). Lowland Forest was characterised by a tall overstorey of messmate stringybark *Eucalyptus obliqua*, over a midstorey of scattered prickly moses *Acacia verticillata* and hazel pomaderris *Pomaderris aspera*. The understorey consisted of a dense layer of ferns, grasses and herbs. Dominant species included Austral bracken *Pteridium esculentum*, spiny-headed mat-rush *Lomandra longifolia*, tall sword-sedge *Lepidosperma elatius*, weeping grass *Microlaena stipoides* var. *stipoides*, forest wire-grass *Tetrarrhena juncea*, blue bottle-daisy *Lagenophora stipitata* and shade wood-sorrel *Oxalis exilis*.

Damp Sands Herb-rich Woodland (EVC 3)

This EVC was found to be in moderate condition, with the ground layer generally lacking diversity. The rich array of grasses, herbs and orchids expected in an unmodified representation of this EVC was not present. Damp Sands Herb-rich Woodland generally consisted of a dense, immature woodland of swamp gum *Eucalyptus ovata* over a dense understorey of Austral bracken. Scattered shrubs such as prickly moses, red-fruit saw-sedge *Gahnia sieberiana* and snowy daisy bush *Olearia lirata* were also present. Scattered ground layer flora present included species such as weeping grass, forest wire-grass, annual fireweed *Senecio glomeratus*, shrubby fireweed *Senecio minimus*, bidgee-widgee *Acaena novae-zelandiae* and hairy pennywort *Hydrocotyle hirta*.

Swampy Riparian Woodland (EVC 83)

Swampy Riparian Woodland occurred along the main channel of Boundary Creek and a channel that bisects the swamp (Eco Logical Australia 2019). This EVC was generally found to be in very good condition, with a high floristic and structural diversity. This EVC encompasses a permanently inundated

area at the eastern end of the swamp, which comprises dead stags of Eucalypts and soft tree-fern *Dicksonia antarctica*. Amphibious species have begun to colonise the margins of this waterbody. Swampy Riparian Woodland is characterised by an overstorey primarily consisting of swamp gum, manna gum *Eucalyptus viminalis* subsp. *viminalis* and Brooker's gum *Eucalyptus brookeriana*. A tall shrub layer comprising blackwood *Acacia melanoxylon*, hazel pomaderris *Pomaderris aspera* and prickly tea-tree was common along the main channel of Boundary Creek, accompanied by a ground layer consisting of tall sedge, red-fruit saw-sedge, tall sword-sedge, weeping grass, slender tussock grass *Poa tenera*, Austral bracken and forest wire-grass. A number of fern species such as fishbone water-fern *Blechnum nudum* and soft water-fern *Blechnum minus* commonly lined the main channel. Within the waterway itself, the aquatic species common water-ribbons *Cyanogeton procerum* was abundant.

Wet Verge Sedgeland (EVC 932)

Wet verge sedgeland was found to be in good condition, although lacking in herb diversity. This EVC was mapped on the western side of the swamp, adjacent to the main channel (Eco Logical Australia 2019). However, small patches of this EVC were also found scattered throughout the inundation area during the 2024 site visit. Wet Verge Sedgeland was completely inundated at the time of the survey. This vegetation community was characterised by a treeless vegetation community dominated by tassel sedge *Carex fascicularis* and scattered tall sedge, common spike-sedge, Australian gypsywort *Lycopus australis* and tall rush. Herbs were present at low abundances, including slender knotweed *Persicaria decipiens*, lesser joyweed *Alternanthera denticulata*, common sneezeweed *Centipeda cunninghamii* and variable willow-herb *Epilobium billardioreanum* subsp. *intermedium*.

Riparian Fern Scrub (EVC A120)

Riparian Fern Scrub varied considerably in floristic composition across the study area. Occurring at the lowest point of the swamp, this EVC was likely to be the most heavily affected by changes in hydrology due to groundwater extraction from the Barwon Downs borefield. The lack of moisture availability coupled with previous fire events (which occurred in 1998 and 2011), likely facilitated the encroachment of opportunistic dryland species into this EVC. As a result, monospecific thickets of tea-tree and scented paperbark occur across much of the area once occupied by Riparian Fern Scrub. In these areas, low light penetration to the understorey has resulted in a ground layer almost entirely devoid of vegetation. Where canopy gaps exist within the inundation area, Wet Verge Sedgeland appears to have colonised.

Some remnant high quality Riparian Fern Scrub persists at the western end of the swamp, consisting of scattered swamp gum and a high diversity of largely amphibious sedges, rushes and herbs. Common species included tall sedge, tall sword sedge, tassel sedge, various *Juncus* species, Australian gypsywort, weeping grass, shrubby fireweed, showy lobelia, wing pennywort, swamp club-sedge *Isolepis inundata* and lesser joyweed.

3.2 Transect monitoring

A list of species found along each of the transects monitored between 2019 and 2024 is presented in Appendix 4 and photos taken at the start of each transect are presented in Appendix 5.

2024 results show a decrease from 2022 in the number of point intercepts of lesser joyweed, tall sedge, tassel sedge and swamp gum along Transect 1, while Australian gypsywort showed an increase in the number of intercepts (Appendix 4). However, no overall trend across years is apparent across these species, aside from Australian gypsywort, which appears to be growing increasingly dominant within the Wet Verge Sedgeland vegetation community.

Transect 2 showed an increase in blackwood, tall sedge and swamp club-sedge and a decrease in prickly moses between 2022 and 2024. Of these species, blackwood appears to be gradually increasing in density across all years of assessment.

Scented paperbark along Transect 3 has shown a marked increase in density between 2020 and 2022, and again in 2024.

Transect 4 showed a marked decrease in scented paperbark and red-fruit saw-sedge between 2022 and 2024, but there is no apparent trend across all years of assessment.

Transect 5 showed a decrease in Yorkshire fog, hazel pomaderris and forest wire-grass between 2022 and 2024, though no obvious trend is apparent across all years of assessment. However, a gradual increase in tall rush and tall sedge has occurred across years.

