Langwarrin Quarry Rehabilitation

Boggy Creek Biodiversity Corridor Concept Plan

Burdett Sands Pty Ltd

January 2023

→ The Power of Commitment

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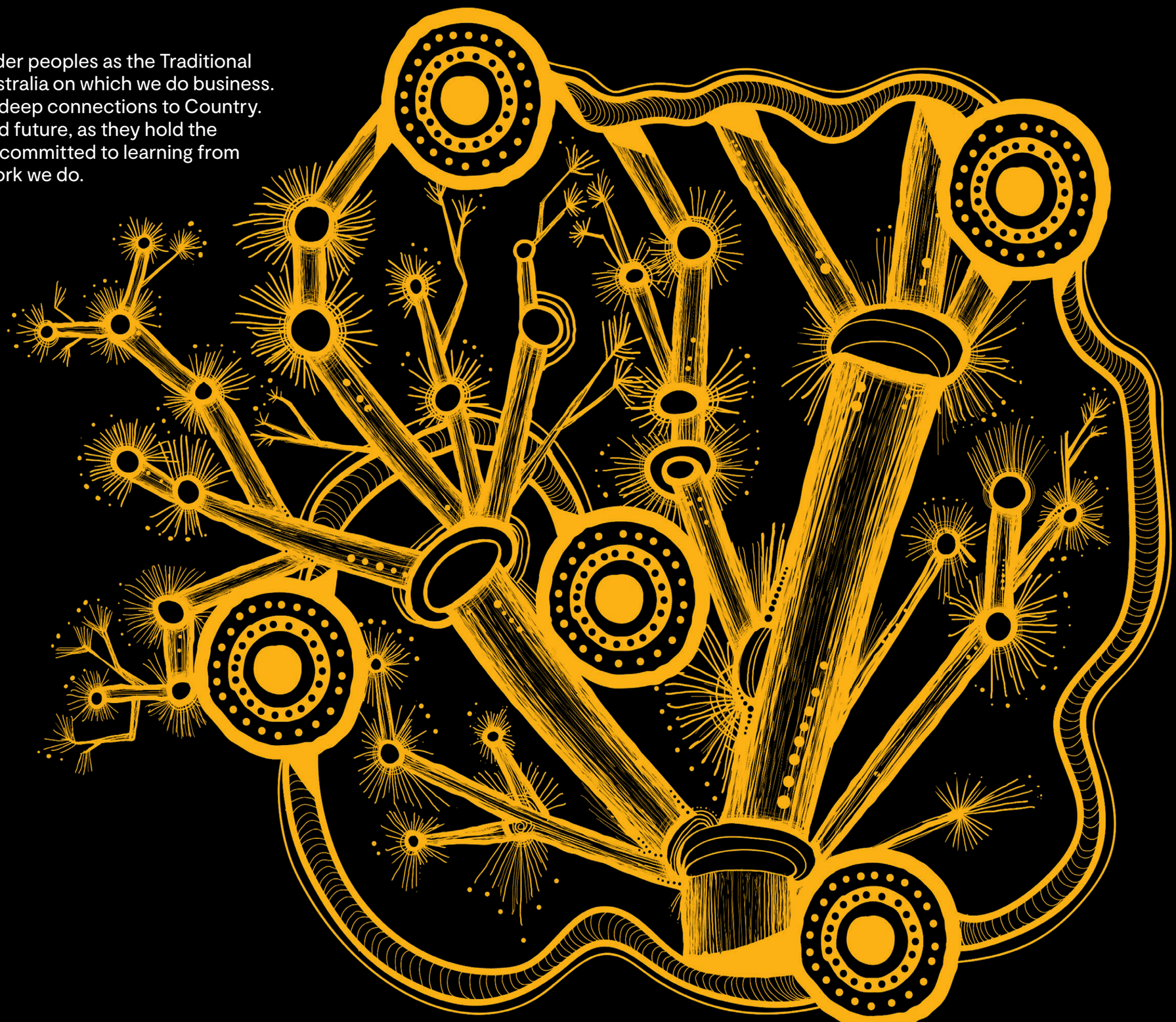
Contents

Acknowledgement of Country

GHD acknowledges Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of the land, water and sky throughout Australia on which we do business. We recognise their strength, diversity, resilience and deep connections to Country. We pay our respects to Elders of the past, present and future, as they hold the memories, knowledges and spirit of Australia. GHD is committed to learning from Aboriginal and Torres Strait Islander peoples in the work we do.



1. Introduction

Burdett Sands Pty Ltd (Burdetts) is currently in the process of revising the overall site rehabilitation plan for the Burdett Sands Langwarrin Quarry, which includes the filling of the extraction void, the reclamation of the slimes dam area and the restoration of the Boggy Creek corridor. Little Boggy Creek (Boggy Creek) is an existing Melbourne Water managed drainage easement located in the south-east of Melbourne and has been identified by Frankston City Council as a fauna linkage. The creek is earmarked for future restoration with the quarry to better support habitat for local flora and fauna, improve waterway health and ultimately will provide a missing bio-link between existing nature reserves throughout the region for wildlife and people.

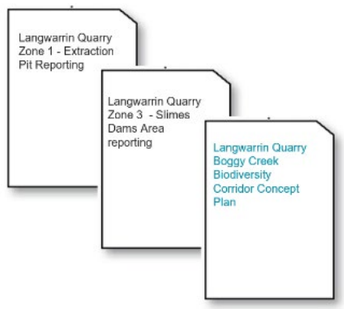
1.1 Background context

Burdetts have signed a funding agreement with the Department of Environment, Land, Water and Planning (DELWP) as part of the Innovative Quarry End Land Use Grant Project (also known as the Quarry Transformation Grants). Funding for this project has been subsidised by DELWP as part of the Innovative Quarry End Land Use Grant Project, which aims to promote innovation in land uses for quarries as they reach the end of their operational life. Key objectives are to develop and test ideas and opportunities for repurposing land after quarrying stops include to have a direct and tangible positive impact on surrounding land and property values, and improve the overall liveability of an area, e.g., for open space and recreation (Map 1).

GHD has been engaged to prepare a high-level concept plan for the Boggy Creek Biodiversity Corridor that will supplement Burdetts Work Plan Variation. The following activities to inform the proposed design recommendations:

- Desktop ecological and terrestrial ecosystem field assessment and supporting report which will highlight the current status of the Boggy Creek environs.
- Desktop floodplain and waterway assessment of existing and wholistic rehabilitated landform including the impacts of the fully infilled, 'pre-quarrying' extraction pit and fines areas landforms, to quantify the expected flow and possible flooding conditions.
- Preparation of a concept plan to demonstrate the rehabilitation potential for the Boggy Creek corridor environs and recommended design considerations.
- Development of a supporting risk assessment to address risks posed by Boggy Creek works.

The Biodiversity concept plan draws on finding previous studies undertaken by GHD for the Langwarrin Quarry as part of the rehabilitation plan and will form part of the quarry end of use planning approvals documentation.



1.2 Purpose of Biodiversity Corridor Concept Plan

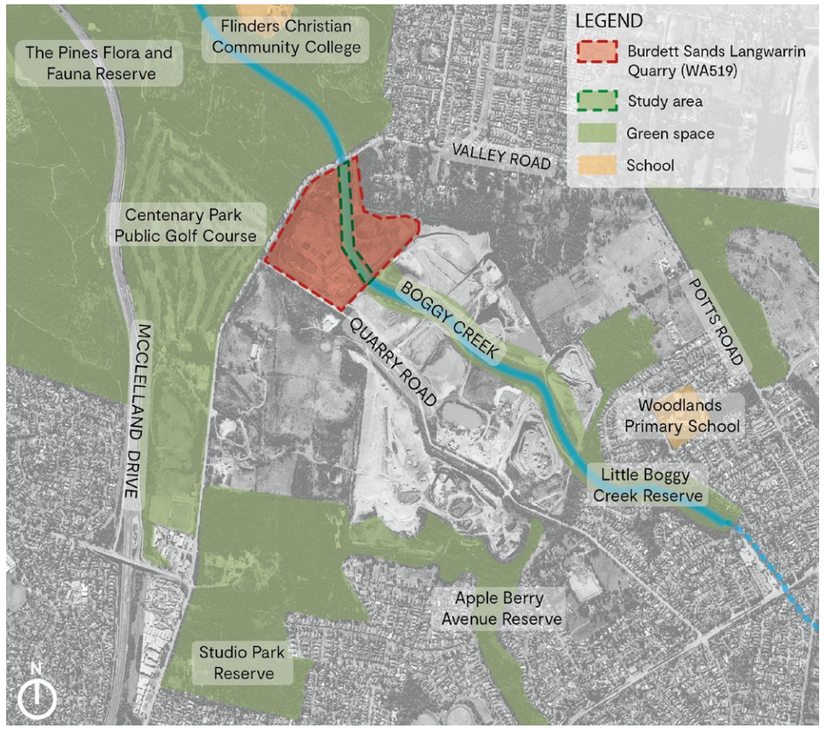
The purpose of the Boggy Creek Biodiversity Corridor Plan is to develop a vision for the transformation of the Boggy Creek environs that is underpinned by biodiversity objectives, to inform future stakeholder engagement with local government, agencies and adjacent landholders. The plan highlights how the creek corridor could be rehabilitated to support the local community by providing walking and cycling trails, create habitat for flora and fauna via identification of target species, and repair a missing link to the surrounding existing nature reserves and green links.

1.3 Assumptions

The findings in this report are based on desktop and field assessments undertaken as agreed with Burdett.

No vegetation survey or arborist reports were available to review at the time of preparing the concept plan.

This concept plan focuses only on the Boggy Creek corridor and biodiversity outcomes. The plan does not consider any potential adjacent land use adaptations of the sand mine. In the instance stakeholder consultation key findings identifies future activation or land use opportunities, GHD can review the concept plan to align.



Map 1. Boggy Creek study area

Map 2. Burdett Sands Langwarrin Quarry (WA519) – Rehabilitation domains

2. Existing conditions

2.1 Langwarrin quarry rehabilitation

Burdetts own and operate the sand extraction quarry site at 260 Quarry Road, Langwarrin, Victoria. Quarrying on the site commenced in 2001 pursuant to Work Authority No. 519 (WA 519) and Planning Permit No. 0015. The sand resource is now depleted, with the main quarry excavation bottoming on Silurian bedrock.

The quarry consists of three rehabilitation domains across the site as shown in Map 2 including the extraction pit, the processing area, the fines / historic slimes storage area and the Boggy Creek Reserve corridor. Figure 1 Section AA showed existing conditions. Rehabilitation works are required to be undertaken in all zones. The rehabilitation plan approved pursuant to WA 519 shows the extraction pit being partially backfilled and containing a water body with a final water level at RL17.

Burdetts proposed Work Plan Variation submission to Earth Resources Regulation (ERR) includes backfilling of the extraction pit with clean fill. Backfilling would be carried out in a number of stages commencing with initial floor filling, followed by 5 “lifts” of backfill earthworks, and then final filling and reprofiling. The final landform for the extraction pit would approximate the pre-extraction levels with land shaping and drainage to Boggy Creek and be suitable to support nonstructural land uses such as pastures. The design for the fines area consists of three stages, each stage progressively emptying the fines storages and then finally reprofiling the area so as to achieve the ‘pre-quarrying’ landform.

Existing utilities and built features include a sewerage pipeline located along the eastern side of the creek and a vehicular access bridge connecting the western mine site to the existing slimes dam location. It is envisaged that this bridge will be required to continue operations in this area, while the zone 3 fines area is being rehabilitated. A haul road also exists within the creek reserve which is planned to be decommissioned.

2.2 Landscape condition and character

The broader landscape character of the region is dominated with a rich diversity of upper and mid-storey vegetation. The quarry is well screened along McClelland Drive with native vegetation which act as both a visual buffer and a continuity in the landscape character. Boggy Creek is also dominated by existing upper and mid-storey trees and shrubs, which is further described in Section 2.8 Ecology and environment.

Site photos taken by GHD

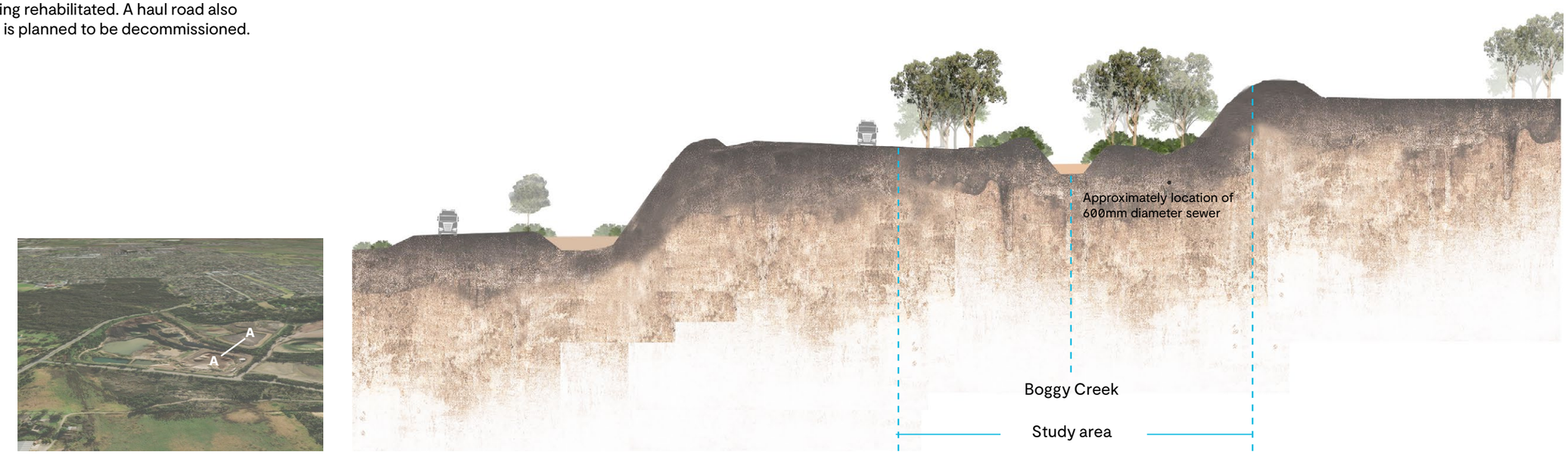


Figure 1. Langwarrin Quarry cross section AA index plan and existing section

2.3 Land use

The Boggy Creek corridor study area is adjacent to public open space land uses to the north-west and residential and commercial land uses to the south. Adjacent land uses include active recreation, a private golf course, The Pines Flora and Fauna Reserve and McClelland Sculpture Gallery. Frankston City Council has identified three strategic corridors for habitat connectivity in the region, which are shown on Map 3 and overlap with the study area. The quarry site is currently well screened along McClelland Drive with layered native vegetation contributing to the landscape character of the area.

The Boggy Creek Melbourne Water Corporation (MWC) waterway study area is nominally 50m in width and extends the length of Burdetts' WA519 area. The creek line is highly modified with artificial earth bunds on either site to protect quarry operations from potential impacts of flooding.

Fauna Links

C1 Corridor 1 (The Pines Flora and Fauna Reserve to Royal Botanical Gardens Cranbourne)

S1 Corridor 2 (The Pines Flora and Fauna Reserve to Langwarrin Flora and Fauna Reserve)

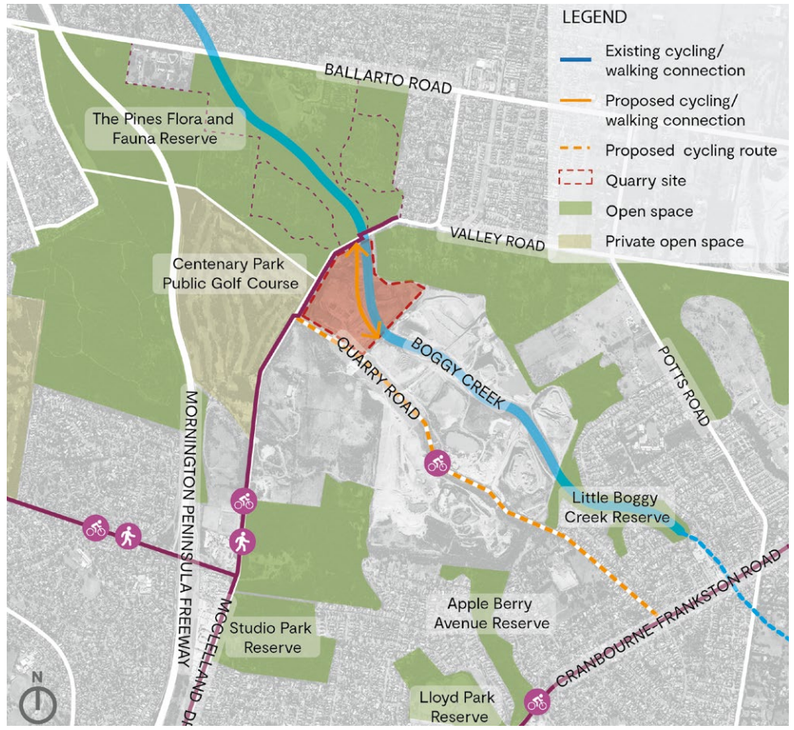
S2 Subsidary Corridor 1 (The Pines Flora and Fauna Reserve to Boggy Creek via Studio Park)

Map 3. Land use zoning

2.4 Accessibility and movement

Map 4 showed existing and proposed accessibility and movement. Currently there is a cycling route along Cranbourne-Frankston Road and McClelland Drive with a proposed route on Quarry Road. The principal bicycle corridor along McClelland Drive is a shared user path which runs on the west side of McClelland Drive. At the intersection of Quarry Road, the path switches to the east side of McClelland Drive where there is potential for a future connection to Boggy Creek creating further accessibility through to Little Boggy Creek Reserve and Langwarrin Flora and Fauna Reserve.

This strategic action is highlighted in the Frankston to Mornington Parklands Draft Directions Plan (DELWP), which identifies the Boggy Creek corridor as a strategic regional connector corridor for pedestrians and cyclists. Informal walking and cycling trails exist in the Pines Flora and Fauna Reserve and provide connections to the northern perimeter of the park. The closest bus route to Boggy Creek is on Cranbourne-Frankston Road.