Transect 6 showed a decrease in mountain clematis, swamp gum and red-fruit saw-sedge and an increase in tall sword-sedge, blackwood and snowy daisy-bush between 2022 and 2024.

Transect 7 was not monitored during the 2024 survey period. This transect could not be safely accessed due to dense regrowth of vegetation and deep inundation levels surrounding the transect.

Transect 8 showed an increase in Yorkshire fog, tall sedge, prickly tea-tree and scented paperbark between 2022 and 2024.

3.3 Quadrat monitoring

A total of 91 flora species were recorded within quadrats in the study area in 2024. Of these species, 77 are native and 14 are exotic. Two threatened flora species listed under the FFG Act were recorded in quadrats in 2024, including Brooker's gum *Eucalyptus brookeriana* (listed as endangered) and showy lobelia *Lobelia beaugleholei* (listed as vulnerable). A full inventory of flora species found across quadrats is presented in Appendix 1 and photos taken of each quadrat are displayed in Appendix 6.



Figure 3 Brooker's gum found along the main channel within the Big Swamp study area



Figure 4 Showy lobelia found in Riparian Fern Scrub within the Big Swamp study area

Overall species richness in pre-existing quadrats (quadrats 1 – 5) was seen to increase in quadrats 1, 3, 4 and 5 in 2024 compared with 2022. Generally, this included an increase in the number of terrestrial dry and terrestrial damp species present in these quadrats. Conversely, a decrease in species richness was seen in quadrat 2 in 2024 compared with 2022. A substantial decrease in species richness was seen in quadrats 1 and 5 from 2020 to 2022 (Figure 5).

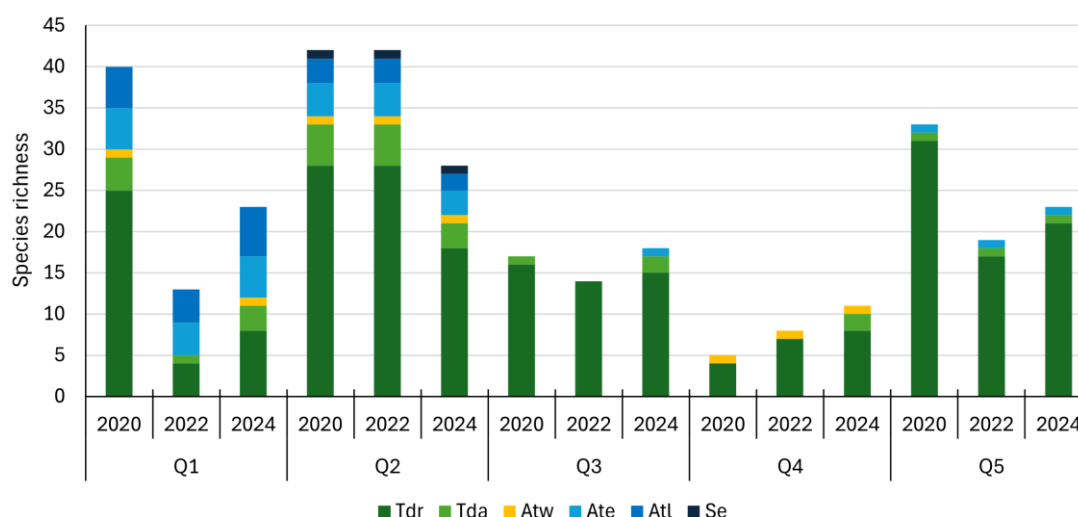


Figure 5 Functional group species richness recorded within each of the five pre-existing quadrats in 2020 (Eco Logical 2021), 2022 (Eco Logical 2023) and 2024.

While species richness has increased across most quadrats, the proportional abundance of species in each functional group has remained relatively stable in quadrats 2 to 5 across years (Figure 6). Conversely, the proportional abundance of species in quadrat one has varied considerably, particularly with regards to terrestrial dry, terrestrial damp and emergent amphibious species.

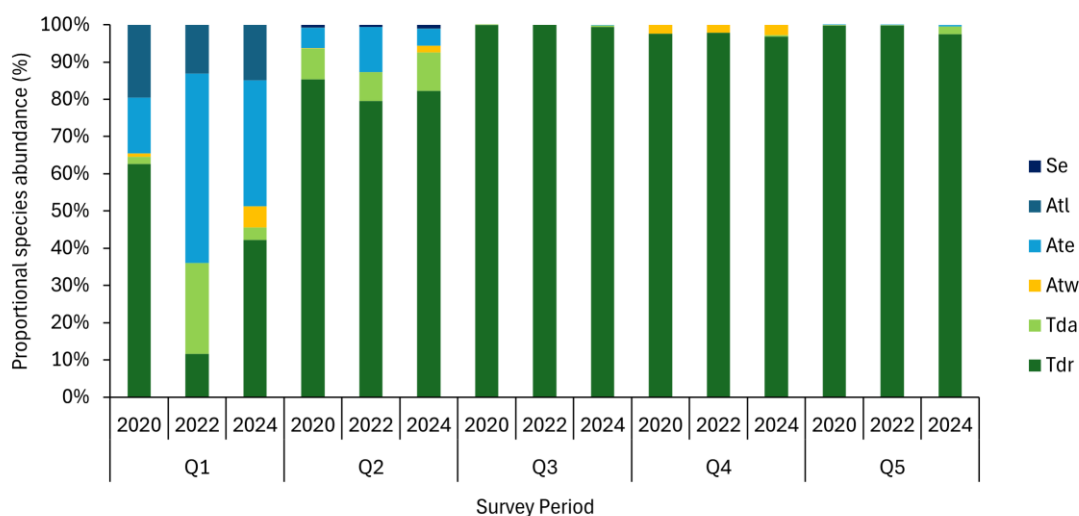


Figure 6 Proportional functional group species abundance recorded within each of the five pre-existing quadrats in 2020 (Eco Logical 2021), 2022 (Eco Logical 2023) and 2024.