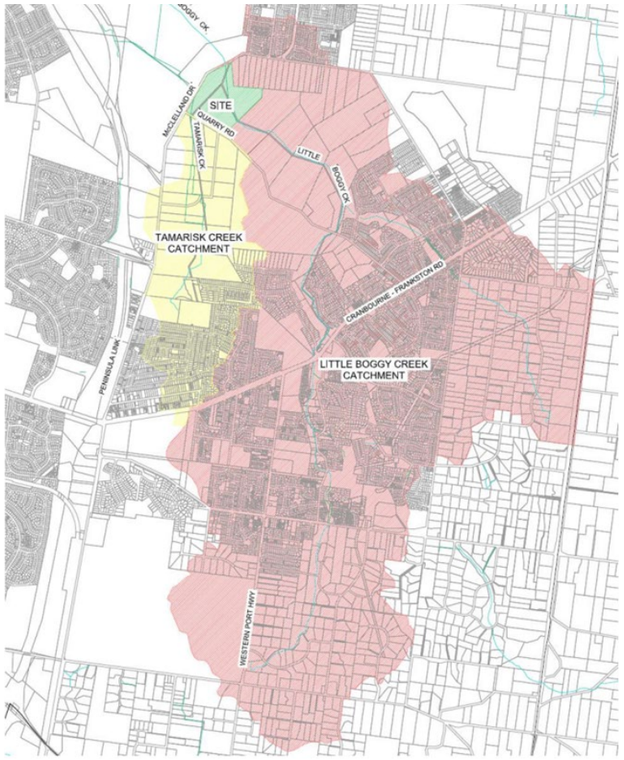


Map 4. Accessibility and movement

2.5 Hydrology

The MWC waterway of Boggy Creek bisects the quarry site with the quarry pit to the west and the fines dams to the east. The reach of Boggy Creek through the site is a straightened channel, with steep side banks and scattered trees along the banks. The top of bank width of the channel varies from 20 to 30 m and exists within a nominal 50 m wide corridor reserve.

The catchment to Boggy Creek is delineated below (Map 5, copied from Incitus, 2021). It is approximately 16km2 and consists of mixed land use including standard and low density residential as well as other quarrying activities immediately upstream of the site.



Map 5. Boggy Creek catchment delineation (Incitus, 2021)

The following design flows, see Table 1, have been adopted by GHD based on previous TUFLOW floodplain modelling for the broader catchment. It is noted the design flows are lower than the previously reported design flows from the Incitus report (Incitus, 2021), but are derived based on more contemporary floodplain modelling app roaches. A HEC-RAS model of Boggy Creek was created for the reach shown below with the adopted flows applied to the upstream end of the reach. The model was established for the purpose of assessing and understanding the existing hydraulic conditions within the reach of Boggy Creek adjacent to the quarrying activities within the Burdett site.

Map 6. Boggy Creek modelled reach

ARI	Adopted Flow (m^3/s)	INCITUS Adopted Flow (m^3/s) (2021)
1 in 100	28.3	42.3
1 in 50	26.3	36.6
1 in 20	19.8	25.4
1 in 10	15.5	18.7
1 in 5	12.5	13.9

Table 1. Boggy Creek adopted flows

2.6 Existing waterway characteristics

The existing Boggy Creek waterway is perennially flowing with an estimated observed average water depth of approximately ~0.5 m across the base of the channel. The channel reach through the site is a straightened and incised channel segment, with sections of steep sided banks. Depths vary between 2 to 3 m from top of bank to bed and in addition there are segments of bund walls providing protection from surface flows spilling from the waterway into the quarry site activities. While the channel is incised, it is relatively stable though deepening may have occurred immediately downstream of the access bridge culvert. Riparian vegetation within Boggy Creek consists of scattered deep-rooted trees that provides some bank stability benefit, with limited understorey typically consisting of grassy weeds.

Figure 2. Boggy Creek – existing conditions (looking downstream from access crossing)

Within the vicinity of the site there are 3 road crossings with culverts conveying flow underneath (labelled Culvert 1 through 3 in Map 6 above).

- Culvert 3 represents the access crossing at the upstream end of the site and includes 3 reinforced concrete box culverts of 2.7 m wide and 0.9 m high.
- Culvert 2, the only culvert within the Work Authority boundary, is located roughly a third of the way downstream through the site and consists of a singular 1.8 m x 1.8 m reinforced concrete box culvert with a road height of approximately 30.9 mAHD. This culvert is a significant constriction through the site given the limited flow area through the pipe in comparison to the flow area of the channel at this location (see Figure 4).
- Culvert 1 is at the downstream end of the reach within the site and represents McClelland Drive consisting of two 1.35 m diameter circular culverts. This section of Boggy Creek is relatively shallow and so it appears that McClelland Drive may overtop during heavy rainfall events.

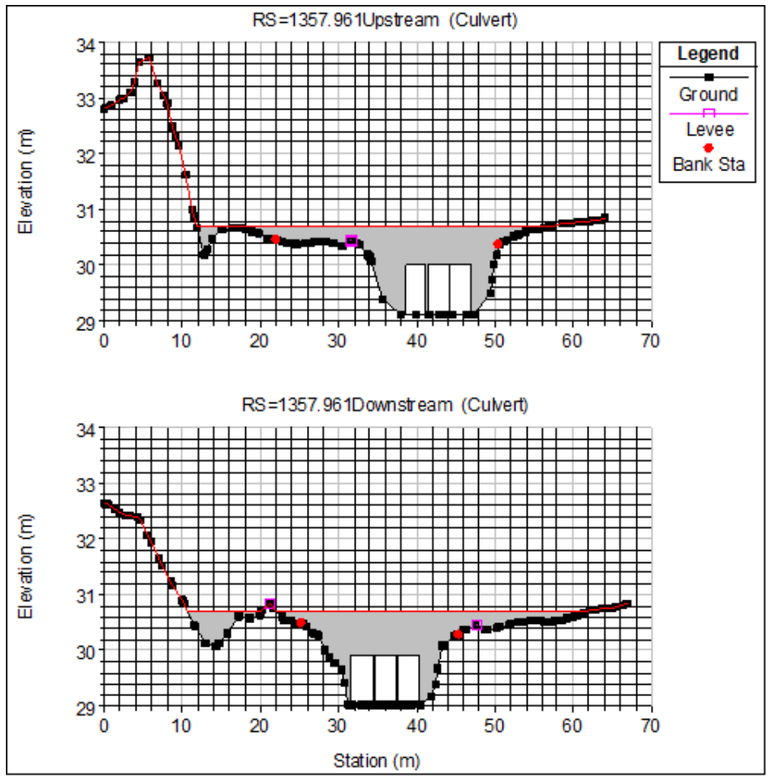


Figure 3. Access Bridge Crossing HEC-RAS Arrangement (Culvert 3)

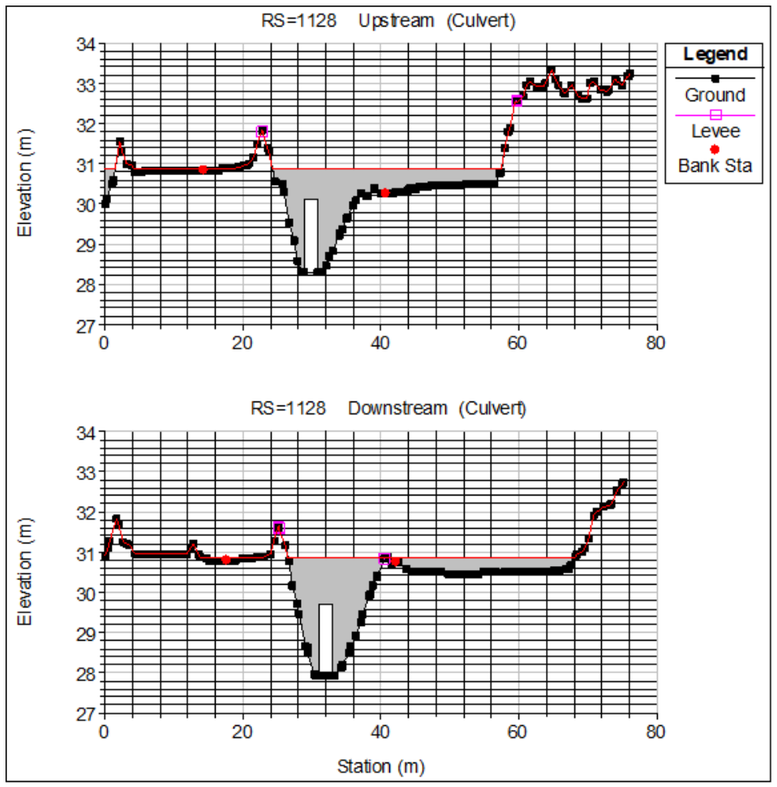


Figure 4. Culvert 2 HEC-RAS Arrangement

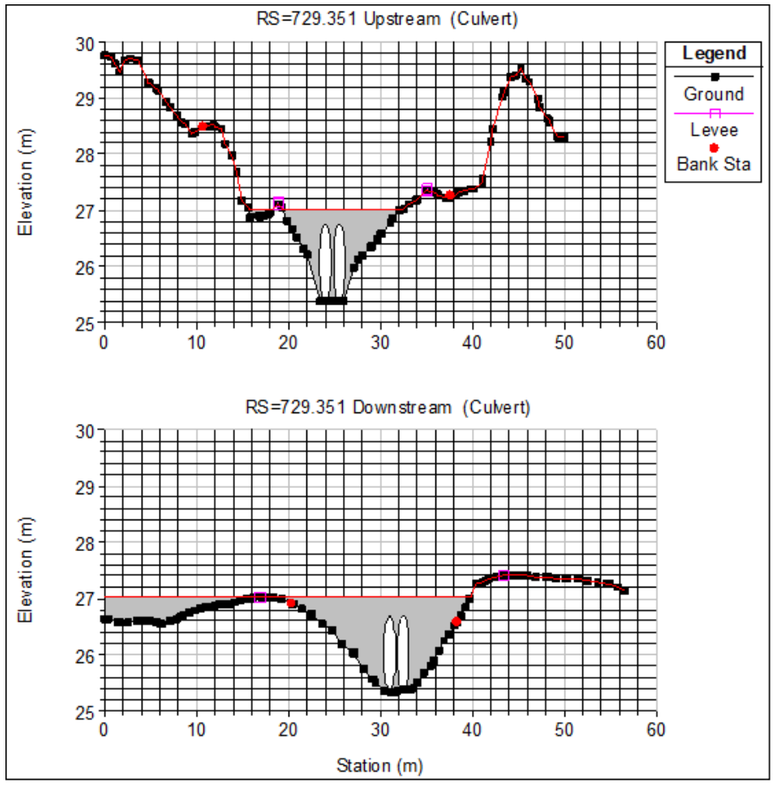


Figure 5. McClelland Drive Bridge Crossing HEC-RAS Arrangement (Culvert 1)

2.7 Hydraulic function

GHD have modelled the reach of Boggy Creek shown in Map 6 above in HEC-RAS using available LIDAR information and representing the above road crossing culvert configurations as represented from previous TUFLOW floodplain modelling completed by GHD. The following has been interpreted from the modelling:

- From Figure 10, the effect of the Culvert 2 constriction is evident with the backwater behind the culvert crossing. The backwater from Culvert 2 drowns out the access crossing at Culvert 3 for all modelled events
- Whilst the backwater overtops the access crossing and adjacent roads, the flooding appears to be contained between the bunds and therefore the adjacent quarry site activities are protected
- Downstream of Culvert 2 flows are largely contained within the Boggy Creek channel
- Flow remains contained within the defined channel to the McClelland Drive crossing where there appears local backwater ponding immediately upstream causing occasional overtopping of the road
- The flow velocities are influenced by the presence of the culvert structures, with the highest velocities through and immediately downstream of the culverts and low velocities within the backwater areas
- The channel velocities between Culvert 2 and Culvert 1 represent the typical channel velocities to be expected (without any influence due to the culverts), with maximum velocity of 1.5 m/s

Location	River Station	Average Channel Velocity (m/s)				
		1% AEP	2%AEP	5%AEP	10%AEP	20%AEP
Upstream of Culvert 3	1360.34	0.44	0.42	0.36	0.31	0.28
Through Culvert 3	1357.961	0.40	0.48	0.34	0.35	0.36
Downstream of Culvert 3	1334.87	0.44	0.43	0.37	0.32	0.29
Upstream of Culvert 2	1129.98	0.71	0.68	0.56	0.48	0.42
Through Culvert 2	1128.00	4.08	4.12	3.56 (US) 5.73 (DS)	3.43 (US) 5.64 (DS)	3.88 US) 5.34 (DS)
Downstream of Culvert 2	1113.10	1.90	1.86	1.68	1.55	1.44
Between Culvert 2 and 1	850.51	1.55	1.50	1.37	1.24	1.15
Upstream of Culvert 1	750.62	1.04	0.98	0.86	0.74	0.65
Through Culvert 1	729.351	2.50	2.14	2.23	2.06	2.05
Downstream of Culvert 1	700.18	1.02	0.82	0.79	0.64	0.58

Table 2. Average Velocity

In summary, the Culvert 2 structure in particular influences both the effective channel capacity and flood levels, as well as local effects on velocities. Whilst flooding is not expected to impact current quarrying site activities, this structure may be causing nuisance flooding of the access roads and there may be localized scour of the bed of the Boggy Creek. With the removal or replacement of this structure with a more appropriate crossing configuration, the flows would be contained within the channel and the typical channel velocities estimated are not expected to cause erosion. Any proposed enhancement of Boggy Creek that involves pools and riffles within the base of the channel as well channel shaping and revegetation will further promote long term bed and bank stability.

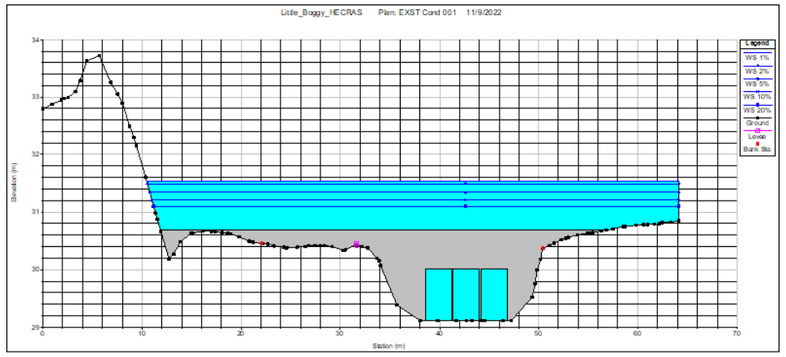


Figure 6. HEC-RAS Model Results immediately upstream of Access Bridge (Culvert 3)

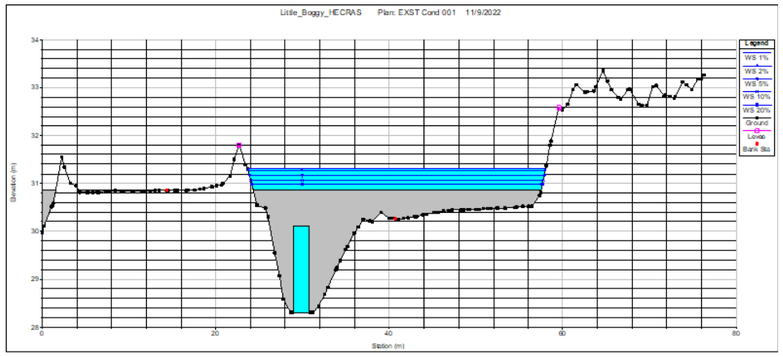


Figure 7. HEC-RAS Model Results immediately upstream of Culvert 2

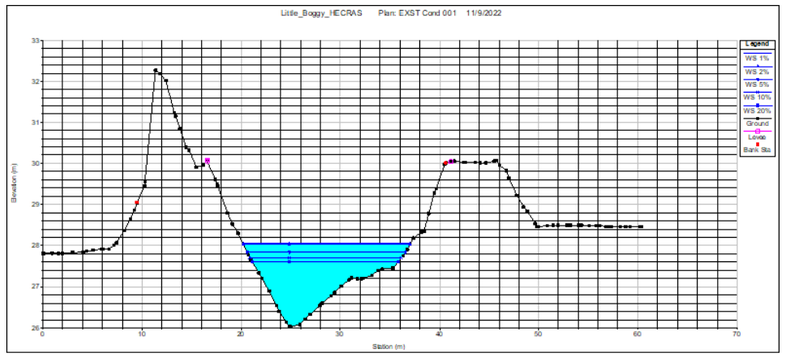


Figure 8. HEC-RAS Model Results between Culvert 2 and McClelland Drive (Culvert 1)

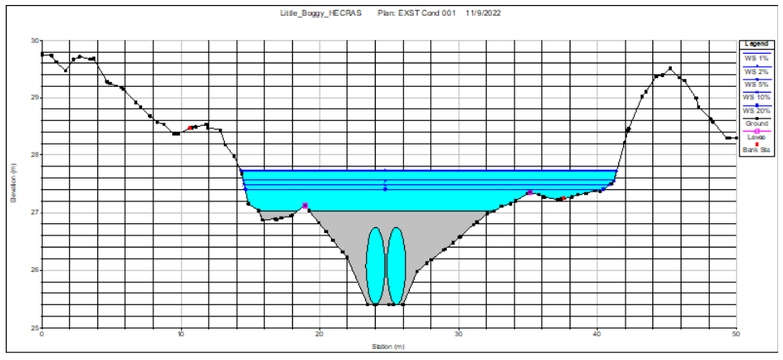


Figure 9. HEC-RAS Model Results immediately upstream of McClelland Drive (Culvert 1)

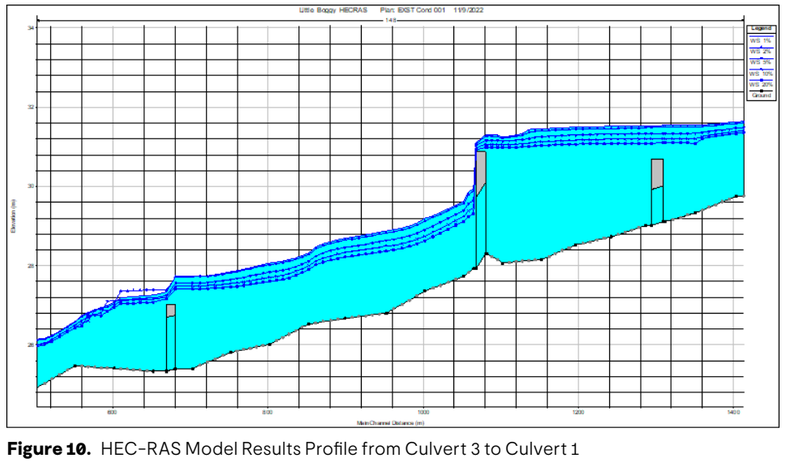


Figure 10. HEC-RAS Model Results Profile from Culvert 3 to Culvert 1

2.8 Ecology and environment

Terrestrial flora and vegetation

The Victorian Biodiversity Atlas (VBA) and Protected Matters Search Tool (PMST) databases have records of 1,721 species of flora from within 10 km of the study site. These records consist of 1,057 native species, 614 introduced species, and 49 native species that are not indigenous to the area (refer to ecology memo).