In 2024, quadrats within the inundation area generally had a lower proportion of terrestrial dry species compared to quadrats outside of the inundation area (Figure 7). However, Quadrat 2 was the only quadrat that contained submerged aquatic species in 2024. Although outside of the inundation area, quadrats 12 and 14 had a high proportion of terrestrial damp and amphibious woody species present.

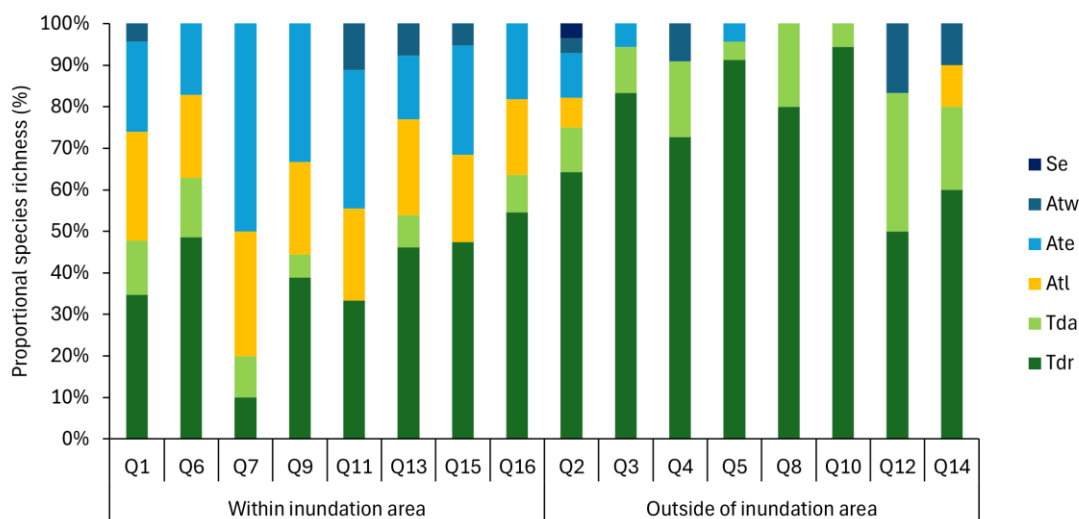


Figure 7 Proportional functional group species richness recorded within each of the 16 quadrats (5 pre-existing and 11 new) monitored in 2024. Quadrats 6 – 16 were established in 2024. Quadrats are sorted into two groups according to whether they are located within the mapped inundation area within the swamp.

Analogous to species richness, the proportional abundance of species within the terrestrial dry functional group was generally higher in the quadrats located outside of the inundation area (Figure 8). This is with the exception of quadrats 12 and 14. Quadrat 7 had a very high proportional abundance of amphibious emergent species and a very low abundance of terrestrial dry species present.

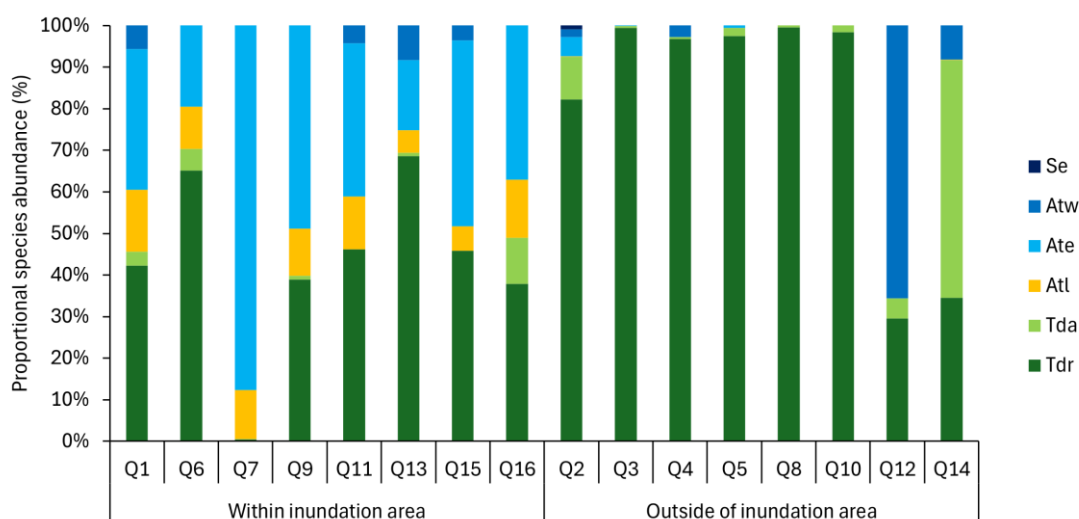


Figure 8 Proportional functional group species abundance recorded within each of the 16 quadrats (5 pre-existing and 11 new) monitored in 2024. Quadrats 6 – 16 were established in 2024. Quadrats are sorted into two groups according to whether they are located within the mapped inundation area within the swamp.

4 Discussion

4.1 Transect monitoring

Increases in some species and concurrent decreases in others were found across transects between the 2022 and 2024 monitoring periods. Despite these changes, overall trends in species compositions across all years of monitoring (between 2019 and 2024) were generally limited.

These transects were established to assess boundaries between vegetation communities in order to monitor changes in the extent of these communities over time. However, it is likely that any changes to the extent of the different vegetation communities present is likely to be a very gradual process, particularly outside of the immediate inundation area. Furthermore, while the point intercept method used to collect this transect data can provide a measure of relative species richness, it often fails to detect species with low abundances. Therefore, fine-scale changes in vegetation composition are likely to be overlooked using this method. The inability to uncouple gradual changes in the extent of the vegetation from natural variation and sampling variability using this method suggests that it is not a suitable way to monitor vegetation changes within the swamp. Changes in species compositions along the transects may largely be attributed to a combination of natural variation and the inability to accurately relocate the alignment of transects during each monitoring event, particularly due to the dense vegetation within the swamp.

4.2 Quadrat monitoring

While an increase in species richness was observed across the majority of pre-existing quadrats in 2024, no apparent trend can be drawn across years due to the general decrease in richness observed between 2020 and 2022. While species richness in Quadrat 4 was lower than all other quadrats in any given year, it was the only quadrat to show a consistent increase in species richness across years. Notably, the increase in species richness in quadrat 4 during the 2024 survey period can be attributable to the addition of terrestrial damp species, including soft tree-fern. This species was also observed to be recruiting in quadrat 1. This species grows on moist soils (and is tolerant of acidic conditions), particularly in shaded gullies and near streams (VicFlora 2024). Soft tree-fern was likely more widespread across the swamp prior to groundwater pumping impacts being realised, evident by the dead or dormant stags of this species noted at the eastern end of the swamp during field surveys. Although capable of regenerating after fire, this species is intolerant of dry conditions (Hunt *et al.* 2002). The recolonisation of this species into the swamp suggests suitable conditions to sustain this species have returned.

The substantial decrease in species richness observed in quadrats 1 and 5 between the years 2020 and 2022 appears to be the result of the inability to relocate these quadrats and establishment of new locations between survey periods (Eco Logical Australia 2023). This likely accounts for the prominent differences in species compositions and abundances in these quadrats between years.

The addition of new quadrats to the study area in 2024 included the establishment of 7 new quadrats within the inundation area, in addition to 4 quadrats outside of the inundation area. Prior to this round of monitoring, only 1 quadrat had been established within the inundation area. Generally, quadrats within this area had a higher proportion of terrestrial damp and amphibious species including tall sedge, tassel sedge, various species of juncus such as tall rush, swamp club-sedge, lesser joy-weed, as well as

wing pennywort. Amphibious species (those able to tolerate fluctuations in water levels) and terrestrial damp species (those that typically occur in damp habitats following draw down) are common in wetlands, indicating the presence of suitable prolonged moisture levels within the inundation area of the swamp.

Consistent with species richness, the proportional abundance of species within the terrestrial dry functional group was generally lower within quadrats located within the inundation area compared with those outside of it. Despite this, the terrestrial dry function group was still relatively dominant in terms of abundance within these quadrats. This is largely attributable to high covers of two species; prickly tea-tree *Leptospermum continentale* and swamp gum *Eucalyptus ovata*. Both of these species are known to grow on the margins of swamps (Vic Flora 2024). However, periodic fire events (which occurred in 1998 and 2011), coupled with changes in hydrology, have likely facilitated the encroachment of these opportunistic species into the inundation area. These species are known to be early-successional colonisers after fire, and while primarily terrestrial, they are tolerant of short periods of inundation at maturity. Thus, even though the pre-extraction hydrological regime within Big Swamp has been partially re-instated, these species are still able to persist within these inundated areas.

Throughout much of the Swamp Plain (the area encompassing the Swampy Riparian Woodland, Riparian Fern Scrub, and Wet Verge Sedgeland EVCs), prickly tea-tree has formed mono-specific thickets with a dense canopy and a depleted understorey (Figure 9). While this vegetation structure bears affinities with other wetland EVCs (e.g Swamp Scrub and Riparian Thicket), it is unlikely to have naturally occurred within the inundation area prior to groundwater pumping impacts being realised. At the lowest points of the wetland, prickly tea-tree was observed to have up-rooted in some areas (Figure 10). It is possible that prolonged inundation due to groundwater level recovery and the provision of supplementary flows into Boundary Creek has eroded the soil around these shrubs and has caused the root system to become unstable. Likely coupled with a high wind event, these shrubs have collapsed and created gaps in the canopy. Where this had occurred, recolonisation of rushes and sedges was evident, including species such as tall sedge, tassel sedge, swamp club-sedge and broad-leaf rush. This vegetation structure and composition is consistent with the Wet Verge Sedgeland wetland EVC. It is likely that the Swamp Plain once consisted of a mosaic of both Wet Verge Sedgeland in the more deeply inundated areas and Riparian Fern Scrub in the more elevated areas, according to the water depth requirements of these EVCs (Frood and Papas 2016). Two quadrats (Q11 and Q13) were established in these tea-tree canopy-gap areas to monitor future successional changes in vegetation structure and condition. It is predicted that continued prolonged inundation within the Swamp Plain will cause thinning of tea-tree and scented paperbark thickets, facilitating the re-establishment of vegetation communities that may have occurred within the swamp historically.



Figure 9 Monospecific thicket of prickly tea-tree with a depleted understorey within Big Swamp



Figure 10 Prickly tea-tree *Leptospermum continentale* up-rooting within the inundation area of Big Swamp

5 Objective attainment

The remedial action to provide suitable conditions for wetland species to recolonise impacted areas and the remedial objective to preserve/improve the ecological values of Big Swamp and Boundary Creek appear to be met. The inundation areas of the swamp support an array of amphibious species common in wetland vegetation communities. This suggests that the current conditions within the inundation area are likely conducive to supporting the vegetation types that are thought to have once been more prevalent across the swamp plain; Riparian Fern Scrub and Wet Verge Sedgeland. Indicator species listed for these EVCs are mostly amphibious species that can tolerate at least brief periods of drying (DSE 2004; DELWP 2022). Aquatic species (i.e. those that require permanent water) were largely absent from the site, however it is possible that the inundation areas within the swamp never contained aquatic flora.

The term aquatic flora in the REPP is used to include all aquatic and amphibious flora that are representative of wetland vegetation communities. However, aquatic and amphibious flora are widely regarded as distinct vegetation types. It is therefore recommended that the term 'aquatic' be changed or clearly defined in the REPP to include both aquatic and amphibious species, as amphibious species are likely to have formed the dominant functional groups represented across the inundation area historically.

The updated quadrat-based approach used in this round of monitoring provides a greater opportunity to measure progress against the objective to ensure wetland vegetation has the potential to develop than the previous methods used, as quadrats have been established in locations that are more likely to remain inundated for sustained periods.

After one round of monitoring, it is too early to conclusively state whether the Tier 1 and Tier 2 contingency measures described in the REPP are required or not. Current monitoring suggests the removal of dry vegetation species from the swamp plain may not be required. It is possible that natural thinning of these species may be occurring due to prolonged inundation periods resulting from the provision of supplementary flows and the cessation of groundwater pumping activities. At this stage, there is no evidence to suggest undesired species are providing a barrier to achieving improved environmental outcomes. However, further monitoring using the updated methods will be required to determine this more conclusively.