During the field assessment 25 species were identified including six native and 19 introduced species (refer to ecology memo). There was no threatened flora found during the field assessment but there were two Acacia species that are both classed as protected flora under the Flora and Fauna Guarantee Act 1988 (FFG Act).

There were six species listed as noxious weeds under the CaLP Act in the Port Phillip Catchment Management Authority region recorded during the field assessment (refer to ecology memo). Three of these species are also listed as a Weed of National Significance (WoNS). *Asparagus asparagoides* (Bridal Creeper) and *Rubus fruticosa spp. agg.* (Blackberry) were found along most of the length of Boggy Creek in high numbers, while *Chrysanthemoides monilifera* (Boneseed) was limited to one individual approximately 10-15 m from the edge of the creek.

Although the Boggy Creek corridor within the quarry has experienced modification and disturbance due to the local land use in and around the site, the riparian vegetation includes relatively healthy upper and mid-storey trees and shrubs. The dominant species are *Eucalyptus spp.*, M*elaleuca ericifolia* (Swamp Paperbark) and *Pittosporum undulatum* (Sweet Pittosporum). There is a high cover of understorey weeds all along the corridor including noxious weeds such as *Chrysanthemoides monilifera* (Boneseed), *Rubus fruticosus spp. agg*, (Blackberry), *Asparagus asparagoides* (Bridal Creeper), *Cirsium vulgare* (Spear Thistle) and *Oxalis pes-caprae* (Soursob). The key strata are the large tussock grasses, sedges and herbs.

Within the Pines Flora and Fauna Reserve to the northwest of the project area there was medium to large shrubs and trees along the Boggy Creek, but in much lower densities compared to the corridor in the quarry. The understory was a lot more open, and the weed species different being mostly *Dactylis glomerata* (Cocksfoot), *Vulpia spp.* (Fescue) and *Lolium spp* (Perennial Rye-grass).

Terrestrial fauna habitat

The VBA databases has records of 614 fauna species within 10 km of the study site. These records consist of 579 native species and 35 introduced species. Of the 614 fauna species, 84 are threatened under one or more of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and Flora and Fauna Guarantee Act 1988 (refer to ecology memo). Thirty species identified by the VBA and PMST are listed as Migratory under the EPBC Act (refer to ecology memo).

During the field assessment 13 species were identified including 11 native species and two introduced species (birds). Fauna species recorded within the study site are listed in Appendix A.

In its current state, the riparian vegetation within the Boggy Creek corridor provides habitat to a range of common and adaptable native fauna. Birds observed foraging in trees along the creek include Grey Fantail (*Rhipidura albiscapa*), New Holland Honeyeater (*Phylidonyris novaehollandiae*), Little Wattlebird (*Anthochaera chrysoptera*) and Spotted Pardalote (*Pardalotus punctatus*). Non-native Starling (*Sturnus vulgaris*) and Common Myna (*Sturnus tristis*) were also observed in woodland habitat along the corridor.

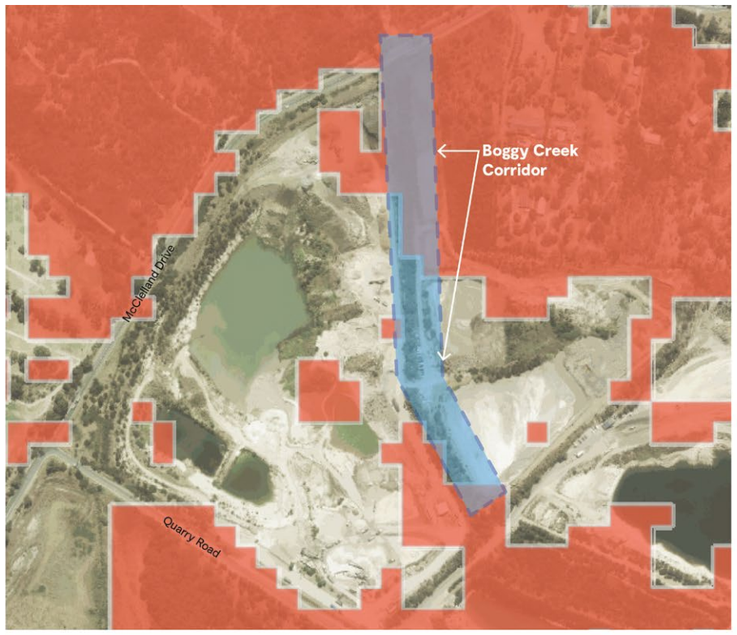
Two species of frog were recorded during the field assessment in wetlands - Common Froglet (*Crinia signifera*) and Southern Banjo Frog (*Lymnodynastes dyneriilli*). Both species were calling from the wetlands immediately east of the Boggy Creek corridor. The frogs were not heard in Boggy Creek itself, likely due to the relatively fast flow rate of the creek. However, these species could occur within the creek and simply be more difficult to hear due to truck noise from the quarry road on the western side.

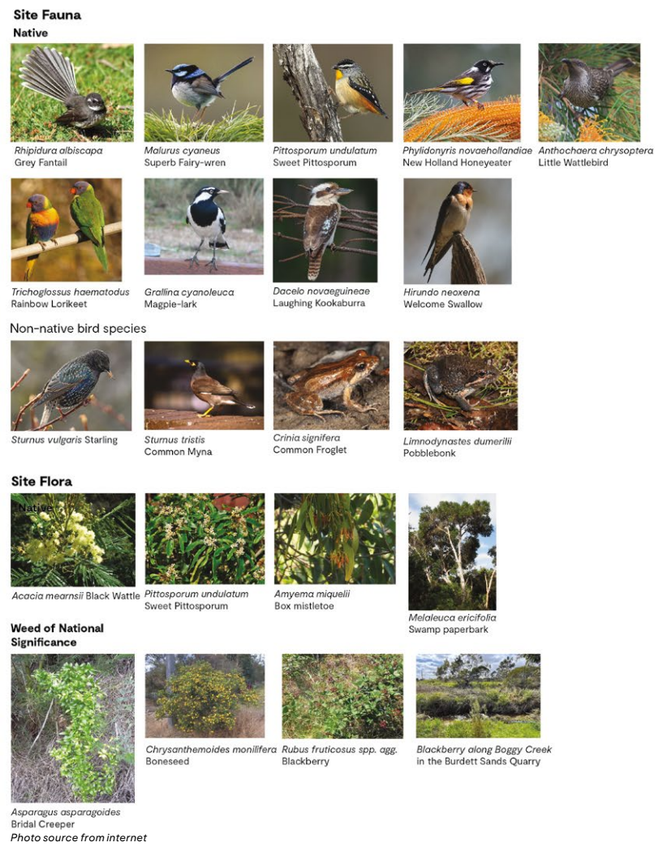
Aquatic fauna habitat

At the time of the field assessment, the Boggy Creek contained turbid, relatively fast flowing water due to recent rain events. The entire length of the creek within the corridor was flowing with an abundance of shallow water run and riffle habitats. At other times when flow is lower, the creek is likely to contain standing water in the in the form of pool habitats. Water widths ranged from approximately 0.5 to 2 m, with bank widths (i.e. top of banks) in excess ranging from 20 to 30 m. Noticeably, the left bank (looking downstream) was steep and highly eroded in some areas while the right bank had a lower gradient and was less eroded.

The substrate of the creek was predominately clay/silt (>70%) although there were some areas with larger size classes including sand, gravel and pebbles. There were some snags and other woody debris within the creek although this was limited – likely due to the lack of significant stands of large trees. Shading of the creek by riparian vegetation was estimated at 26-50%. Other aquatic habitat features currently present in the Boggy Creek corridor includes undercut banks, tree roots and trailing bank vegetation.

Map 7. Existing ecology condition map





2.9 Strategic context

This section provides an overview of the current strategic planning framework, including state and local policies and strategies.

State & federal planning documents:

Victorian Government Extractive Resources Strategy 2018

Melbourne Water Living Rivers program

Melbourne Water Healthy Waterways Strategy

Victorian Government Open Space Strategy for Metropolitan Melbourne 2021

Victorian Government Protecting Victoria's Environment –Biodiversity 2037

Protecting Victoria's Biodiversity 2021

Australia's Strategy for Nature 2019-2030

DELWP Self-Determination Reform Strategy

DELWP Quarry End of Land Use Grant Guidelines

Local planning documents:

Frankston Open Space Strategy 2016-2036

Frankston Green Wedge Management Plan 2019

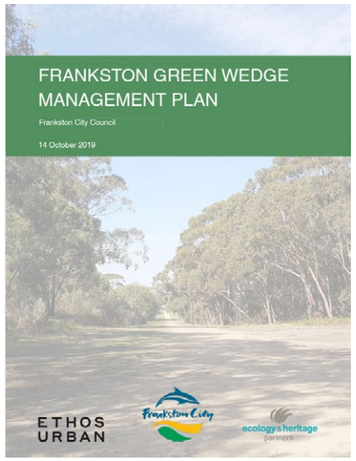
Frankston City Council Biodiversity Action Plan 2021–2036

Frankston City Council Long Term Infrastructure Plan 2020-2030

Frankston Vegetation Study 2006

Frankston City Council Integrated Water Action Plan 2016 – 2026

Frankston to Mornington Parklands Draft Future Directions Plan 2022

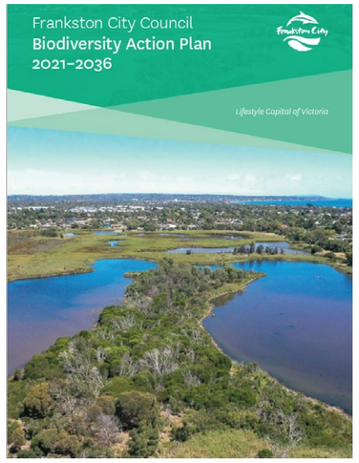


Frankston Green Wedge Management Plan 2019

Frankston City Council sets out a management plan to protect existing vegetation and valued environs. Through its vision, goals, and strategies to establish linkages between green spaces.

The following goals and strategies are of relevance and should be supported through the concept plan include:

- Ensure that the rehabilitation of extractive industries sites does not adversely affect the surrounding flora and fauna reserves, and waterways (Boggy Creek).
- Investigate the feasibility of creating a riparian or terrestrial habitat linkage between Little Boggy Creek and Langwarrin Flora and Fauna Reserve (in Precinct 6) via patches of native vegetation on private property and Apple Berry Avenue Reserve.

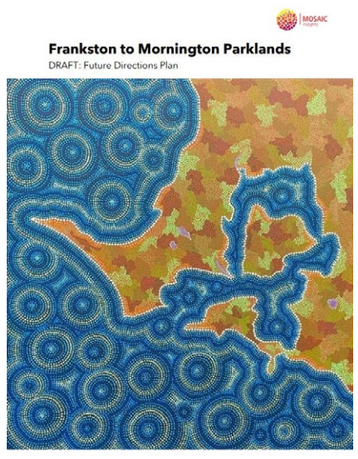


Frankston City Council Biodiversity Action Plan 2021–2036

The FCC Biodiversity Action Plan identifies strategic recommendations to protect, restore and enhance existing vegetation and habitat within the municipality.

The following goals and strategies are of relevance and should be supported through the concept plan:

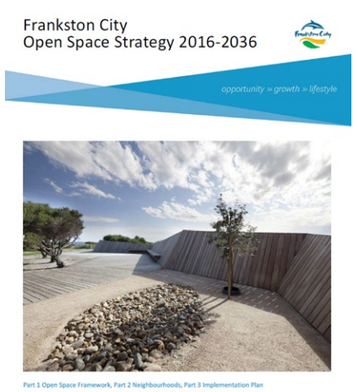
- Ensuring that remaining fragments are well connected and allow unimpeded, safe movement of fauna, especially through two priority corridors.
  - Corridor 1 from The Pines Flora and Fauna Reserve to the Royal Botanic Gardens Cranbourne · Corridor 2 from The Pines Flora and Fauna Reserve to Langwarrin Flora and Fauna Reserve



Frankston to Mornington Parklands Draft Future Directions Plan 2022

The Frankston to Mornington Parklands project is part of the Metro Suburban Parks Program covering existing parks and reserves. The Directions Plan nominates actions to create ecological corridors to areas of ecological significance within the region, expand trail networks to connect with adjacent communities such as Western Port Bay to the east, and identify future opportunities for expanding open space. Actions that are relevant to this project include:

- Investigate an ecological link between Boggy Creek and the Seaford Wetlands to promote environmental values
- Construct an off-road shared use path along Boggy Creek linking the Pines Flora and Fauna Reserve to Langwarrin
- Investigate the feasibility of revegetation and ecological restoration to improve ecological connections between The Pines Flora and Fauna Reserve, The Langwarrin Flora and Fauna Reserve and Cranbourne Botanical Gardens



Frankston City Open Space Strategy 2016-2036

The Frankston City Open Space Strategy 2016-2036 comprises of a framework, opportunities and an implementation plan. Frankston City Council values its open space and natural assets and understands they provide a diversity of experiences that promote connection to place, cultural identity, and community appreciation of nature. The strategy identifies The Pines Flora and Fauna Reserve as a significant open space and Little Boggy Creek environs as a site for future development of a masterplan. Investigations at Langwarrin Quarry and Boggy Creek are highlighted as a recommendation.

3. Boggy Creek Biodiversity Corridor Concept Plan

3.1 Applying Biodiversity Sensitive Urban Design

As global urbanisation presents increasingly complex challenges, the role of urban environments is becoming more critical in the creation of inspired and resilient communities. Biodiversity Sensitive Urban Design (BSUD) is a protocol that aims to create urban environments that are a net benefit to native biodiversity through careful design that provides habitat and resources, mitigates threats, and plans for connectivity in the landscape.

The BSUD approach is based on five principles: maintaining and introducing habitat, facilitating dispersal, minimising threats and anthropogenic disturbances, facilitating natural ecological processes, and improving potential for positive human-nature interactions. The diverse and scalable nature of BSUD implementation is one of its great strengths, from people proactively wanting to reduce their impact on nature, to local and regional authorities responsible for the planning and development of major towns and cities. Other instrinisic benefits are shown in Figure 11.

BSUD planning and delivery can proceed in six steps, including an optional step to allow for a quantitative assessment of the built environment's contribution to biodiversity.The step -by-step approach is summarised in Figure 12. For this project we have investigated the site, developed biodiversity objectives to guide the transformation of Boggy Creek, identified target species their specific habitat requirements, and proposed an integrated concept design that responds and delivers on the biodiversity objectives in Section 3 of this report.

The BSUD design approach is an innovative way of prioritizing biodiversity in the early planning phases of quarry rehabilitation while also maximising opportunities for people to engage with nature through the creation of greener urban environments that move us forward towards a decarbonised future. This project meets the following goals set out in Australia's Nature Strategy, UN Sustainable Development Goals and UN Aichi Biodiversity Targets (as implemented by the Convention on Biological Diversity treaty) as shown in Table 3.

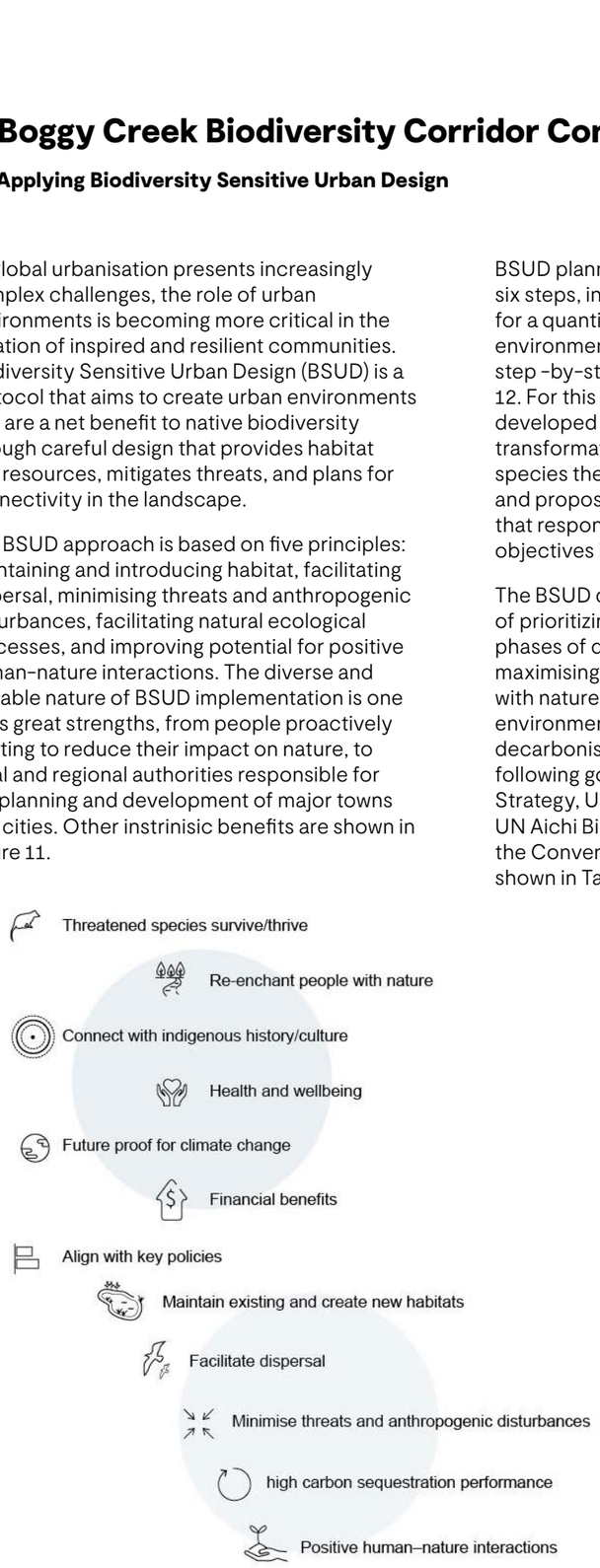


Figure 11. Benefits of biodiverse rich environments

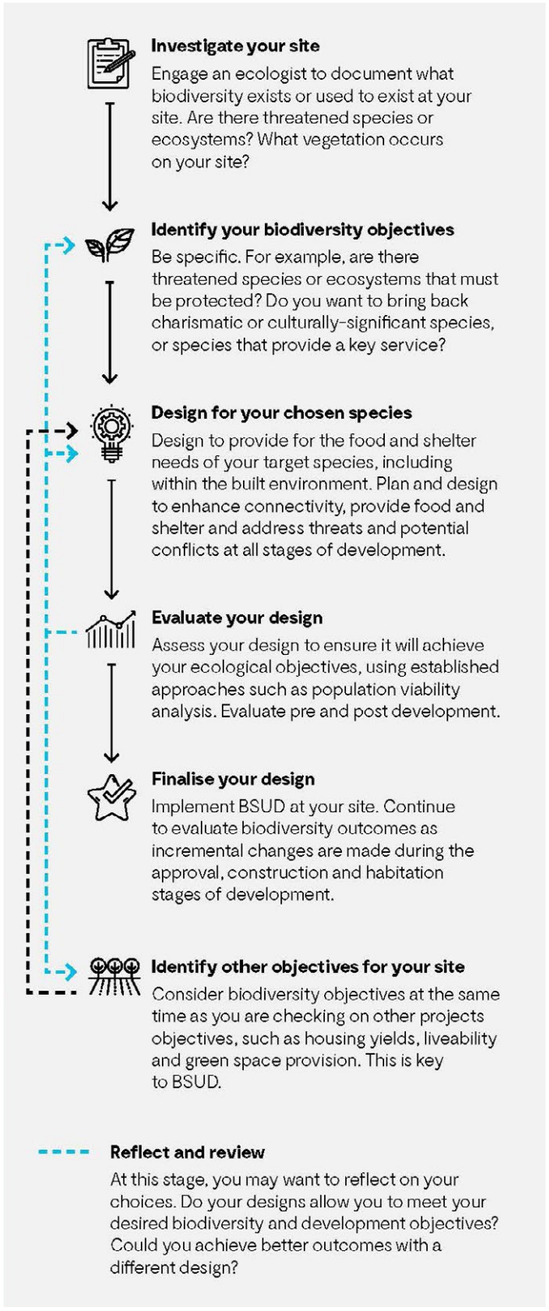


Figure 12. BSUD approach, source: Garrard, G.E., Williams, N.S.G., Mata, L., Thomas, J. and Bekessy, S.A. (2018), Biodiversity Sensitive Urban Design. CONSERVATION LETTERS, 11: e12411. https://doi.org/10.1111/conl.12411

Aichi biodiversity targets	Sustainable Development Goals
Goal 1: Connect all Australians with nature	
Goal 2: Care for nature in all its diversity	
Goal 3: Share and build knowledge	

Table 3. Boggy Creek Biodiversity Corridor delivering on Australia's Strategy for Nature goals. Visit www.cbd.int/sp/targets for further information on the Aichi Targets and https://sustainabledevelopment.un.org for further information on the Sustainable Development Goals.

3. Boggy Creek Biodiversity Corridor Concept Plan

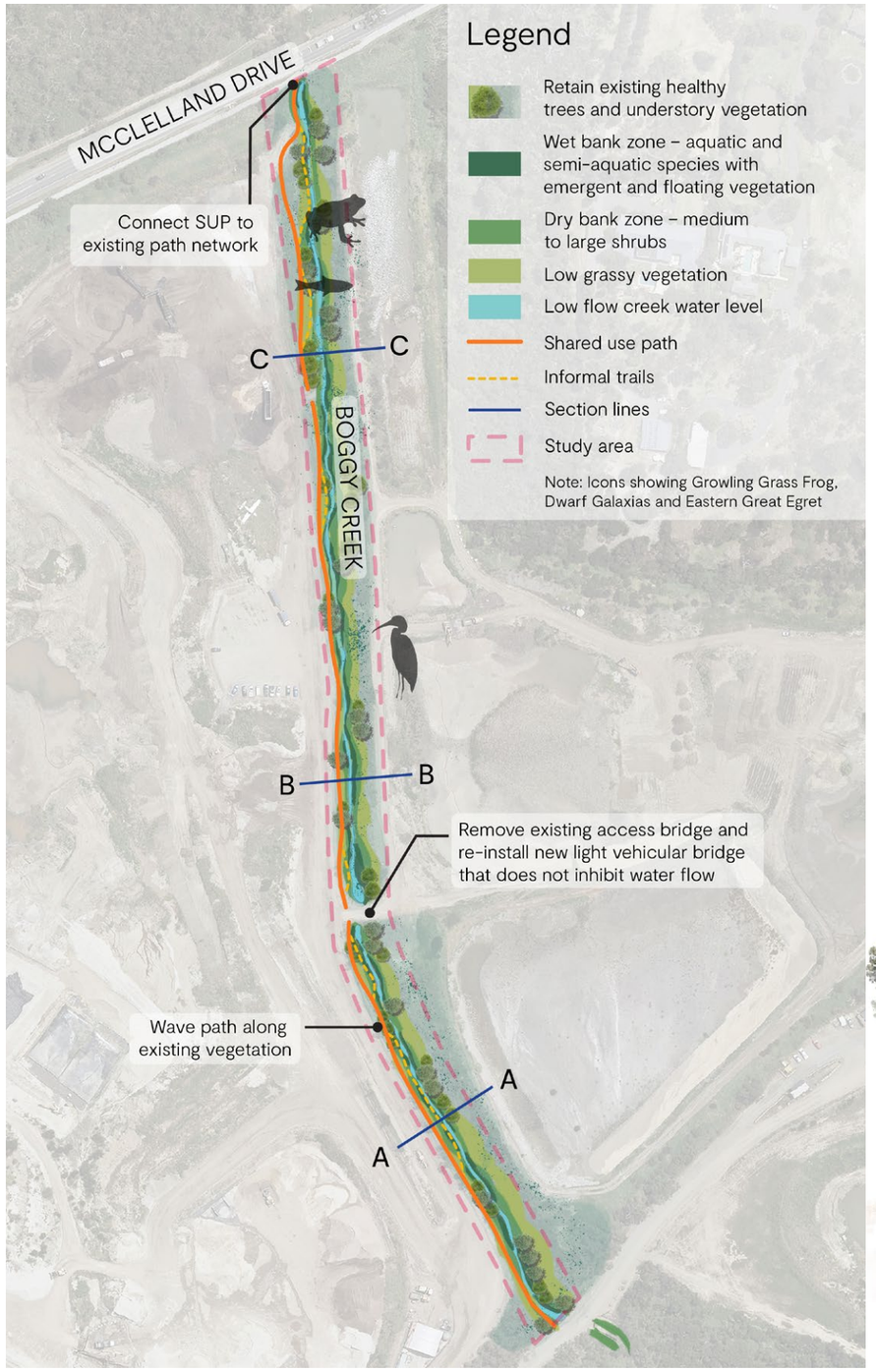


Figure 13. Boggy Creek biodiversity concept proposed plan

Biodiversity objectives

The results of the desktop and field assessment determined there is some capacity to support native flora and fauna species and communities in the Boggy Creek corridor under existing conditions. However, further rehabilitation of the site would increase the potential for increases in biodiversity, including the presence of threatened species.

With consideration given to the Melbourne Water Performance Objectives, the overarching biodiversity objectives for the Boggy Creek corridor are:

A place of diversity, for habitats for multiple species

A place that ecologically links to the Pines Flora Reserve and other remnant native communities

A waterway where pools and riffles meander to create rich habitats

An aquatic wonderland where low flows form connections into the broader landscape

To address these objectives, the habitat requirements for target species, as well as additional rehabilitation recommendations for general ecological health including common species, are discussed below.

- Target species and habitat requirements
- Flora and vegetation
- Fauna habitats
- Growling Grass Frog (GGF)
- Dwarf Galaxias
- Eastern Great Egret (EGE)

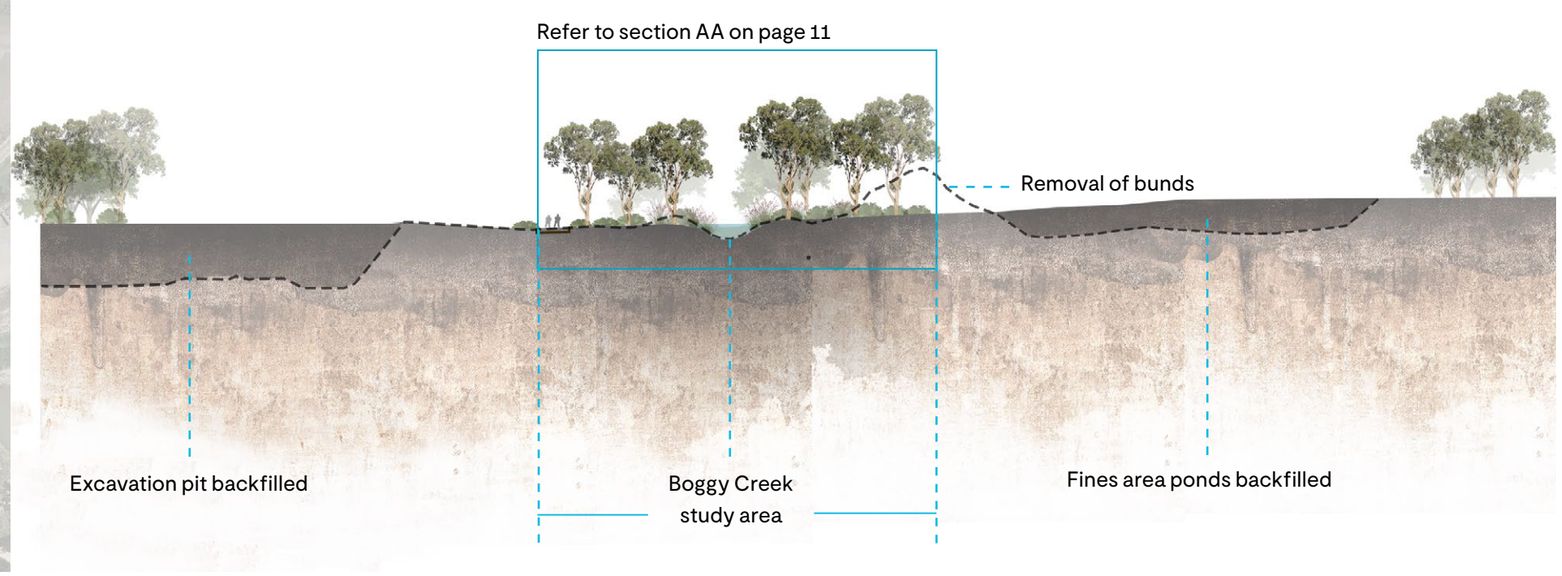
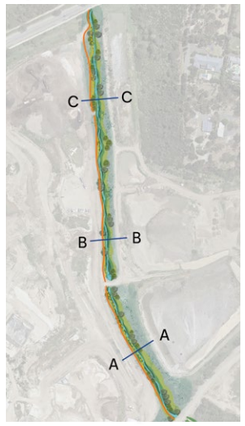


Figure 14. Boggy Creek biodiversity corridor concept section

Boggy Creek Section A

Key plan



RETAIN AND PROTECT EXISTING TREES OF SIGNIFICANT VALUE. UNDERTAKE WEED REMOVAL AND ON-GOING MANAGEMENT ALONG THE CORRIDOR