6 Recommendations

The pre-existing point intercept (transect) method was intended to address targets developed in the superseded REPP and does not adequately measure the current remedial actions and objectives. In addition, this method often fails to detect species with low abundances. The dense vegetation within Big Swamp also inhibits the accurate relocation and alignment of transects. In contrast to the transect monitoring method, the quadrat sampling method is both highly repeatable and feasible on-ground. Increasing the sampling effort as done during the 2024 monitoring event is much more likely to detect species composition more accurately and allow for more accurate monitoring of fine-scale changes to vegetation assemblages going forward. This data will help to address how the swamp is responding to the reinstatement of groundwater levels and flows through Boundary Creek and will more appropriately measure progress towards meeting the actions and objectives outlined in the REPP. It is therefore recommended that the transect method be removed from the Big Swamp Vegetation Monitoring program and that the additional quadrats established by Ecology Australia during the 2024 monitoring event be included in the monitoring program going forward.

The extent of the monospecific thickets of prickly tea-tree are predicted to reduce should inundation levels be maintained for prolonged periods within the inundation area. This may facilitate the re-establishment of vegetation communities that likely occurred within the swamp prior to groundwater extraction activities. A few quadrats have already been established within canopy gaps of these thickets (where the tea-tree has up-rooted), in order to monitor successional changes in species assemblages in these areas over time. We recommend that the monitoring program should be updated to include these additional quadrats, and potentially add more.

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8 Glossary

Biodiversity	The variety of all life-forms, plants, animals, fungi, protists (including algae) and bacteria, their encoded genes, and the ecosystems of which they form a part
Bioregion	Defined geographical regions of Australia with similar climatic and geophysical characteristics, and which generally contain a suite of distinct ecosystems and species
CaLP Act	Victorian <i>Catchment and Land Protection Act 1994</i>
Conservation status	Categorisation of the threat risk to biological assets (plant and animal species, EVCs or plant communities) at a defined scale (e.g. national, state), as determined by specific criteria
Ecological Vegetation Class (EVC)	A vegetation classification described through a combination of its floristic composition, life form and ecological characteristics, and its association with particular environmental attributes. EVCs may include one or more floristic communities that occur across a biogeographic range, and have similar habitat and ecological processes operating
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
Exotic	Plants, animals, fungi and other organisms that have been introduced (deliberately or accidentally) to Australia or a given area after European settlement
Exotic vegetation	Vegetation comprised wholly or substantially of exotic species
FFG Act	Victorian <i>Flora and Fauna Guarantee Act 1988</i>
Floristic	Of or pertaining to plant species, i.e. flora
GIS	Geographic Information System. A digital platform for creating, analysing and viewing maps and other spatially referenced data
Indigenous	Plant and animal species native to the geographic area of interest
Indigenous vegetation	Vegetation native to the geographic area of interest
Introduced	Deliberately or accidentally brought to Australia or part of Australia, usually by human agency
Life form	An abbreviated description of the habit, growth form and longevity of a plant species (e.g. tree, shrub, vine, annual, submerged aquatic)
Native species	Species occurring naturally in Australia as part of the pre-European flora or fauna
Vegetation community	Term for interacting plant populations forming vegetation. A vegetation community in formal classifications may have characteristic plant species, composition and structure

Appendix 1 List of all flora species recorded within quadrats in 2024

Code	Key to species statuses
cr	Critically endangered under the FFG Act
en	Endangered under the FFG Act
vu	Vulnerable under the FFG Act
*	Exotic species
#	Species native to Victoria though potentially not indigenous within study area
P	Protected flora species under the FFG Act
C	Species listed as Regionally Controlled under the CaLP Act
R	Species listed as Restricted under the CaLP Act

Status	FG	Scientific name	Common name
	Tdr	<i>Acacia melanoxylon</i>	Blackwood
	Tdr	<i>Acacia verticillata</i>	Prickly Moses
	Tdr	<i>Acaena novae-zelandiae</i>	Bidgee-widgee
	Tdr	<i>Ajuga australis</i>	Austral Bugle
	Atl	<i>Alternanthera denticulata</i> s.s.	Lesser Joyweed
*	Tdr	<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass
	Tdr	<i>Billardiera mutabilis</i>	Common Apple-berry
	Tda	<i>Blechnum minus</i>	Soft Water-fern
	Ate	<i>Blechnum nudum</i>	Fishbone Water-fern
	Ate	<i>Carex appressa</i>	Tall Sedge
	Ate	<i>Carex fascicularis</i>	Tassel Sedge
*	Tdr	<i>Centaureum erythraea</i>	Common Centaury
	Atl	<i>Centipeda cunninghamii</i>	Common Sneezeweed
	Atl	<i>Centipeda</i> spp.	Sneezeweed
*	Tdr	<i>Cerastium glomeratum</i> s.s.	Sticky Mouse-ear Chickweed
P	Tda	<i>Chiloglottis</i> spp.	Bird Orchid
*	Tdr	<i>Cirsium vulgare</i>	Spear Thistle
	Tdr	<i>Clematis aristata</i>	Mountain Clematis
	Tdr	<i>Coprosma quadrifida</i>	Prickly Currant-bush
	Se	<i>Cynogeton procerum</i> s.s.	Common Water-ribbons
	Ate	<i>Cyperus gunnii</i> subsp. <i>gunnii</i>	Flecked Flat-sedge
	Tda	<i>Dicksonia antarctica</i>	Soft Tree-fern
	Ate	<i>Eleocharis acuta</i>	Common Spike-sedge
	Tda	<i>Epilobium billardioreanum</i> subsp. <i>intermedium</i>	Variable Willow-herb
en P	Tdr	<i>Eucalyptus brookeriana</i>	Brooker's Gum
	Tdr	<i>Eucalyptus obliqua</i>	Messmate Stringybark
	Tdr	<i>Eucalyptus ovata</i>	Swamp Gum
	Tdr	<i>Eucalyptus viminalis</i> subsp. <i>viminalis</i>	Manna Gum
	Tda	<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge
*	Tdr	<i>Galium aparine</i>	Cleavers
	Tdr	<i>Galium ciliare</i> subsp. <i>terminale</i>	Hairy Bedstraw
	Tdr	<i>Gonocarpus humilis</i>	Shade Raspwort