POTENTIAL FOR STAGS AND ROCK PLACEMENT FOR HABITAT

EXISTING GROUNDLINE

SPECIES AND PLANTING DENSITY TO BE INFORMED BY EVC 83 SWAMPY RIPARIAN WOODLAND SPECIES LIST

WET BANK SPECIES

DRY BANK SPECIES

1 IN 100 YEAR FLOOD

1 IN 10 YEAR FLOOD

APPROX. LOCATION OF 600mm DIA. SEWER

SHARED USER PATH

2m CLEARANCE ON EITHER SIDE OF SUP

POTENTIAL TO SPLAY EMBANKMENT TO 1:6 IN REACHES TO CREATE SINUOSITY ALONG CREEK ALIGNMENT

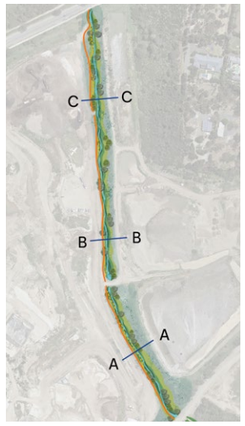
BOGGY CREEK

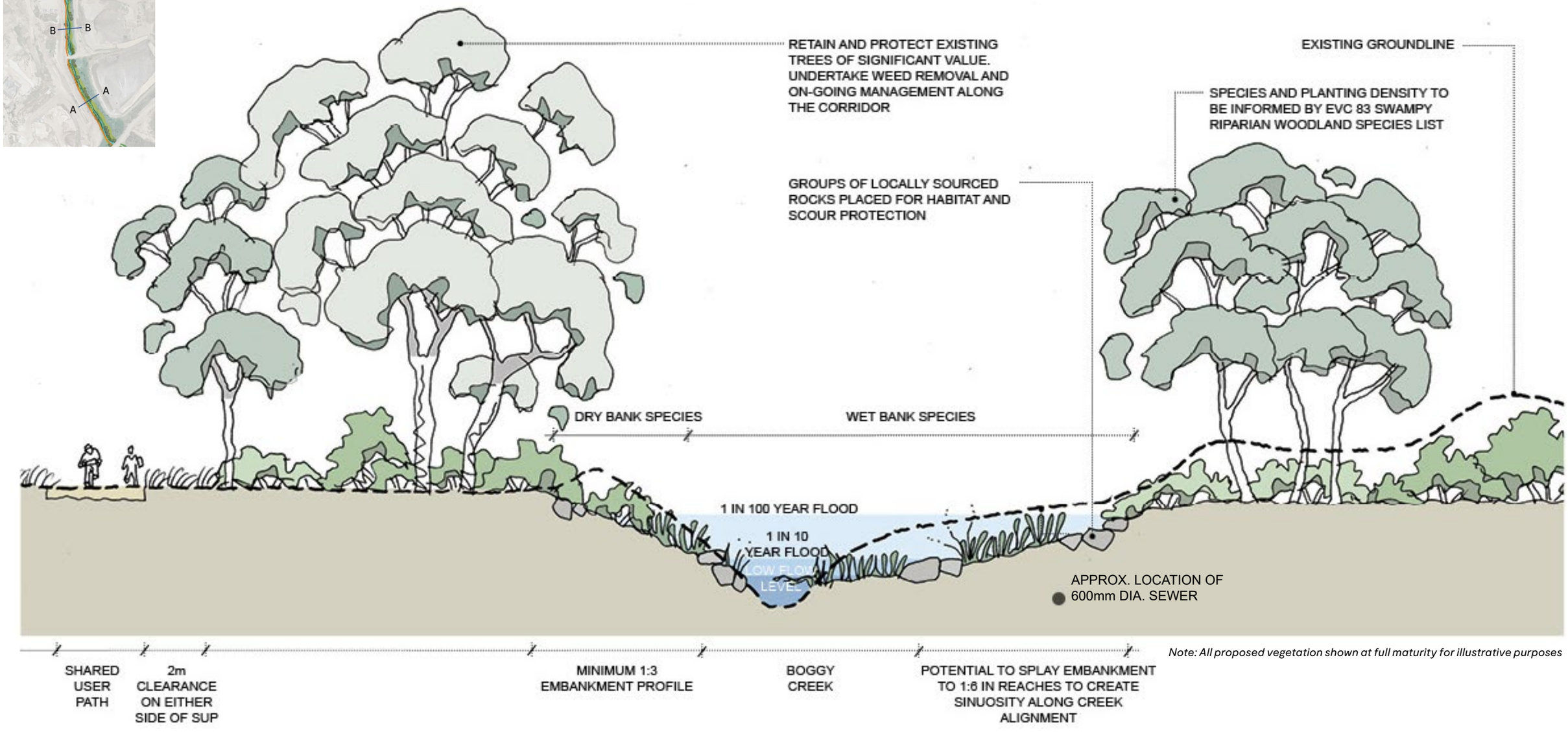
MINIMUM 1:3 EMBANKMENT PROFILE

Note: All proposed vegetation shown at full maturity for illustrative purposes

Boggy Creek Section B

Key plan

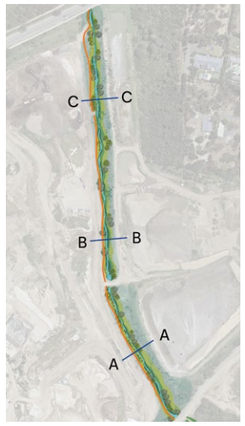


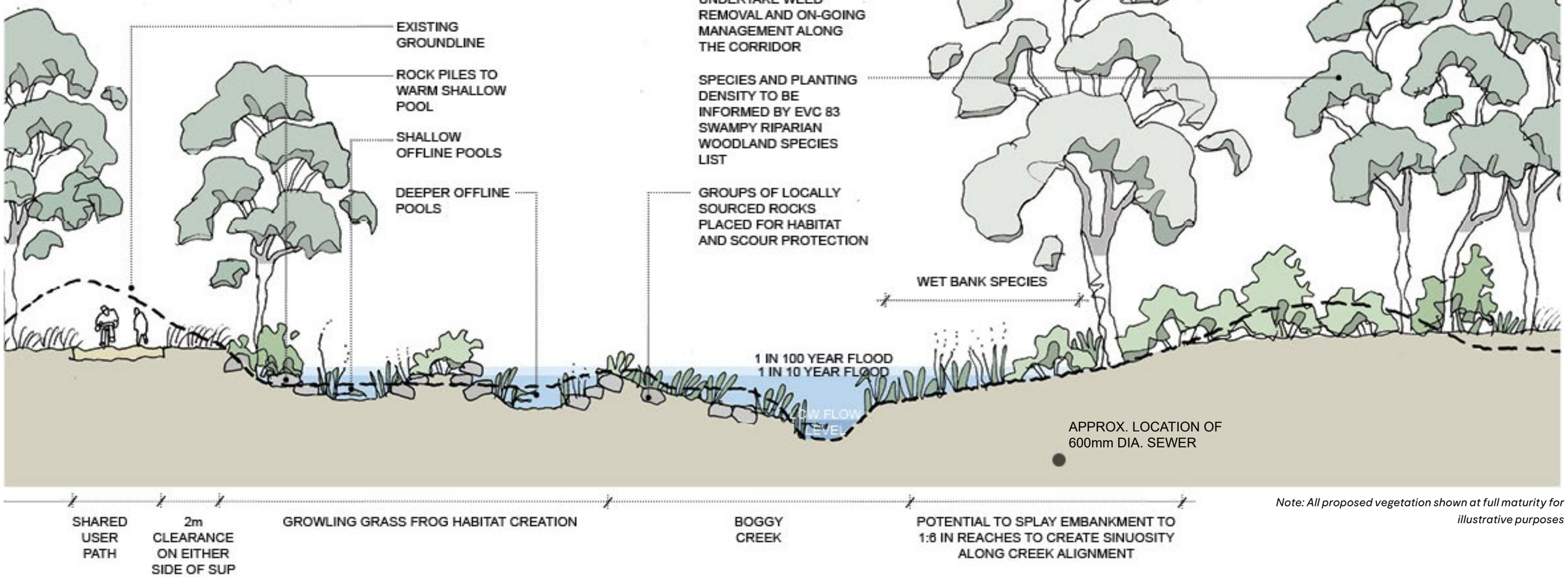


Note: All proposed vegetation shown at full maturity for illustrative purposes

Boggy Creek Section C

Key plan





Note: All proposed vegetation shown at full maturity for illustrative purposes

Figure 15. Shared user path among landscape

Figure 16. Rehabilitation of water edge

Figure 17. Immersive landscape

Figure 18. Landscape adaptable to wet and dry seasons

Figure 19. Opportunity for reclaimed log and rocks for habitat

Figure 20. Signage for wayfinding and information

Figure 21. Pools and ponds for habitat

Photo source from internet

3.3 Key design considerations

Waterway form and hydraulic function

The rehabilitation and enhancement of the Boggy Creek corridor provides an opportunity to improve both waterway and floodplain management outcomes. The waterway stability and form can be improved through bank shaping (i.e. reducing batter slopes) and denser riparian vegetation through revegetation (of both banks and terrestrial areas above the banks), as well as targeted use of rock beaching for habitat improvement creating pools and riffles within the bed of the channel. The removal of the internal access crossing constriction and removal of artificial bunds provides an opportunity to configure the waterway form and floodplain conveyance. The waterway shaping improvement works and creation of habitat features will result in increasing effective waterway area allowing for containing the range of flood flows up to and including the 1 in 100 years flood flows within the 50m waterway corridor. In addition to this there could be further opportunity to create additional floodplain storage outside of the corridor as part of achieving broader flood mitigation outcomes (e.g. improving downstream flood conditions).

Target species and communities

Swampy Riparian Woodland

Vegetation within the Boggy Creek Corridor aligns with EVC 83 Swampy Riparian Woodland. As outlined in the Melbourne Water Healthy Waterways Strategy (Melbourne Water 2021), the establishment and maintenance of vegetation should be informed by the relevant EVC benchmark (Appendix A). In this case, as an example, the dominant canopy trees would comprise Eucalyptus ovata (Swamp Gum) and *Eucalytpus radiata s.l* (Narrow-leaf Peppermint) and account for 20% cover, and a range of understorey life forms would be present, including immature trees and medium shrubs such as *Melaleuca ericifolia* (Swamp Paperbark) and *Leptospermum continentale*. These life forms would form 30% cover and 20% cover respectively. The benchmark could also provide guidance on the density of logs and organic litter cover (in this case 20 m/0.1 ha and 20% respectively). In addition to use of the EVC benchmark, existing vegetation at the site, other guides, such as council planting guides and vegetation of higher quality in nearby areas (e.g., the Pines Flora and Fauna Reserve) can help inform the improvement of habitat quality and planting selection. Recommendations specific to improving the condition of the Swampy Riparian Woodland include:

- Create a weed management plan and treat the noxious weeds present. Manual control or herbicide is recommended for managing Kikuyu, which is particularly prolific along both sides of Boggy Creek
- The seedbank in the ground is likely to be dominated by noxious weed species so replanting understory plants such as small shrubs, grasses, sedges and herbs will be important
- Conduct an arborist assessment to understand the health of trees and inform the detailed design, e.g., to understand trees requiring removal for safety
- During the development of the project's detailed design, determine if any trees or native vegetation require removal. Avoid and minimise impacts to remnant vegetation in the design process, keeping in mind the aim of the transformation is net positive outcomes for biodiversity

Growling Grass Frog

Growling Grass Frogs primarily need still or slow moving water with mats of floating and submerged vegetation. The GGF is an aquatic species (i.e., with strong association with water), and its survival and persistence at a site appear to rely on particular habitat attributes (see Heard et al. 2008), including access to a well-connected matrix of ponds that have varying water permanence and depth, along with high cover and diversity of aquatic and fringing vegetation. At least some ponds need to provide suitable aquatic habitat at the right time of year for breeding.

According to the Growling Grass Frog Habitat Design Standards (DELWP 2017), the habitat conditions that should be considered to maximise the potential for GGF to inhabit an ecosystem include:

- Shallow water areas (20-30% of wetland) with emergent and floating vegetation
- Deep water (>1.5 m) with submerged and floating vegetation (minimum 50% and preferably 60–70% of wetland)
- Rock piles (at least 20%)
- Approximately 50% of the area within 10 m of wetland maintained as low, grassy vegetation up to 10 cm in height
- Where tussock-forming grasses and sedges are used within 10 m of normal water level, planting density should allow for no greater than 20% cover when mature
- Tree cover within 100 m of a wetland should not exceed 10% and shrub cover 10%
- A patchy arrangement of denser plantings of tussock-forming species is encouraged
- Connectivity to other waterbodies.

Dwarf Galaxias

Throughout the year, the species takes advantage of different types of wetlands providing transient habitat, spawning habitat and short and long-term refuge habitat. In accordance with threat mitigation approaches for the species outlined by DCCEEW 2022b, the following features are recommended to enhance habitat suitability for Dwarf Galaxias within the Boggy Creek corridor:

- Include multiple water velocities across sections of the creek with relatively deep, slow water areas
- Pools with a depth up to 1 m and slow flowing water (5 cm/sec) should be available to fish during low flows
- Provide aquatic vegetation to provide complexity of in stream habitat structure
- Riparian vegetation should consist of a range of structural elements to provide cover and support habitat for terrestrial insects and aquatic macroinvertebrates.

Eastern Great Egret

Within its wide distribution across Australia, the EGE inhabits a range of wetland habitats including freshwater and saline, permanent and ephemeral, open and vegetated and inland and coastal areas. When feeding, the bird wades in shallow to moderately deep water and pecking nearby prey, from vegetation but not from sediments (DCCEEW 2022c). Inclusion of aquatic vegetation and multiple water velocities across sections of the creek is also recommended to enhance habitat suitability for Eastern Great Egret and other waders and migratory wetland birds.

Other revegetation recommendations

- Reduce creek bed erosion. This could be achieved by manually excavating the slope of the steepest areas of bank which are most unstable
- Monitor pest fauna such as foxes, to determine their frequency at the site to inform a pest control plan, if required
- Increase bioconnectivity across. With the exception of an area near McClelland Drive immediately northwest of the quarry, the canopy and mid-story vegetation of the Boggy Creek corridor is similar quality to the terrestrial woodland habitat occurring within the Pines Flora and Fauna Reserve. Maintaining and improving the woodland vegetation within the corridor is likely to attract more birds, reptiles and mammals to the Boggy Creek corridor from within and surrounding the Pines Flora and Fauna Reserve, particularly as the woodland matures.
- Maintaining waterflow and habitat along all sections of the creek for fish and aquatic fauna is important to support migration and dispersal into and out of the Boggy Creek corridor. Melbourne Water (2021) suggest fish condition can be improved in the Dandenong Creek catchment by improving instream connectivity to provide opportunities for fish to move into areas they are currently absent.
- Maintain or improve water quality. Since the water quality of the Boggy Creek corridor is largely influenced by factors outside the control of the rehabilitation program (for example, water quality upstream and upstream discharges and runoff), there are limited actions this project could undertake to improve water quality. However, water quality measures taken from both the Boggy Creek corridor now and from locations upstream could inform the development of specific water quality targets for the project. In a general sense, actions within the Boggy Creek corridor as part of the rehabilitation, such as planting more indigenous understorey and aquatic plants along the creek is likely to improve the local water quality through increasing natural filtering and reducing silt build up from erosion.
- Coordinate the creek transformation works with local utility authorities to ensure the sewer has sufficient cover and retention capabilities to avoid any overflow events.

3.3 Key design considerations

Recycling and material re-use

- Where trees are to be removed, retain logs on-site for habitat creation
- Utilise recycled concrete or other locally sourced materials to construct shared use pathways, bridges, seating and walkways
- Reduce heat
- Identify and protect areas of cultural heritage sensitivity when excavating the creek slopes
- Re-use existing bridge culvert concrete blocks as stepping-stones or landscape features adjacent to creek
- Consider specification of materials with recycled content for works in the public realm, i.e. composite timber (plastic+wood); recycled building aggregate. Specify products and material that are Responsibly Sourced and request supplier contracts demonstrating compliance
- Consider use of Rapidly Growing Materials: e.g. reeds, bamboo, palm fronds, straw, wool is the manufacturing of public realm furniture, in accordance with Frankston City Council maintenance requirements
- Revegetation techniques that aim to reduce erosion of creek embankment

Place connectivity

- Investigate opportunities for activation along the shared use path such as pause spots, seating or picnic spots
- Install wayfinding signage to adjacent destinations and surrounding recreation facilities including travel times
- Install interpretive signage to showcase the biodiversity in the area and engage the community through storytelling and creative media
- Apply CPTED principles in the corridor to increase visibility within and around a space including natural access management—landscape and wayfinding elements that help define and guide community members throughout space, and space delineation—physical and environmental attributes that help define space and express a positive sense of ownership.
- Include opportunities for people to access the creek for informal connections to nature. These spaces should be away from targeted habitat created for the Growling Grass Frog
- Identify complementary adjacent land uses that support the biodiversity objectives for Boggy Creek and create further bio links to meet council aspirations and strategic directions

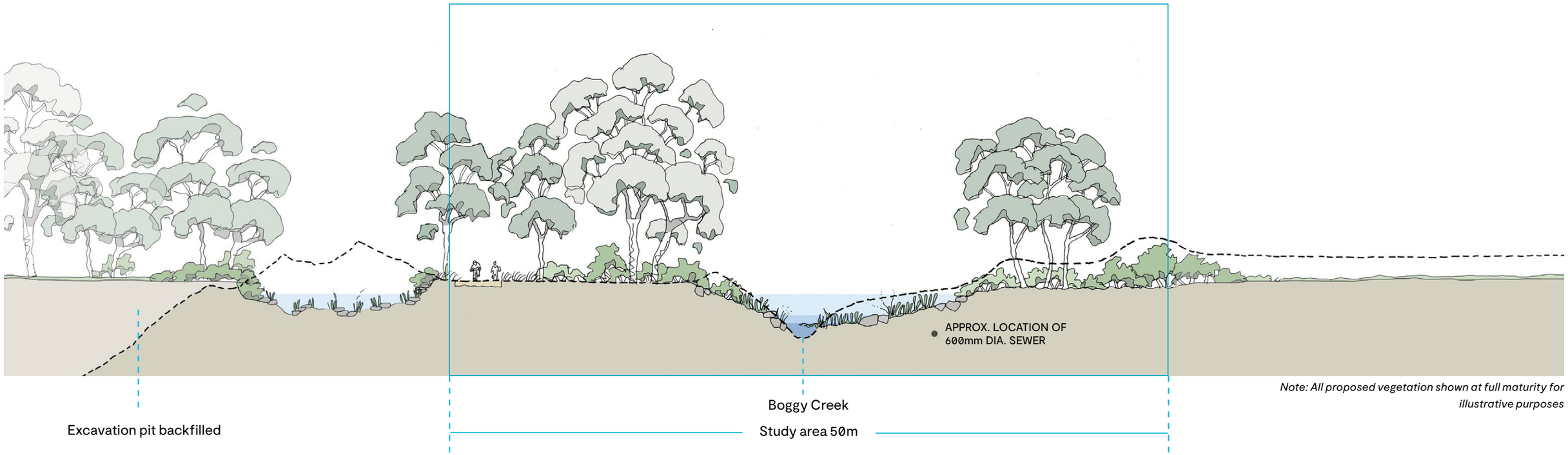
Future regeneration ideas

To further improve the viability of the biodiversity corridor we recommend exploring a wider corridor for:

- Greater resilience in habitat quality
- Improved water quality and water storage in high flow events through incorporating habitat features (e.g. wetlands, ephemeral pools etc) connected to but beyond the waterway corridor
- Improved control of stormwater to minimise erosion by slowing water flows
- Better integrate Boggy Creek with adjacent land uses and provide a transitional green space to support ecological services.

Boggy Creek Section B 100 meters

Refer to section BB on page 12



Note: All proposed vegetation shown at full maturity for illustrative purposes

4 Risk assessment

Regulation 11 (2) (f) (MRSD (EI) Regulations 2019) requires a rehabilitation plan to include an identification and assessment of relevant risks that the rehabilitated land may pose to the environment, to any member of the public or to land, property or infrastructure in the vicinity of the rehabilitated land, including:

- The type, likelihood and consequence of the risks
- The activities required to manage the risks
- The projected costs to manage the risks
- Any other matter that may be relevant to risks arising from the rehabilitated land

Relevant risks are defined in regulation 11 (5) as risks that may require monitoring, maintenance, treatment or other ongoing land management activities after rehabilitation is complete. The purpose of the post-rehabilitation risk assessment is to inform Earth Resources Regulation (ERR) of the ongoing impact (if any) the proposed quarrying operation will have after the proposed rehabilitation is completed. This risk assessment should include any risks that will require activities or incur a cost after rehabilitation is complete.

For the rehabilitation and post-rehabilitation, risks are tabulated in a singular risk assessment, see Appendix B.

For each hazard, it is noted whether they occur during the rehabilitation or whether they occur during the post rehabilitation phase. Sensitive receptors are listed and an inherent risk assessment is completed, prior to the implementation of controls. Control measures are listed, along with any possible performance standards. The residual risk assessment has then been completed with ongoing monitoring and management controls listed for completeness.

The consequence criteria used for the assessment is based on the ERR descriptors on assessing the harm caused by a risk event (refer to Table A1 in the Preparation of Work Plans and Work Plan Variations – Guideline for Extractive Industry Projects).

The likelihood criteria used for the assessment is based on the ERR likelihood descriptors (refer to Table A2 in the Preparation of Work Plans and Work Plan Variations – Guideline for Extractive Industry Projects).

The risk matrix below (Table 4) was used from ERR to determine the risk rating for each risk event. The purpose of rating risk is to guide decision making on risk management to eliminate or otherwise reduce the risk to an acceptable level.

Where there were multiple consequences for a single risk event, the highest risk rating (after assessment of consequence and likelihood for each consequence), was used to categorise the risk rating.

Any hazard, with associated risk event initially rated inherently as high or very high, as per the Preparation of Work Plans and Work Plan Variations – Guideline for Extractive Industry Projects, requires a risk treatment plan. However there have been no high or very high risks identified during the process, and therefore no risk treatment plans have been prepared.

		Consequence				
		Insignificant	Minor	Moderate	Major	Critical
Likelihood	Almost Certain	Medium	High	Very High	Very High	Very High
	Likely	Medium	Medium	High	Very High	Very High
	Possible	Low	Medium	Medium	High	Very High
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Medium	Medium	High
	Eliminated	Eliminated				

Table 4. Earth Resources Regulation Rehabilitation Risk Matrix

5 Next steps

To further develop the proposed concept plan the following next steps are recommend:

- Undertake key stakeholder consultation
- Undertake tree aboriculture and canopy cover assessment to determine health of trees and existing coverage to ensure there is no net loss to tree canopy cover

6 Future stakeholder engagement

It is understood stakeholder consultation will be carried out with key agencies and landholders including Melbourne Water, DELWP and Frankston City Council in the next design phase. It is also recommended to engage early with Bunurong Land Council Aboriginal Corporation through meaningful, respectful and transparent engagement as traditional custodians of land and water, to determine future engagement opportunities, identify key recommendations, and to seek an understanding of project accountability mechanisms and integrity approaches.

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Preparation of Rehabilitation Plans - Guideline for Extractive Industry Projects March 2021 (Version 1.0)

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https://icon-science.org/bsud-home/

The Power of Commitment

Appendix A: Boggy Creek Biodiversity and ecological assessment

Boggy Creek

Biodiversity and ecological assessment

Compliance Manager, Burdett Sands Pty Ltd

23 December 2022

→ **The Power of Commitment**

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23 December 2022

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Boggy Creek biodiversity and ecological assessment

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Project name		Burdett Sands - Langwarrin Quarry Rehabilitation Plan					
Document title		Boggy Creek biodiversity and ecological assessment | Biodiversity and ecological assessment					
Project number		12576404					
File name		12576404-LET-Ecology_V2.docx					
Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S3	A	Jessie Moyses Peter Lind	Anissa Webb		Anissa Webb		18/11/2022
S4	0	Jessie Moyses Peter Lind	Anissa Webb		Anissa Webb		23/12/2022
[Status code]							
[Status code]							
[Status code]							

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Contents

Appendices

1. Introduction

Burdett Sands Pty Ltd (Burdett) owns and operates a sand extraction industry at Quarry Road, Langwarrin, Victoria. Quarrying on the site commenced in 2001 pursuant to Work Authority No. 519 (WA 519) and Planning Permit No. 0015. The sand resource is depleted, with the main quarry excavation bottoming on Silurian bedrock. The extraction of sand from the site has ceased.

Burdett have signed a funding agreement with the Department of Environment, Land, Water and Planning (DELWP) as part of the Innovative Quarry End Land Use Grant Project (also known as the Quarry Transformation Grants). The funding has been approved on the basis that Burdett will engage a suitable consultant to develop a concept design for the transformation of the Boggy Creek environs, an existing Melbourne water drainage easement that intersects the site, into a biodiversity corridor. The corridor will support the local community by providing walking and cycling trails as well as support habitat for local flora and fauna, ultimately linking existing nature reserves with Boggy Creek.

GHD has been engaged by Burdett to develop the concept design for the biodiversity corridor. The overall scope of work includes:

1. A floodplain and waterway assessment to assess and quantify the expected flow and possible flooding conditions of revitalised Boggy Creek environs
2. An ecological assessment of Boggy Creek and associated environs to inform the development of habitat and biodiversity targets for the corridor
3. Generation of a concept design that will provide an appreciation of the rehabilitation potential for the Boggy Creek environs
4. Development of a supporting risk assessment which addresses risks posed by the works and associated mitigation strategies.

1.1 Purpose of this report

The purpose of this report is to present the findings of an ecological assessment of Boggy Creek and associated environs. This report:

– Summarises the results of an existing conditions assessment of the Boggy Creek environs that considered habitat and flora and fauna species/communities currently residing in the corridor
– Considers ecological conditions that were historically present based on past records of species/communities and the conditions associated with more ‘natural’ areas such as the Pines Flora and Fauna Reserve
– Considers site-specific issues associated with the corridor that potentially influence current and future ecological conditions
– Based on the above, recommends biodiversity objectives (e.g. species, community and habitat targets) for the corridor to improve ecological values
– Recommends steps to increase the quality and quantity of habitat to promote recovery or maintenance of biodiversity objectives.

This ecological assessment will inform the concept design for the transformation of the Boggy Creek environs into a biodiversity corridor. The approach to the assessment outlined above will ensure the concept design considers the native flora and fauna habitat requirements so that the best chance for benefits to native biodiversity and ecological values are realised.

1.2 Limitations

This report has been prepared by GHD Pty Ltd (GHD) for Burdett Sand Pty Ltd (Burdett) and may only be used and relied on by Burdett for the purpose agreed between GHD and Burdett as set out in this report. GHD otherwise disclaims responsibility to any person other than Burdett arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible. The services undertaken by GHD in connection with preparing this report:

– Were limited to those specifically detailed in the report and are subject to the scope limitations stated in this section and also set out in the report.
– Were limited to vascular plant species (ferns, conifers and flowering plants) and visual terrestrial vertebrate fauna during field surveys. No field surveys were undertaken for aquatic fauna.
– Did not include non-vascular flora (e.g. mosses, liverworts, lichens), fungi, or terrestrial invertebrates during field surveys, except where listed threatened species are known or are suspected to occur, or where bryophytes comprise part of the EVC benchmark used for the habitat hectare assessment.
– Included an ecological field survey during spring, which is generally an optimal time of year for conducting botanical assessments. Additional native species may be recorded at the site at other times of the year. Therefore, it is possible that threatened flora may be present but were not detected during the survey because of its timing. This limitation is somewhat overcome by consideration of records from the Victorian Biodiversity Atlas (VBA) databases, which span all seasons and many years.
– Involved the use of Collector for ArcGIS mapping application to record site information. This mapping tool was accurate to within ten metres on site.
– Did not involve any targeted surveys for rare or threatened flora or fauna, although did include identification of flora that were fertile and/or flowering at the time of the field surveys. It was beyond the scope of this assessment to employ more detailed flora and fauna survey techniques.
– Did not include a detailed assessment of planning implications with relation to legislation outside of those considered from an ecological perspective. A detailed assessment of planning overlays (and other sources of legislative information) has not been undertaken as part of this project unless otherwise discussed.

The opinions, conclusions and any recommendations in this report are based on conditions encountered, observations made, and information reviewed up to the date of preparation of the report. As GHD was only present on specific dates and certain time periods, this report is only indicative (and not definitive) of flora and fauna present on the site. Flora and fauna (whether in type or quantity) can also change and fluctuate at different times throughout the year (due to factors including seasonal changes, external events or third-party intervention), and it is generally not possible to observe such changes or fluctuations where only a discrete site visit has taken place. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

GHD has prepared this report on the basis of information provided by Burdett and others (including Government authorities). GHD has not independently verified or checked this information beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

Maps presented in this report displaying site information should not be relied on for the detailed design during the construction process. The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD and described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

1.3 Acknowledgement of country

GHD acknowledges Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of the land, water and sky throughout Australia on which we do business. We recognise their strength, diversity, resilience and deep connections to Country. We pay our respects to Elders of the past, present and future, as they hold the memories, knowledges and spirit of Australia. GHD is committed to learning from Aboriginal and Torres Strait Islander peoples in the work we do. GHD recognises the Bunurong people upon whose land this project takes place and the Bunurong Land Council Aboriginal Corporation who are the registered Aboriginal Party representing the Bunurong people.

2. Methods

The Biodiversity Sensitive Urban Design (BSUD) approach has been applied in this project so that biodiversity and ecological values are considered in the concept design. The BSUD approach is based on six stages:

– Investigate your site
– Identify your biodiversity objectives
– Design for your chosen species or communities
– Evaluate your design
– Finalise your design
– Identify other objectives for your site.

One of the main differences between BSUD and standard rehabilitation practices is that it considers biodiversity objectives in the context of target species or communities. The habitat requirements of these are incorporated into the design stages of a project. Therefore, while increases in biodiversity are expected due to standard rehabilitation practices, application of the BSUD approach will benefit target species and communities that are of value to the community and stakeholders (Garrard et al. 2018).

This assessment applied the first three stages of the BSUD approach based on an assessment of ecological values at a desktop and field assessment stage. Details of these stages are outlined below.

2.1 Site investigation

2.1.1 Desktop assessment

Desktop assessments were conducted to determine the ecological values present or historically present at the site and included reviews of ecological databases and reports including:

– NatureKit database (maintained by DELWP)
– The Victorian Biodiversity Atlas (VBA) database for flora and fauna species recorded within a 10 km radius of the study site (maintained by DELWP)
– The Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (PMST), which predicts the occurrence of Matters of National Environmental Significance listed under the *Environment Protection and Biodiversity Conservation Act* (EPBC) *1999*
– The Atlas of Living Australia dataset of biodiversity records (maintained by the Commonwealth Scientific and Industrial Research Organisation (CSIRO))
– DELWP GIS mapping including the extant and pre-European Ecological Vegetation Classes (EVCs), Location maps and Native Vegetation Extent maps
– Aerial imagery of the study site
– Melbourne Water Healthy Waterways Strategy.

2.1.2 Field assessment

A one-day field assessment was completed by a GHD botanist and zoologist on 17 October 2022 to identify the presence and type of native vegetation, terrestrial and aquatic habitats, and likelihood of threatened species and communities occurring within the site. The site assessment included the Boggy Creek corridor within the Burdett Sands Quarry in Langwarrin, and a section of Boggy Creek further downstream within the Pines Flora and Fauna Reserve to the north of the site. Assessment of the creek within the reserve helped to inform aspirational conditions for the biodiversity corridor based on more ‘natural’ areas.

The assessment of native vegetation and terrestrial fauna habitat within the project area was completed in accordance with the *Guidelines for the Removal, Destruction or Lopping of Native Vegetation* (DELWP 2017). The assessment included:

– Undertaking a Vegetation Quality Assessment (VQA) using the Habitat-hectare (HabHa) assessment approach, as outlined in the *Vegetation Quality Assessment Manual – Guidelines for Applying the Habitat Hectare Scoring Method* (DSE 2004). This will include assessment of any patches of native vegetation within the project area including the condition, extent (in hectares), Ecological Vegetation Classes (EVCs) and bioregional conservation status
– Recording and mapping the location of all areas of native vegetation, including all Canopy Trees (that meet the benchmark for Large Trees) and Scattered Trees, within or immediately beside the proposed works area
– Identifying and mapping the location of any listed flora or fauna species or listed communities within the site under the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the *Victorian Flora and Fauna Guarantee Act 1988* (FFG Act)
– Undertaking a habitat-based assessment of listed fauna species (EPBC Act and FFG Act) within the site, including an assessment of habitat quality
– Determining the likelihood of occurrence of threatened flora and fauna and migratory fauna (based on presence and condition of suitable habitat)
– Identifying the presence of significant weed species including those declared under relevant State and national legislation, policy or strategy, e.g. *Catchment and Land Protection Act 1994* (CALP Act) and National Weeds Strategy
– Collecting general site data and photographs of ecological values and threatening processes.

The assessment of aquatic fauna habitat and waterway conditions was completed in accordance with the *Guideline for Environmental Management (GEM) - Rapid Bioassessment Methodology for Rivers and Streams* (EPA Victoria 2021) and included:

– Stream habitat types and distribution in surveyed reach (riffles, runs and pools)
– Substrate description (% cover of boulders, cobble, pebbles, silt/clay, etc)
– Other stream features (e.g. willow roots, moss, filamentous algae, macrophytes)
– Depth and current velocity
– Presence of backwaters, leaf packs and coarse organic material, undercut banks, logs, trailing bank vegetation
– Evidence of catchment erosion and other sources of contamination.

2.2 Biodiversity objectives

The biodiversity objectives for this project have been developed using the BSUD approach. That is, threatened species were selected for consideration based on the likelihood of presence determined from the desktop and field assessment stages. However, consideration has also been given to Performance Objectives documented in the Melbourne Water Healthy Waterways Strategy (Melbourne Water 2021). A summary of Performance Objectives relevant to this project are:

– Establish and maintain continuous vegetated buffers using EVC benchmarks
– Maintain high and very high-quality vegetation
– Conserve all currently threatened water dependent species and communities
– Mitigate threats to physical form (e.g. erosion) and other high values (including impacts of urbanisation)
– Reduce nutrient and sediment runoff.

Although the Performance Objectives listed above may be applicable to specific waterways or catchment areas (see Melbourne Water 2021), they have been considered in this project to ensure the rehabilitation of the Boggy Creek corridor aligns with broader targets within the Dandenong Creek catchment.

In addition to biodiversity objectives for threatened species and those related to Melbourne Water performance objectives, broader habitat objectives were also identified with the aim of rehabilitating habitat for both threatened species and more common native species. Melbourne Water (2018) indicate that although some common animals such as turtles, lizards, freshwater crayfish or small mammals such as bandicoots and water rats are not amongst the key values, they are still an important part of waterway-associated biodiversity. They go on to say that it is

assumed that when waterway management addresses chosen ‘key values’, it will also be managing for other species and values.

2.3 Design considerations

Following the selection of target species, design guidelines were reviewed (where available) to determine the habitat requirements of these species. These requirements were subsequently used to inform the concept design. Available guidelines include:

– *Bioregions and EVC benchmarks*: Ecological Vegetation Classes (EVCs) are the standard unit for classifying vegetation types in Victoria and the benchmarks provide a general description of each EVC along with typical vegetation species, percentage cover of large trees and understory, organic litter percentage cover, and density of large logs (see DELWP 2022c).
– *Growling Grass Frog Habitat Design Standards*: Provides advice in cases where the proponent wishes to provide Growling Grass Frog habitat as an objective (see DELWP 2017). Includes recommendations on aquatic and terrestrial habitat (i.e. vegetation species and abundance, coverage of rocks and logs).

Where guidelines are not available for particular species, general ecological and habitat requirements were determined from available literature and other sources. In addition, general recommendations to improve habitat conditions of terrestrial and aquatic environs have also been made.

3. Results

3.1 Site investigation

3.1.1 Site overview

The Boggy Creek area considered in this report is within the Kananook Creek sub-catchment within the broader Dandenong Creek catchment that covers around 870 km^2. Urban areas cover around 60% of the Dandenong Catchment, 30% is used for agriculture, and about 10% is natural vegetation including the Pines Flora and Fauna Reserve, the Dandenong Ranges and parts of the middle Dandenong Creek (Melbourne Water 2021).

From the quarry site, Boggy Creek flows in a northwest direction through the Pines Flora and Fauna Reserve before joining with the highly modified and channelised Eel Race Drain. The drain subsequently joins with Kananook Creek that discharges into Port Phillip Bay at Frankston.

Boggy Creek retains some good vegetation in higher reaches but is heavily modified in lower reaches (Melbourne Water 2018; 2021). It is reported vegetation condition may deteriorate unless opportunities for improvement are implemented (Melbourne Water 2021). Due to land use impacts in the Dandenong Creek catchment, the conditions of bird values are considered moderate while other biodiversity and ecological values (i.e. fish, frogs and macroinvertebrates) are in a low condition (Melbourne Water 2021). The low condition for fish is largely a reflection of the extent of barriers to movement that prevent some species from accessing some parts of the catchment while frogs have been impacted by spreading urbanisation, land use intensification, introduced predators, and deteriorating water quality (Melbourne Water 2021). Macroinvertebrate scores are low as much of the catchment has been impacted by increasing expansion of urban and industrial areas and associated changes in stream flows, water quality and instream habitat (Melbourne Water 2021).

Despite waterway modifications and impacts from urban development and industrial areas, waterways in the catchment continue to support multiple and varied uses and values including Dwarf Galaxias and Growling Grass Frogs (Melbourne Water 2021). The Dandenong Catchment also retains some natural features such as the Ramsar listed Edithvale-Seaford Wetlands (listed as a Ramsar site in 2001) that is home to large concentrations of waterbirds including migratory shorebirds (Melbourne Water 2021). These wetlands are south of the Eel Race Drain approximately 5 km northwest of the quarry site.

3.1.2 Terrestrial flora and vegetation

The VBA and PMST databases have records of 1,721 species of flora from within 10 km of the study site. These records consist of 1,057 native species, 614 introduced species, and 49 native species that are not indigenous to the area (Appendix A).

During the field assessment 25 species were identified including six native and 19 introduced species (Appendix B). There was no threatened flora found during the field assessment but there were two *Acacia* species that are both classed as protected flora under the FFG Act.

There were six species listed as noxious weeds under the CaLP Act in the Port Phillip Catchment Management Authority region recorded during the field assessment (Appendix B). Three of these species are also listed as a Weed of National Significance (WoNS). *Asparagus asparagoides* (Bridal Creeper) (Plate 1) and *Rubus fruticosa* spp. agg. (Blackberry) (Plate 2) were found along most of the length of Boggy Creek in high numbers, while *Chrysanthemoides monilifera* (Boneseed) (Plate 3) was limited to one individual approximately 10-15 m from the edge of the creek.

Plate 1 Bridal creeper along Boggy Creek in the Burdett Sands Quarry

Plate 2 Blackberry along Boggy Creek in the Burdett Sands Quarry

Plate 3 Bonesee along Boggy Creek in the Burdett Sands Quarry

Although the Boggy Creek corridor within the quarry has experienced modification and disturbance due to the local land use in and around the site, the riparian vegetation includes relatively healthy upper and mid-storey trees and shrubs. The dominant species are *Eucalyptus* spp., *Melaleuca ericifolia* (Swamp Paperbark) and *Pittosporum undulatum* (Sweet Pittosporum) (Plate 4 to Plate 8). There is a high cover of understorey weeds all along the corridor including noxious weeds such as *Chrysanthemoides monilifera* (Boneseed), *Rubus fruticosus* spp. agg, (Blackberry), *Asparagus asparagoides* (Bridal Creeper), *Cirsium vulgare* (Spear Thistle) and *Oxalis pes-caprae* (Soursob). The key strata are the large tussock grasses, sedges and herbs.

Within the Pines Flora and Fauna Reserve to the northwest of the project area there was medium to large shrubs and trees along the Boggy Creek, but in much lower densities compared to the corridor in the quarry (Plate 9). The understory was a lot more open, and the weed species different being mostly *Dactylis glomerata* (Cocksfoot), *Vulpia* spp. (Fescue) and *Lolium* spp (Perennial Rye-grass).

Plate 4 Boggy Creek in Burdett Sands Quarry, Langwarrin next to an internal road used by trucks and other plant machinery in the Quarry

Plate 5 Boggy Creek in Burdett Sands Quarry, Langwarrin next to an internal road used by trucks and other plant machinery in the Quarry

Plate 6 Southern end of Boggy Creek

Plate 7 Southern end of Boggy Creek

Plate 8 Northern extent of Boggy creek in Burdett Sands Quarry, discharge outlet in the north

Plate 9 Boggy Creek downstream in Pines Reserve to north

3.1.3 Terrestrial fauna habitat

The VBA databases has records of 614 fauna species within 10 km of the study site. These records consist of 579 native species and 35 introduced species. Of the 614 fauna species, 84 are threatened under one or more of the EPBC Act (36) and FFG Act (79)[1](Appendix C). Thirty species identified by the VBA and PMST are listed as Migratory under the EPBC Act (Appendix D).

During the field assessment 13 species were identified including 11 native species and two introduced species (birds). Fauna species recorded within the study site are listed in Appendix B.

In its current state, the riparian vegetation within the Boggy Creek corridor provides habitat to a range of common and adaptable native fauna. Birds observed foraging in trees along the creek include Grey Fantail (*Rhipidura albiscapa*), New Holland Honeyeater (*Phylidonyris novaehollandiae*), Little Wattlebird (*Anthochaera chrysoptera*) and Spotted Pardalote (*Pardalotus punctatus*). Non-native Starling (*Sturnus vulgaris*) and Common Myna (*Sturnus tristis*) were also observed in woodland habitat along the corridor (Plate 10).

Two species of frog were recorded during the field assessment in wetlands - Common Froglet (*Crinia signifera*) and Southern Banjo Frog (*Lymnodynastes dyneriilli*) (Plate 11). Both species were calling from the wetlands immediately east of the Boggy Creek corridor. The frogs were not heard in Boggy Creek itself, likely due to the relatively fast flow rate of the creek. However, these species could occur within the creek and simply be more difficult to hear due to truck noise from the quarry road on the western side.

Plate 10 Terrestrial woodland habitat

Plate 11 Wetland to the east of the Boggy Creek corridor where Common Froglet and Southern Banjo Frog were heard calling

3.1.4 Aquatic fauna habitat

At the time of the field assessment, the Boggy Creek contained turbid, relatively fast flowing water due to recent rain events. The entire length of the creek within the corridor was flowing with an abundance of shallow water run and riffle habitats. At other times when flow is lower, the creek is likely to contain standing water in the form of pool habitats. Water widths ranged from approximately 0.5 to 2 m, with bank widths (i.e. top of banks) in excess ranging from 20 to 30 m. Noticeably, the left bank (looking downstream) was steep and highly eroded in some areas while the right bank had a lower gradient and was less eroded (e.g., Plate 12).