Status	FG	Scientific name	Common name
	Ate	<i>Gonocarpus micranthus</i>	Creeping Raspwort
	Tdr	<i>Goodenia lanata</i>	Trailing Goodenia
	Ate	<i>Gratiola peruviana</i>	Austral Brooklime
	Tda	<i>Gratiola</i> spp.	Brooklime
	Tdr	<i>Gynatrix pulchella</i> s.s.	Hemp Bush
	Tda	<i>Histiopteris incisa</i>	Bat's Wing Fern
*	Tdr	<i>Holcus lanatus</i>	Yorkshire Fog
	Tdr	<i>Hydrocotyle hirta</i>	Hairy Pennywort
	Atl	<i>Hydrocotyle pterocarpa</i>	Wing Pennywort
*	Tdr	<i>Hypochaeris radicata</i>	Flatweed
	Atl	<i>Isolepis inundata</i>	Swamp Club-sedge
	Atl	<i>Isolepis subtilissima</i>	Mountain Club-sedge
*	Atl	<i>Juncus articulatus</i> subsp. <i>articulatus</i>	Jointed Rush
	Ate	<i>Juncus pauciflorus</i>	Loose-flower Rush
	Ate	<i>Juncus planifolius</i>	Broad-leaf Rush
	Ate	<i>Juncus procerus</i>	Tall Rush
	Ate	<i>Juncus sarophorus</i>	Broom Rush
	Ate	<i>Lachnagrostis filiformis</i> s.s.	Common Blown-grass
	Tdr	<i>Lagenophora stipitata</i> s.s.	Blue Bottle-daisy
	Tda	<i>Lepidosperma elatius</i>	Tall Sword-sedge
	Tdr	<i>Leptospermum continentale</i>	Prickly Tea-tree
	Tda	<i>Leptostigma reptans</i>	Dwarf Nertera
	Atl	<i>Lilaeopsis polyantha</i>	Australian Lilaeopsis
	Atl	<i>Lobelia anceps</i>	Angled Lobelia
vu P	Tda	<i>Lobelia beaugleholei</i>	Showy Lobelia
	Tdr	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Wattle Mat-rush
	Tdr	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
	Tdr	<i>Lotus</i> spp.	Trefoil
	Atl	<i>Lycopus australis</i>	Australian Gipsywort
	Tda	<i>Melaleuca squarrosa</i>	Scented Paperbark
	Tdr	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass
	Tdr	<i>Olearia lirata</i>	Snowy Daisy-bush
	Tdr	<i>Oxalis exilis</i>	Shade Wood-sorrel
	Ate	<i>Persicaria decipiens</i>	Slender Knotweed
	Tdr	<i>Poa morrisii</i>	Soft Tussock-grass
	Tdr	<i>Poa tenera</i>	Slender Tussock-grass
	Tda	<i>Polystichum proliferum</i>	Mother Shield-fern
	Tda	<i>Polytrichum juniperinum</i>	Juniper Haircap
	Tdr	<i>Pomaderris aspera</i>	Hazel Pomaderris
	Tdr	<i>Pteridium esculentum</i> subsp. <i>esculentum</i>	Austral Bracken
P	Tda	<i>Pterostylis falcata</i> s.s.	Large Sickie Greenhood
	Tda	<i>Rosulabryum</i> spp.	Thread Moss
* YES	Tdr	<i>Rubus anglocandicans</i>	Common Blackberry
*	Tdr	<i>Salix cinerea</i>	Grey Sallow
	Tdr	<i>Senecio biserratus</i>	Jagged Fireweed

Status	FG	Scientific name	Common name
	Tdr	<i>Senecio glomeratus</i>	Annual Fireweed
	Tdr	<i>Senecio hispidulus s.s.</i>	Rough Fireweed
	Tdr	<i>Senecio minimus</i>	Shrubby Fireweed
	Tdr	<i>Senecio prenanthoides</i>	Beaked Fireweed
	Tdr	<i>Solanum laciniatum</i>	Large Kangaroo Apple
*	Tdr	<i>Sonchus asper s.s.</i>	Rough Sow-thistle
*	Tdr	<i>Sonchus oleraceus</i>	Common Sow-thistle
*	Tda	<i>Stellaria media</i>	Chickweed
	Tdr	<i>Tetrarrhena distichophylla</i>	Hairy Rice-grass
	Tdr	<i>Tetrarrhena juncea</i>	Forest Wire-grass
	Tdr	<i>Tetralthea ciliata</i>	Pink-bells
	Tdr	<i>Viola hederacea sensu Entwistle (1996)</i>	Ivy-leaf Violet
*	Tdr	<i>Vulpia bromoides</i>	Squirrel-tail Fescue
	Tdr	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell

Appendix 2 Vegetation transect locations

Transect ID	Vegetation communities intersected	Start coordinates	End coordinates
T1	High-diversity Swampy Riparian Woodland (SRW83-A) / Wet Verge Sedgeland (WVS932-A) / Wet riparian fern scrub (RFS120-C)	143.6936314°E 38.4232329°S	143.6940257°E 38.4229404°S
T2	High-diversity Swampy Riparian Woodland (SRW83-A) / Wet riparian fern scrub (RFS120-C)	143.6948870°E 38.4213221°S	143.6953516°E 38.4215672°S
T3	Modified, open Damp Sands Herb-rich Woodland (DSHW3-A) / Dry riparian fern scrub (RFS120-B)	143.6968624°E 38.4223555°S	143.6967122°E 38.4218873°S
T4	Modified, closed Damp Sands Herb-rich Woodland (DSHW3-B) / Wet riparian fern scrub (RFS120-C)	143.6985101°E 38.4215616°S	143.6983417°E 38.4211540°S
T5	Lowland Forest (LF16-A1) / Flooded Swampy Riparian Woodland (SRW83-B)	143.7012825°E 38.4218103°S	143.7013104°E 38.4222623°S
T6	Open Damp Sands Herb-rich Woodland (DSHW3-A) / Lowland Forest (LF16-A1)	143.6977054°E 38.4222951°S	143.6980549°E 38.4226921°S
T7	High-diversity Swampy Riparian Woodland (SRW83-A) / Wet riparian fern scrub (RFS120-C)	143.6983890°E 38.4203060°S	143.6983593°E 38.4207234°S
T8	Closed Damp Sands Herb-rich Woodland (DSHW3-B) / Flooded Swampy Riparian Woodland (SRW83-B)	143.6998259°E 38.4219640°S	143.7004203°E 38.4218893°S