The substrate of the creek was predominately clay/silt (>70%) although there were some areas with larger size classes including sand, gravel and pebbles. There were some snags and other woody debris within the creek although this was limited – likely due to the lack of significant stands of large trees. Shading of the creek by riparian vegetation was estimated at 26-50%. Other aquatic habitat features currently present in the Boggy Creek corridor includes undercut banks, tree roots and trailing bank vegetation.

[1] Marine fauna were excluded from the desktop searches as the study site is not within or near to a marine area.

The banks of the creek in the Pines Flora and Fauna Reserve were less eroded and more stable than the Boggy Creek corridor. The creek is likely to support common fish, including exotic Mosquito Fish (Gambusia affinis), a tolerant pest species found commonly in Victorian waterways.

Plate 12 Boggy Creek

4. Biodiversity objectives

The results of the desktop and field assessment determined there is some capacity to support native flora and fauna species and communities in the Boggy Creek corridor under existing conditions. However, further rehabilitation of the site would increase the potential for increases in biodiversity, including the presence of threatened species.

With consideration given to the Melbourne Water Performance Objectives, the overarching biodiversity objectives for the Boggy Creek corridor are:

– A place of diversity, for habitats for multiple species
– A place that ecologically links to the Pines Flora Reserve and other remnant native communities
– A waterway where pools and riffles meander to create rich habitats
– An aquatic wonderland where low flows form connections into the broader landscape.

The address these objectives the habitat requirements for target species, as well as additional rehabilitation recommendations for general ecological health including common species are discussed below.

4.1 Target species and habitat requirements

4.1.1 Flora and vegetation

The modelled EVC in the area is EVC 48 Heathy Woodland and some of the characteristics of Boggy Creek match the description of this EVC. However, different areas of Boggy Creek (particularly further upstream) have modelled EVC 83 Swampy Riparian Woodland and the characteristics of this EVC seem more fitting to the study area. The higher cover of immature trees and medium-large shrubs observed during the site assessment is characteristic of the swampy riparian woodland and the landform and geology are more appropriate (Appendix E).

4.1.2 Fauna habitats

There are a range of native fauna species, including threatened and migratory species, occurring within 10 km of the Boggy Creek corridor (VBA, PMST 2022). GHD recommends targeting creation of habitat within the corridor for Growling Grass Frog (*Litoria raniformis*), Dwarf Galaxias (*Galaxiella pusilla*) and Eastern Great Egret (*Ardea alba modesta*). While it is considered unlikely these species occur within or use the site at present, it is assumed these species could occur there in the future if the habitat is suitable and they are able to disperse there. In improving the diversity of habitats available to target species it is expected all local fauna would benefit and that diversity and abundance of biodiversity is likely to increase if new, specific habitat attributes are introduced to the corridor.

4.1.2.1 Growling Grass Frog (GGF)

The GGF is a threatened species, listed as vulnerable under the EPBC Act and the FFG Act. The GGF is a large frog (up to 100 mm long), usually green or green-brown with darker markings. It tends to be active throughout the warmer months (October – March), with a peak breeding and calling season in November and December. Individuals forage for invertebrates and small vertebrates (including small frogs and including small GGF) in aquatic and adjacent terrestrial habitat. GGF are able to disperse reasonable distances across wet grassland and along waterways. The frogs shelter during the inactive season in cool moist locations, such as earth cracks and under debris (rocks, logs, vegetation). The GGF has not been recorded in the Boggy Creek corridor but has been recorded seven times within 10 km of the site. The closest records within 10 km of the site are in Patterson River approximately 8 km north of the corridor. The most recent of these observations was recorded in 1990.

4.1.2.2 Dwarf Galaxias

The Dwarf Galaxias is a threatened fish species, listed as vulnerable under the EPBC Act and endangered under the FFG Act. The Dwarf Galaxias is a small, slender, freshwater fish that is olive in colour with a silvery belly growing between 30 and 40 mm in length. It lacks scales on its body, has all soft-rayed fins and one dorsal fin. The species is sexually dimorphic, with males having three black stripes along the side which is faint or lacking in females (DCCEEW 2022b). The species spawns in late winter to spring and eggs are laid beneath aquatic vegetation (e.g., leaves and stems). The Dwarf Galaxias is distributed in southern Victoria, northern Tasmania and south-east South Australia. The Dwarf Galaxias has been recorded 44 times within 10 km of the Boggy Creek corridor, most recently in 2019. There is one record within the corridor and other records nearby within connected habitat. The most recent of these observations was in 2009, immediately upstream of the Boggy Creek Corridor.

4.1.2.3 Eastern Great Egret (EGE)

The EGE is a threatened species, listed as vulnerable under the FFG Act. The EGE is a moderately large wetland bird with white plumage, black or yellow bill and long legs. The species often occurs solitarily or in small groups when feeding. This species has been recorded within 10 km of the site 71 times, most recently in 2020. These records are scattered across the landscape, appearing to occur in temporary and permanent waterbodies and wetlands (Naturekit 2022). The Eastern Great Egret may visit Boggy Creek to forage and habitat suitability for the species is likely to be enhanced by remediation of the corridor.

5. Design considerations

5.1 Target species and communities

5.1.1 Swampy Riparian Woodland

Vegetation within the Boggy Creek Corridor aligns with EVC 83 Swampy Riparian Woodland. As outlined in the Melbourne Water Healthy Waterways Strategy (Melbourne Water 2021), the establishment and maintenance of vegetation should be informed by the relevant EVC benchmark (Appendix E). In this case, as an example, the dominant canopy trees would comprise *Eucalyptus ovata* (Swamp Gum) and *Eucalytpus radiata* s.l (Narrow-leaf Peppermint) and account for 20% cover, and a range of understorey life forms would be present, including immature trees and medium shrubs such as *Melaleuca ericifolia* (Swamp Paperbark) and *Leptospermum continentale*. These life forms would form 30% cover and 20% cover respectively. The benchmark could also provide guidance on the density of logs and organic litter cover (in this case 20 m/0.1 ha and 20% respectively). In addition to use of the EVC benchmark, existing vegetation at the site, other guides, such as council planting guides and vegetation of higher quality in nearby areas (e.g., the Pines Flora and Fauna Reserve) can help inform the improvement of habitat quality and planting selection. Recommendations specific to improving the condition of the Swampy Riparian Woodland include:

– Creating a weed management plan and treat the noxious weeds present. Manual control or herbicide is recommended for managing Kikuyu, which is particularly prolific along both sides of Boggy Creek
– The seedbank in the ground is likely to be dominated by noxious weed species so replanting understory plants such as small shrubs, grasses, sedges and herbs will be important
– Conduct an arborist assessment to understand the health of trees and inform the detailed design, e.g., to understand trees requiring removal for safety
– During the development of the project's detailed design, determine if any trees or native vegetation require removal. Avoid and minimise impacts to remnant vegetation in the design process, keeping in mind the aim of the transformation is net positive outcomes for biodiversity

5.1.2 Growling Grass Frog

Growling Grass Frogs primarily need still or slow moving water with mats of floating and submerged vegetation. The GGF is an aquatic species (i.e., with strong association with water), and its survival and persistence at a site appear to rely on particular habitat attributes (see Heard et al. 2008), including access to a well-connected matrix of ponds that have varying water permanence and depth, along with high cover and diversity of aquatic and fringing vegetation. At least some ponds need to provide suitable aquatic habitat at the right time of year for breeding.

According to the *Growling Grass Frog Habitat Design Standards* (DELWP 2017), the habitat conditions that should be considered to maximise the potential for GGF to inhabit an ecosystem include:

– Shallow water areas (20-30% of wetland) with emergent and floating vegetation
– Deep water (>1.5 m) with submerged and floating vegetation (minimum 50% and preferably 60–70% of wetland)
– Rock piles (at least 20%)
– Approximately 50% of the area within 10 m of wetland maintained as low, grassy vegetation up to 10 cm in height
– Where tussock-forming grasses and sedges are used within 10 m of normal water level, planting density should allow for no greater than 20% cover when mature
– Tree cover within 100 m of a wetland should not exceed 10% and shrub cover 10%
– A patchy arrangement of denser plantings of tussock-forming species is encouraged
– Connectivity to other waterbodies.

5.1.3 Dwarf Galaxias

Throughout the year, the species takes advantage of different types of wetlands providing transient habitat, spawning habitat and short and long-term refuge habitat. In accordance with threat mitigation approaches for the species outlined by DCCEEW 2022b, the following features are recommended to enhance habitat suitability for Dwarf Galaxias within the Boggy Creek corridor:

– Include multiple water velocities across sections of the creek with relatively deep, slow water areas
– Pools with a depth up to 1 m and slow flowing water (5 cm/sec) should be available to fish during low flows
– Provide aquatic vegetation to provide complexity of in stream habitat structure
– Riparian vegetation should consist of a range of structural elements to provide cover and support habitat for terrestrial insects and aquatic macroinvertebrates.

5.1.4 Eastern Great Egret

Within its wide distribution across Australia, the EGE inhabits a range of wetland habitats including freshwater and saline, permanent and ephemeral, open and vegetated and inland and coastal areas. When feeding, the bird wades in shallow to moderately deep water and pecking nearby prey, from vegetation but not from sediments (DCCEEW 2022c). Inclusion of aquatic vegetation and multiple water velocities across sections of the creek is also recommended to enhance habitat suitability for Eastern Great Egret and other waders and migratory wetland birds

5.2 Other recommendations

– Reduce creek bed erosion. This could be achieved by manually excavating the slope of the steepest areas of bank which are most unstable
– Monitor pest fauna such as foxes, to determine their frequency at the site to inform a pest control plan, if required
– Increase connectivity. With the exception of an area near McClelland Drive immediately northwest of the quarry, the canopy and midstory vegetation of the Boggy Creek corridor is similar quality to the terrestrial woodland habitat occurring within the Pines Flora and Fauna Reserve. Maintaining and improving the woodland vegetation within the corridor is likely to attract more birds, reptiles and mammals to the Boggy Creek corridor from within and surrounding the Pines Flora and Fauna Reserve, particularly as the woodland matures.
– Maintaining waterflow and habitat along all sections of the creek for fish and aquatic fauna is important to support migration and dispersal into and out of the Boggy Creek corridor. Melbourne Water (2021) suggest fish condition can be improved in the Dandenong Creek catchment by improving instream connectivity to provide opportunities for fish to move into areas they are currently absent.
– Maintain or improve water quality. Since the water quality of the Boggy Creek corridor is largely influenced by factors outside the control of the rehabilitation program (for example, water quality upstream and upstream discharges and runoff), there are limited actions this project could undertake to improve water quality. However, water quality measures taken from both the Boggy Creek corridor now and from locations upstream could inform the development of specific water quality targets for the project. In a general sense, actions within the Boggy Creek corridor as part of the rehabilitation, such as planting more indigenous understorey and aquatic plants along the creek is likely to improve the local water quality through increasing natural filtering and reducing silt build up from erosion.

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Appendices

Appendix A

Threatened flora recorded within 10 km in the VBA

Key to Table

EPBC - Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

FFG - Victorian *Flora and Fauna Guarantee Act 1988*

PMST - Protected Matters Search Tool

VBA - Victorian Biodiversity Atlas

VBA Recs - Count Number of individuals recorded within VBA for each species

VBA Last - Indicates the most recent date each species was recorded if data from VBA

CR - Critically Endangered under the EPBC Act or FFG Act

EN - Endangered under the EPBC Act or FFG Act

VU - Vulnerable under the EPBC Act or FFG Act

Scientific Name	Common Name	EPBC	FFG	Count	Last Record	Source
Acacia boormanii	Snowy River Wattle		en	2	1996	VBA
Acacia howittii	Sticky Wattle		vu	4	2017	VBA
Amphibromus fluitans	River Swamp Wallaby-grass	VU		5	2009	VBA, PMST
Avicennia marina subsp. *australasica*	Grey Mangrove		en	1	2010	VBA
Banksia saxicola	Rock Banksia		en	1	1968	VBA
Billardiera scandens s.s.	Velvet Apple-berry		en	9	2010	VBA
Burnettia cuneata	Lizard Orchid		en	4	1902	VBA
Caladenia aurantiaca	Orange-tip Finger-orchid		en	3	2009	VBA
Caladenia oenochila	Wine-lipped Spider-orchid		cr	1	1920	VBA
Caladenia orientalis	Eastern Spider-orchid	EN	en			PMST
Caladenia robinsonii	Frankston Spider-orchid	EN	cr	4	2017	VBA, PMST
Caladenia thysanochila	Fringed Spider-orchid	EN	ex			PMST
Caladenia xanthochila	Yellow-lip Spider-orchid	EN	en	2	2017	VBA
Cardamine moirensis	Riverina Bitter-cress		en	1	1998	VBA
Chiloglottis X pescottiana	Bronze Bird-orchid		en	2	1997	VBA
Coronidium gunnianum	Pale Swamp Everlasting		cr	7	2016	VBA
Correa reflexa var. *lobata*	Powelltown Correa		en	2	2009	VBA
Corybas fimbriatus	Fringed Helmet-orchid		en	1	1920	VBA
Corymbia maculata	Spotted Gum		vu	23	2018	VBA
Craspedia canens	Grey Billy-buttons		cr	5	2009	VBA
Dianella amoena	Matted Flax-lily	EN	cr			PMST
Diuris punctata var. *punctata*	Purple Diuris		en	11	2009	VBA
Eucalyptus fulgens	Green Scentbark		en	4	2009	VBA
Eucalyptus globulus subsp. *globulus*	Southern Blue-gum		en	1	2017	VBA
Eucalyptus leucoxylon subsp. *connata*	Melbourne Yellow-gum		en	1	2018	VBA
Eucalyptus sideroxylon subsp. *sideroxylon*	Mugga		en	1	2017	VBA
Eucalyptus X studleyensis	Studley Park Gum		cr	3	2019	VBA

Scientific Name	Common Name	EPBC	FFG	Count	Last Record	Source
Eucalyptus yarraensis	Yarra Gum		cr	3	2009	VBA
Euphrasia collina subsp. *muelleri*	Purple Eyebright	EN	en	6	1929	VBA
Glycine latrobeana	Clover Glycine	VU	vu			PMST
Grevillea dimorpha	Flame Grevillea		en	1	1995	VBA
Hakea macraeana	Willow Needlewood		cr	1	1995	VBA
Lachnagrostis semibarbata var. *filifolia*	Purple Blown-grass		en	10	2009	VBA
Lepidium aschersonii	Spiny Peppercress	VU	en			PMST
Melaleuca armillaris subsp. *armillaris*	Giant Honey-myrtle		en	45	2020	VBA
Microseris scapigera s.s.	Plains Yam-daisy		cr	2	2009	VBA
Poa poiformis var. *ramifer*	Dune Poa		en	1	2009	VBA
Prasophyllum frenchii	Maroon Leek-orchid	EN	en	1	2009	VBA, PMST
Prasophyllum lindleyanum	Green Leek-orchid		en	3	2009	VBA
Prasophyllum spicatum	Dense Leek-orchid	VU	cr			PMST
Pterostylis chlorogramma	Green-striped Greenhood	VU	en	1	1991	VBA, PMST
Pterostylis cucullata	Leafy Greenhood	VU				PMST
Pterostylis cucullata subsp. *cucullata*	Leafy Greenhood		en	1	1930	VBA
Pterostylis pedoglossa	Prawn Greenhood		en	6	2009	VBA
Pterostylis X toveyana	Mentone Greenhood		en	5	1927	VBA
Ranunculus amplus	Lacey River Buttercup		cr	2	2002	VBA
Rhytidosporum inconspicuum	Alpine Marianth		en	1	1992	VBA
Senecio macrocarpus	Large-headed Fireweed	VU	cr			PMST
Senecio psilocarpus	Swamp Fireweed	VU				PMST
Thelionema umbellatum	Clustered Lily		vu	6	2011	VBA
Thelymitra circumsepta	Naked Sun-orchid		en	6	2009	VBA
Thelymitra epipactoides	Metallic Sun-orchid	EN	en			PMST
Thesium australe	Austral Toad-flax	VU	en			PMST
Thryptomene calycina	Grampians Thryptomene		en	4	2010	VBA
Utricularia gibba	Floating Bladderwort		en	7	1996	VBA
Xerochrysum palustre	Swamp Everlasting	VU	cr	8	2017	VBA, PMST

Appendix B

Flora and Fauna observations during field assessment

Key to table

– Native but some stands may be alien

P – Protected under the FFG Act

R – Listed as a Restricted weed in the North Central CMA under CaLP Act

C – Listed as Controlled weed in the North Central CMA under CaLP Act

WoNS – Weed of National Significance

Flora observations

Scientific name	Common name	Status
Native		
Acacia mearnsii	Black Wattle	P
Acacia spp.	Wattle	P
Amyema miquelii	Box Mistletoe	
Eucalyptus spp.	Eucalypt	
Melaleuca ericifolia	Swamp Paperbark	#
Pittosporum undulatum	Sweet Pittosporum	#
Introduced		
Malva spp.	Mallow	
Arctotheca calendula	Cape Weed	
Asparagus asparagoides	Bridal Creeper	R, WoNS
Avena spp.	Oat	
Brassica spp.	Turnip	
Cenchrus clandestinus	Kikuyu	
Chrysanthemoides monilifera	Boneseed	C, WoNS
Cirsium vulgare	Spear Thistle	R
Cynodon dactylon var. *dactylon*	Couch	
Fumaria spp.	Fumitory	
Holcus lanatus	Yorkshire Fog	
Lolium perenne	Perennial Rye-grass	
Oxalis pes-caprae	Soursob	R
Pinus spp.	Pine	
Rubus fruticosus spp. agg.	Blackberry	C, WoNS
Senecio pterophorus	African Daisy	P
Solanum nigrum s.l.	Black Nightshade	
Sonchus asper s.l.	Rough Sow-thistle	
Vulpia spp.	Fescue	