Appendix 3 Vegetation quadrat locations

Transect ID	Vegetation community	Within inundation area? Y/N	Coordinates	Orientation
Q1	Riparian Fern Scrub (RFS191-C1)	Y	143.694372°E -38.423293°S	North-west
Q2	Swampy Riparian Woodland (SRW83-A1)	N	143.693532°E -38.422370°S	North-west
Q3	Damp Sands herb-rich Woodland (DSHW3-B1)	N	143.698900°E -38.421810°S	North-east
Q4	Riparian Fern Scrub (RFS191-B2)	N	143.696874°E -38.421665°S	North-west
Q5	Lowland Forest (LF16-A1)	N	143.698566°E -38.422409°S	South-east
Q6	Riparian Fern Scrub (RFS191-A1)	Y	143.693825°E -38.423661°S	North-Northwest
Q7	Wet Verge Sedgeland (WVS932-A1)	Y	143.693862°E -38.423077°S	North-west
Q8	Damp Sands herb-rich Woodland (DSHW3-A2)	N	143.695033°E -38.422018°S	North
Q9	Riparian Fern Scrub (RFS191-C1)	Y	143.695605°E -38.422453°S	North-west
Q10	Damp Sands herb-rich Woodland (DSHW3-A1)	N	143.696536°E -38.422551°S	South-west
Q11	Riparian Fern Scrub (RFS191-C1)	Y	143.695898°E -38.421557°S	North-west
Q12	Riparian Fern Scrub (RFS191-B2)	N	143.697509°E -38.421445°S	West
Q13	Riparian Fern Scrub (RFS191-C1)	Y	143.69778°E -38.421072°S	North
Q14	Riparian Fern Scrub (RFS191-B2)	N	143.698441°E -38.421299°S	North
Q15	Swampy Riparian Woodland (SRW83-A1)	Y	143.700205°E -38.421635°S	East
Q16	Swampy Riparian Woodland (SRW83-B1)	Y	143.701044°E -38.422422°S	North-east

Appendix 4 Vegetation transect counts of species recorded across each monitoring period

	T1				T2				T3				T4				T5				T6		T7	T8	
Scientific name	2019	2020	2022	2024	2019	2020	2022	2024	2019	2020	2022	2024	2019	2020	2022	2024	2019	2020	2022	2024	2022	2024	2022	2022	2024
<i>Acacia melanoxydon</i>	7		7	6	4	17	38	63										12	23	14	3	13			
<i>Acacia spp.</i>																					1				
<i>Acacia stricta</i>											1														
<i>Acacia verticillata</i>		2	5	5	4	7	11			1	1		5	6	12	15					50	57	35		
<i>Alternanthera denticulata</i> s.l.	3	5	27	6				11																	
<i>Anthoxanthum odoratum</i>													2		1					7	14	12			4
<i>Asperula conferta</i>											3														
<i>Blechnum minus</i>							1																		
<i>Blechnum nudum</i>																							1		
<i>Carex appressa</i>	29	24	40	21	16	20	16	31											13	19					20
<i>Carex fascicularis</i>	28	89	74	38																			3		
<i>Carex spp.</i>			1																						
<i>Cassytha glabella</i>														8	7										
<i>Centaurium erythraea</i>																					1				
<i>Cerastium glomeratum</i> s.l.					4	5	12											1							
<i>Cirsium vulgare</i>																				2					
<i>Clematis aristata</i>			1																		12	1	1		
<i>Coprosma quadrifida</i>			2																						
<i>Cychnogeton procerum</i> s.s.	7	10	1	4																					
<i>Cyperus eragrostis</i>	1																								
<i>Cyperus gunnii</i> subsp. <i>gunnii</i>	7			2																					
<i>Dicksonia antarctica</i>																							11		
<i>Eucalyptus brookeriana</i>																	6	12	11					12	
<i>Eucalyptus obliqua</i>																					75	82			
<i>Eucalyptus ovata</i>		23	34	12				53	79	85	128	178	110	106	164	161				17	35			162	148
<i>Eucalyptus viminalis</i>																							38		
<i>Gahnia sieberiana</i>		2	2	2	1	1		4	4	1	3	11	96	100	105	39	11	9	9	9	26	14		6	
<i>Galium aparine</i>					1	4	1										1	1			3	4		4	3
<i>Galium ciliare</i> subsp. <i>terminale</i>					2	4																			
<i>Galium murale</i>																								1	
<i>Galium spp.</i>						1																			
<i>Gaudium myrsinoides</i>		22	30																				70		
<i>Gonocarpus tetragynus</i>																					2				
<i>Gynatrix pulchella</i> s.l.					22	19	12																		
<i>Histiopteris incisa</i>																							3		1
<i>Holcus lanatus</i>	6	13	3		11	37	1	4								8	12	18	19	4	19	25		14	37
<i>Hydrocotyle hirta</i>					1	4	12								1					2					2
<i>Hydrocotyle pterocarpa</i>		3	2	4	2	9		7																	
<i>Hypochaeris radicata</i>						1															5	3			
<i>Isolepis inundata</i>								13												5					
<i>Isolepis spp.</i>																			1						
<i>Juncus procerus</i>		1															5	7	8	15					4
<i>Lepidosperma elatius</i>	27	5	18	26	9	15	25	33									8	12	23	16	14	28	1		

	T1				T2				T3				T4				T5				T6		T7	T8	
Scientific name	2019	2020	2022	2024	2019	2020	2022	2024	2019	2020	2022	2024	2019	2020	2022	2024	2019	2020	2022	2024	2022	2024	2022	2022	2024
<i>Lepidosperma</i> spp.		5																1							
<i>Leptospermum continentale</i>	79	66	85	98	146	152	160	138	14	15		13	16	7	3	6				4				6	52
<i>Leptospermum lanigerum</i>	29										39				6										
<i>Lobelia beaugleholei</i>	1			3	1	11	1	1																	
<i>Lobelia pedunculata</i> s.l.			1																						
<i>Lobelia pratioides</i>						1																			
<i>Lomandra longifolia</i> subsp. <i>longifolia</i>																				9	1				
<i>Lycopus australis</i>	2	9	12	38																					
<i>Lysimachia arvensis</i>																				2					
<i>Melaleuca squarrosa</i>	1							10	43	44	92	123	21	49	69	5							87		21
<i>Microlaena stipoides</i> var. <i>stipoides</i>				1		10	12	11				2	1	3	4	7				2	4	9			5
<i>Olearia lirata</i>	3	5	9	9				16								2						13			
<i>Oxalis exilis</i>							4	6										2							
<i>Persicaria decipiens</i>	1	6	6	2																					
<i>Persicaria praetermissa</i>			1																						
<i>Poa tenera</i>		3	6	1	3			9												1			13		
<i>Pomaderris aspera</i>	27	13	20	17	3	8	3										4	7	37	14			20		
<i>Prostanthera lasianthos</i>	5	8	10	11																4			12		
<i>Pteridium esculentum</i> subsp. <i>esculentum</i>	5	5	8	9	7	11	17	15	15	48	34	40	30	63	57	47	8	21	14	8	68	39	25	51	52
<i>Ranunculus amphitrichus</i>	1																								
<i>Rubus anglocandicans</i>	2	2	2																			1			
<i>Rubus fruticosus</i> spp. agg.																			1			1			
<i>Senecio glomeratus</i>													1								12	1		4	
<i>Senecio minimus</i>				1	1	1	2	5						3	5	3	1	12	3		7	4		5	3
<i>Senecio prenanthoides</i>			1																			1			
<i>Senecio</i> spp.																		1							
<i>Stellaria media</i>							6														1				
<i>Styphelia humifusa</i>											3														
<i>Tetrarrhena juncea</i>	9	11	11	9	13	17	54	44					5	4	30	47	21	38	46	11	165	117	80		6
<i>Todea barbara</i>	1	4	3																						
<i>Viola hederacea</i> sensu Entwisle (1996)							1																		
<i>Wahlenbergia capillaris</i> s.l.		1																							

Appendix 5 Vegetation transect photos

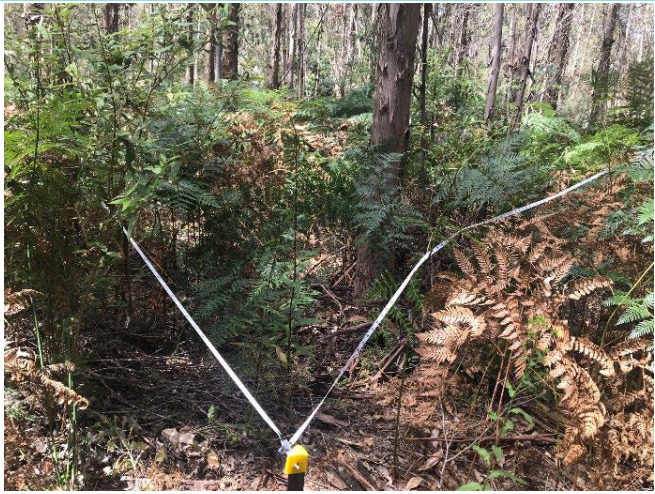
Transect ID	2019	2020	2022	2024
T1	 A photograph of a dense vegetation transect T1 in 2019. The foreground is dominated by tall, green grasses and large, brown fern fronds. A black survey pole with a yellow marker is visible in the center.	 A photograph of a dense vegetation transect T1 in 2020. The vegetation is similar to 2019, with tall grasses and ferns. A black survey pole with a yellow marker is visible in the center.	 A photograph of a dense vegetation transect T1 in 2022. The vegetation is similar to 2019, with tall grasses and ferns. A black survey pole with a yellow marker is visible in the center.	 A photograph of a dense vegetation transect T1 in 2024. The vegetation is similar to 2019, with tall grasses and ferns. A black survey pole with a yellow marker is visible in the center.
T2	 A photograph of a dense vegetation transect T2 in 2019. The foreground is dominated by tall, green grasses and large, brown fern fronds. A black survey pole with a yellow marker is visible in the center.	 A photograph of a dense vegetation transect T2 in 2020. The vegetation is similar to 2019, with tall grasses and ferns. A black survey pole with a yellow marker is visible in the center.	 A photograph of a dense vegetation transect T2 in 2022. The vegetation is similar to 2019, with tall grasses and ferns. A black survey pole with a yellow marker is visible in the center.	 A photograph of a dense vegetation transect T2 in 2024. The vegetation is similar to 2019, with tall grasses and ferns. A black survey pole with a yellow marker is visible in the center.

Transect ID	2019	2020	2022	2024
T3				
T4				

Transect ID	2019	2020	2022	2024
T5				
T6				

Transect ID	2019	2020	2022	2024
T7				Transect not assessed in 2024
T8				

Appendix 6 Vegetation quadrat photos

Quadrat ID	2020	2022	2024
Q1			
Q2			
Q3			

Quadrat ID	2020	2022	2024
Q4			
Q5			

Quadrat ID	2024
Q6	
Q7	
Q8	

Quadrat ID	2024
Q9	
Q10	
Q11	

Quadrat ID	2024
Q12	
Q13	
Q14	

Quadrat ID	2024
Q15	
Q16	