Fauna observations

Common Name	Scientific name
Native	
Welcome Swallow	*Hirundo neoxena*
Grey Fantail	*Rhipidura albiscapa*
Magpie-lark	*Grallina cyanoleuca*
Superb Fairy-wren	*Malurus cyaneus*
Spotted Pardalote	*Pardalotus punctatus*
New Holland Honeyeater	*Phylidonyris novaehollandiae*
Little Wattlebird	*Anthochaera chrysoptera*
Rainbow Lorikeet	*Trichoglossus haematodus*
Laughing Kookaburra	*Dacelo novaeguineae*
Common Froglet	*Crinia signifera*
Pobblebonk Frog	*Lymnodynastes dumerilli*
Introduced	
Starling	*Sturnus vulgaris*
Common Myna	*Sturnus tristis*

Appendix C

Threatened fauna recorded within 10 km in the VBA

Key to Table

EPBC - Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

FFG - Victorian *Flora and Fauna Guarantee Act 1988*

PMST - Protected Matters Search Tool

VBA - Victorian Biodiversity Atlas

Count - Number of individuals recorded within VBA for each species

Last Record - Indicates the most recent date each species was recorded if data from VBA

CR - Critically Endangered under the EPBC Act or FFG Act

EN - Endangered under the EPBC Act or FFG Act

VU - Vulnerable under the EPBC Act or FFG Act

Scientific Name	Common Name	EPBC	FFG	Count	Last Record	Source
Galaxiella pusilla	Dwarf Galaxias	VU	en	44	2019	VBA, PMST
Nannoperca obscura	Yarra Pygmy Perch	VU	vu			PMST
Prototroctes maraena	Australian Grayling	VU	en			PMST
Macquaria australasica	Macquarie Perch	EN	en	2	1760	VBA
Ornithorhynchus anatinus	Platypus		vu	1	1979	VBA
Geopelia cuneata	Diamond Dove		vu	3	2009	VBA
Lewinia pectoralis	Lewin's Rail		vu	44	2021	VBA
Thalassarche melanophris	Black-browed Albatross	VU		2	1994	VBA
Thalassarche cauta	Shy Albatross	EN	en	2	2019	VBA
Gelochelidon macrotarsa	Australian Gull-billed Tern		en	2	2020	VBA
Hydroprogne caspia	Caspian Tern		vu	53	2020	VBA
Sternula albifrons	Little Tern		cr	1	2020	VBA
Arenaria interpres	Ruddy Turnstone		en	4	2018	VBA
Pluvialis fulva	Pacific Golden Plover		vu	20	2021	VBA
Numenius madagascariensis	Eastern Curlew	CR	cr	7	2019	VBA
Numenius phaeopus	Whimbrel		en	2	1984	VBA
Limosa lapponica	Bar-tailed Godwit	VU	vu	14	2021	VBA, PMST
Tringa glareola	Wood Sandpiper		en	54	2021	VBA
Tringa brevipes	Grey-tailed Tattler		cr	3	1987	VBA
Actitis hypoleucos	Common Sandpiper		vu	81	2021	VBA
Tringa nebularia	Common Greenshank		en	104	2020	VBA
Tringa stagnatilis	Marsh Sandpiper		en	42	2019	VBA
Calidris ferruginea	Curlew Sandpiper	CR	cr	113	2021	VBA
Calidris canutus	Red Knot	EN	en	3	2018	VBA
Pachyptila turtur subantarctica	Fairy Prion (southern)	VU				PMST
Pterodroma leucoptera leucoptera	Gould's Petrel, Australian Gould's Petrel	EN				PMST
Sternula nereis nereis	Australian Fairy Tern	VU	cr			PMST
Rostratula australis	Australian Painted-snipe	EN	cr	3	2000	VBA

Scientific Name	Common Name	EPBC	FFG	Count	Last Record	Source
Antigone rubicunda	Brolga		en	2	2009	VBA
Egretta garzetta	Little Egret		en	26	2020	VBA
Ardea intermedia plumifera	Plumed Egret		cr	16	2021	VBA
Ardea alba modesta	Eastern Great Egret		vu	71	2020	VBA
Ixobrychus dubius	Australian Little Bittern		en	4	2002	VBA
Botaurus poiciloptilus	Australasian Bittern	EN	cr	74	2021	VBA, PMST
Anseranas semipalmata	Magpie Goose		vu	12	2020	VBA
Spatula rhynchotis	Australasian Shoveler		vu	401	2021	VBA
Stictonetta naevosa	Freckled Duck		en	46	2020	VBA
Aythya australis	galax		vu	572	2021	VBA
Oxyura australis	Blue-billed Duck		vu	624	2021	VBA
Biziura lobata	Musk Duck		vu	213	2021	VBA
Accipiter novaehollandiae	Grey Goshawk		en	8	2021	VBA
Hieraaetus morphnoides	Little Eagle		vu	96	2021	VBA
Haliaeetus leucogaster	White-bellied Sea-Eagle		en	37	2022	VBA
Lophoictinia isura	Square-tailed Kite		vu	1	2019	VBA
Falco subniger	Black Falcon		cr	12	2019	VBA
Falco hypoleucos	Grey Falcon	VU	vu			PMST
Ninox connivens	Barking Owl		cr	1	2005	VBA
Ninox strenua	Powerful Owl		vu	30	2021	VBA
Calyptorhynchus lathami	Glossy Black-Cockatoo	VU	cr	12	2020	VBA
Callocephalon fimbriatum	Gang-gang Cockatoo	EN		5	2001	VBA, PMST
Polytelis anthopeplus monarchoides	Regent Parrot	VU	vu	1	1914	VBA
Neophema chrysogaster	Orange-bellied Parrot	CR	cr	8	2020	VBA
Lathamus discolor	Swift Parrot	CR	cr	15	2020	VBA
Pezoporus wallicus	Ground Parrot		en	1	1845	VBA
Pycnoptilus floccosus	Pilotbird	VU				PMST
Hirundapus caudacutus	White-throated Needletail	VU	vu	52	2019	VBA
Melanodryas cucullata	Hooded Robin		vu	8	2008	VBA
Pomatostomus temporalis	Grey-crowned Babbler		vu	11	2002	VBA
Calamanthus pyrrhopygius	Chestnut-rumped Heathwren		vu	5	2019	VBA
Pyrrholaemus sagittatus	Speckled Warbler		en	1	1909	VBA
Grantiella picta	Painted Honeyeater	VU	vu	5	2017	VBA, PMST
Anthochaera phrygia	Regent Honeyeater	CR	cr			PMST
Stagonopleura guttata	Diamond Firetail		vu	1	1897	VBA
Macronectes halli	Northern Giant-Petrel	VU	en	2	2006	VBA
Antechinus minimus maritimus	Swamp Antechinus	VU	vu	1	2007	VBA, PMST
Sminthopsis leucopus	White-footed Dunnart		vu	2	2012	VBA
Pteropus poliocephalus	Grey-headed Flying-fox	VU	vu	8	2020	VBA, PMST
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat		vu	1	1909	VBA

Scientific Name	Common Name	EPBC	FFG	Count	Last Record	Source
Pseudomys novaehollandiae	New Holland Mouse	VU	en	12	1999	VBA
Dasyurus maculatus maculatus (SE mainland population)	Spot-tailed Quoll	EN	en			PMST
Petauroides volans	Greater Glider (southern & central)	EN	vu			PMST
Petaurus australis australis	Yellow-bellied Glider (south-eastern)	VU	vu			PMST
Potorous tridactylus trisulcatus	Long-nosed Potoroo (southern mainland)	VU	vu			PMST
Varanus varius	Lace Monitor		en	1	1973	VBA
Lissolepis coventryi	Swamp Skink		en	27	2019	VBA
Pseudemoia rawlinsoni	Glossy Grass Skink		en	1	2010	VBA
Pseudophryne semimarmorata	Southern Toadlet		en	29	2018	VBA
Litoria raniformis	Growling Grass Frog	VU	vu	7	1990	VBA, PMST
Acrodipsas brisbanensis	Large Ant Blue Butterfly		en	2	1760	VBA
Synemon plana	Golden Sun Moth	VU	vu	1	1760	VBA, PMST
Isoodon obesulus obesulus	Southern Brown Bandicoot	EN	en	1667	2021	VBA, PMST
Trapezites luteus luteus	Yellow Ochre Butterfly		en	18	2021	VBA
Temognatha sanguinipennis	Jewel Beetle		en	1	2017	VBA
Limosa limosa	Black-tailed Godwit		cr	10	2018	VBA

Appendix D

Migratory fauna recorded within 10 km in the VBA

Key to Table

PMST - Protected Matters Search Tool

VBA - Victorian Biodiversity Atlas

Count - Number of individuals recorded within VBA for each species

Last record - Indicates the most recent date each species was recorded if data from VBA

Scientific Name	Common Name	Count	Last record	Source
Gelochelidon nilotica macrotarsa	Australian Gull-billed Tern	2	2020	VBA
Limosa lapponica	Bar-tailed Godwit	10	2018	VBA
Thalassarche melanophris	Black-browed Albatross	2	1994	VBA
Monarcha melanopsis	Black-faced Monarch	1	2007	VBA, PMST
Limosa limosa	Black-tailed Godwit	10	2018	VBA, PMST
Hydroprogne caspia	Caspian Tern	53	2020	VBA
Tringa nebularia	Common Greenshank	104	2020	VBA, PMST
Actitis hypoleucos	Common Sandpiper	81	2021	VBA
Calidris ferruginea	Curlew Sandpiper	113	2021	VBA, PMST
Charadrius bicinctus	Double-banded Plover	57	2021	VBA, PMST
Numenius madagascariensis	Eastern Curlew	7	2019	VBA
Ardenna carneipes	Flesh-footed Shearwater	0		PMST
Apus pacificus	Fork-tailed Swift	10	2020	VBA, PMST
Tringa brevipes	Grey-tailed Tattler	3	1987	VBA
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	0		PMST
Sternula albifrons	Little Tern	1	2020	VBA, PMST
Calidris subminuta	Long-toed Stint	14	2018	VBA, PMST
Tringa stagnatilis	Marsh Sandpiper	42	2019	VBA, PMST
Macronectes halli	Northern Giant-Petrel	2	2006	VBA
Pluvialis fulva	Pacific Golden Plover	20	2021	VBA
Calidris melanotos	Pectoral Sandpiper	49	2021	VBA, PMST
Calidris canutus	Red Knot	3	2018	VBA, PMST
Calidris ruficollis	Red-necked Stint	167	2021	VBA, PMST
Arenaria interpres	Ruddy Turnstone	4	2018	VBA
Philomachus pugnax	Ruff (Reeve)	1	2018	PMST
Rhipidura rufifrons	Rufous Fantail	2300	2019	VBA, PMST
Myiagra cyanoleuca	Satin Flycatcher	138	2019	VBA, PMST
Thalassarche cauta	Shy Albatross	2	2019	VBA
Puffinus griseus	Sooty Shearwater	2	1987	VBA, PMST
Numenius phaeopus	Whimbrel	2	1984	VBA
Hirundapus caudacutus	White-throated Needletail	52	2019	VBA, PMST
Tringa glareola	Wood Sandpiper	54	2021	VBA, PMST
Motacilla flava	Yellow Wagtail	2	2006	VBA, PMST

Appendix E

Swampy Riparian Woodland EVC benchmark

Department of Sustainability and Environment

EVC/Bioregion Benchmark for Vegetation Quality Assessment

Gippsland Plain bioregion

EVC 83: Swampy Riparian Woodland

Description:
Woodland to 15 m tall generally occupying low energy streams of the foothills and plains. The lower strata are variously locally dominated by a range of large and medium shrub species on the stream levees in combination with large tussock grasses and sedges in the ground layer.

Large trees:

Species	DBH(cm)	#/ha
Eucalyptus spp.	70 cm	15 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
20%	*Eucalyptus ovata*	Swamp Gum
	Eucalyptus radiata s.l.	Narrow-leaf Peppermint

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Understorey Tree or Large Shrub	4	30%	T
Medium Shrub	5	20%	MS
Small Shrub	1	1%	SS
Prostrate Shrub	1	1%	PS
Large Herb	3	5%	LH
Medium Herb	7	10%	MH
Small or Prostrate Herb	3	5%	SH
Large Tufted Graminoid	3	15%	LTG
Large Non-tufted Graminoid	1	5%	LNG
Medium to Small Tufted Graminoid	5	10%	MTG
Medium to Tiny Non-tufted Graminoid	2	10%	MNG
Ground Fern	2	10%	GF
Scrambler or Climber	2	5%	SC
Bryophytes/Lichens	na	10%	BL

LF Code	Species typical of at least part of EVC range	Common Name
T	*Acacia melanoxylon*	Blackwood
T	*Melaleuca ericifolia*	Swamp Paperbark
T	*Leptospermum lanigerum*	Woolly Tea-tree
MS	*Leptospermum continentale*	Prickly Tea-tree
MS	*Coprosma quadrifida*	Prickly Currant-bush
MS	*Bursaria spinosa*	Sweet Bursaria
LH	*Senecio minimus*	Shrubby Fireweed
MH	*Gonocarpus tetragynus*	Common Raspwort
MH	*Acaena novae-zelandiae*	Bidgee-widgee
MH	*Hydrocotyle hirta*	Hairy Pennywort
SH	*Dichondra repens*	Kidney-weed
LTG	*Carex appressa*	Tall Sedge
LTG	*Cyperus lucidus*	Leafy Flat-sedge
LTG	*Lepidosperma elatius*	Tall Sword-sedge
LTG	*Juncus procerus*	Tall Rush
LNG	*Phragmites australis*	Common Reed
MTG	*Themeda triandra*	Kangaroo Grass
MTG	*Lomandra filiformis*	Wattle Mat-rush
MNG	*Microlaena stipoides* var. *stipoides*	Weeping Grass
GF	*Pteridium esculentum*	Austral Bracken

Recruitment:
Continuous

Organic Litter:
20 % cover

Logs:
20 m/0.1 ha.

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
LH	*Cirsium vulgare*	Spear Thistle	high	high
LH	*Sonchus oleraceus*	Common Sow-thistle	high	low
MH	*Hypochoeris radicata*	Cat's Ear	high	low
MH	*Prunella vulgaris*	Self-heal	high	high
LNG	*Holcus lanatus*	Yorkshire Fog	high	high
MTG	*Anthoxanthum odoratum*	Sweet Vernal-grass	high	high
MTG	*Briza maxima*	Large Quaking-grass	high	low

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→ **The Power of Commitment**

Appendix B: Boggy Creek Rehabilitation Risk Register

RISK REGISTER FOR WORK AUTHORITY NUMBER:

DRAFT ISSUE - FOR COMMENT

Quarrying or Rehabilitation Hazard	Risk No.	Risk Event	Phase		Sensitive Receptors				Inherent Risk Assessment			Control Measures	Performance Standards	Residual Risk Assessment			Monitoring and Ongoing Management		Detailed Risk Treatment Plan attached?
			Rehabilitation	Post-Rehabilitation	Details of sensitive receptor	Location and proximity to site	How hazard may harm or damage sensitive receptor	Evidence to support assessment	Likelihood	Consequence	Risk Rating			Likelihood	Consequence	Risk Rating	Aspect to be monitored	Details of monitoring and ongoing management	
Erosion and sedimentation	1	Erosion of creek batters	Yes	No	Boggy Creek	0 m	Erosion due to surface water runoff causing sediment deposition may impact water quality in the creek.	Daily Inspections.	Possible	Minor	Medium	- Regular inspections for signs of instability; - Surface water managed in accordance with site instituted management plan.	Environmental Reference Standard (water) pursuant to Environment Protection Act	Unlikely	Minor	Low	Ground settlement	Erosion may cause undercutting of slope faces resulting in potential instances of small-scale instabilities	No
Fire	2	Local community / environment is impacted by outbreak of fire and rehabilitation requires renewal.	No	Yes	Local community. Environment	300m	Bushfires burning onto the licence area and from fires igniting on-site and escaping to surrounding areas.		Unlikely	Moderate	Medium	- Fire danger rating checked daily during bushfire season or similar daily and communicated to site personnel. - Fire break	- Bushfire Management Plan	Rare	Moderate	Medium			No
Weeds	3	Environment is impacted by excessive weed infestations and weed spread.	Yes	Yes	Environment	Immediate surroundings	Introducing weeds, pest animals and/or soil-borne disease to the site and threatening biodiversity and/or agricultural production values associated with the site and surrounding areas.		Unlikely	Minor	Low	- Vegetation Management - Verify any imported soils - Vermin management as required		Rare	Minor	Low		- Site inspections for flora and fauna for noxious weeds and pests	No
Noise	4	Excessive noise at any sensitive receptors beyond the boundary of the licence area	Yes	No	Members of the public and residential land uses. Local fauna and agriculture.	Immediate surroundings	Some types of agricultural land use (e.g. horses) and environmental features (e.g. migratory bird breeding areas) may also be highly sensitive to noise	Acoustic modelling	Likely	Insignificant	Medium	- Buffer distances between noise generating equipment and sensitive receptors	- EPA Guideline 1411 – Noise from Industry in Regional Victoria (NIRV).	Unlikely	Insignificant	Low	Machinery noise from operations (during licenced operational hours).	Noise at nearest sensitive residential locations comply with the SEPP requirements. Monitoring occurs when required or for significant change to process occurs.	No
Surface Water	5	Diversion or disturbance of natural path of flows along waterways or drainage lines	No	Yes	Boggy Creek	0m	Alteration of the environment, particularly waterways and related ecosystems	Community complaints	Rare	Moderate	Medium	- Drainage system	- State Environment Protection Policy (Waters) (SEPP Waters)	Rare	Moderate	Medium		Erosion monitoring	No
Groundwater	6	Groundwater flow rates exceed current volumes and require increased inpit pumping and discharge to Boggy Creek.	Yes	No	Boggy Creek	0m	Alteration of the environment, particularly waterways and related ecosystems	Monitoring, inspections.	Unlikely	Moderate	Medium	- Pumping from metered pumps	GW Take and Use licence_Quarry Rd (Southern Rural Water - July 2021).	Rare	Moderate	Medium	Flow rates (exceeding daily or annual limits)	- Flow meter recording volumes attached to pump. - monitoring in-pit and surrounding groundwater levels during pumping to stabilise water levels.	No

Accountable Personnel

List Personnel accountable for the implementation, management and review of the Risk Management Plan

Personnel	Roles and Responsibilities