

Giant Gippsland Earthworm and Warragul Burrowing Crayfish assessment at a proposed Industrial development – including four parcels of land Corner of Kings St and Wills St, Warragul

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ABBREVIATIONS

BBSC: Baw Baw Shire Council

DELWP: Department of Environment, Land, Water and Planning

DoE: Department of the Environment

EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999*

EVC: Ecological Vegetation Class

FFG Act: *Flora and Fauna Guarantee Act 1988*

GGE: Giant Gippsland Earthworm

WBC: Warragul Burrowing Crayfish

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SUMMARY

PROJECT BACKGROUND

A 32 Lot industrial development is proposed on the corner of King St and Wills St, Warragul. The 9.75 ha site is partially covered by the Baw Baw Shire Council's (BBSC) Environmental Significance Overlay Schedule 4 –Giant Gippsland Earthworm (ESO4). In addition, there are a number of local planning provisions that include the consideration of species of local and regional significance such as the Warragul Burrowing Crayfish (WBC) listed under the *Victorian Flora and Fauna Guarantee Act 1988* (FFG Act).

As a consequence, GGE and WBC assessments are required to support a permit application. The aim of the assessment is to facilitate the design of the proposed industrial development to avoid or minimise potential impacts to GGE and WBC habitat. INVERT-ECO has been engaged by Planning Central on behalf of Freeway Business Park Pty Ltd to undertake this assessment.

A field assessment was undertaken on July 4th 2019.

RESULTS

Giant Gippsland Earthworm

One small, isolated colony of GGE was identified from the study area and the anterior of one adult earthworm uncovered. The site was located in a recently disturbed area of the compound of an existing shed that supported suitable habitat characteristics such as the presence of well-drained, blue grey clay on a gentle south-facing slope. Despite further searching in the area, no other evidence of GGE was found. It is likely that this was a larger colony but has been impacted by works at the site, whether very recent or in the past few years and it is possible the site now supports a single earthworm or very low numbers.

Little suitable habitat was observed elsewhere within the subject land.

Warragul Burrowing Crayfish

Evidence of Warragul Burrowing crayfish, including chimneys, burrows and individuals were identified from three main areas within the subject land. One was associated with a drainage channel while the others were in the better drained sections of floodplain. Their distribution is unlikely to be limited to these areas as not all of the site could be accessed and recent disturbance of the site made assessment difficult in some areas.

Potential Impacts

The potential impacts of the proposed construction of an industrial development on GGE and WBC habitat includes habitat loss and reduction in habitat quality. These impacts result from soil disturbance and alterations to local hydrological and drainage patterns and construction of houses and related infrastructure within or adjacent to habitat.

The indicative design of the proposed industrial development does not support the retention of the existing drainage channels (Attachment 1). The development includes the complete modification of the hydrology of the site to lower the watertable and drain the existing water-logged areas to establish the dry conditions required for the construction of the development. Some of this hydrological modification has already occurred during the cleaning out of Hazel creek (See Section 2) and the impacts of this modification on habitat is unclear but likely to have decreased the available suitable habitat. .

In the absence of mitigation, the proposed action is likely to have direct and indirect impacts resulting in the loss of the GGE colony and WBC habitat primarily resulting from the wide-scale hydrological modifications at the site and excavation works.

LEGISLATIVE AND POLICY REQUIRMENTS

Policy/ Legislation	Relevant Fauna	Requirement	Comment
EPBC Act 1999	Giant Gippsland Earthworm	Unlikely	EPBC Act assessment criteria indicate that the development will not have a significant impact on an <u>important</u> populations of GGEs
FFG Act 1988	Giant Gippsland Earthworm Warragul Burrowing Crayfish	A permit is required from DELWP if an action on public land proposes to collect, kill, injure or disturb protected flora and fauna and ecological communities.	Permit not required as site private land
ESO4	Giant Gippsland Earthworm	Development applications for land covered by GGE ES04 must be accompanied by an assessment of the potential impact on GGE habitat and must indicate how this negative impact has been avoided, minimised or offset	Results of this assessment GGE must be presented in a planning permit application to BBSC
Local Planning Provisions		R30 –Developments for land covered by natural waterways, drainage lines or seepages must be accompanied by an assessment of the potential impact of the development on the WBC.	Results of this assessment must be presented in a planning permit application to BBSC

RECOMMENDATIONS

Preliminary recommendations are provided to facilitate the discussion regarding the feasibility of the design elements required to protect GGE and WBC habitat using the avoid, mitigate and offset strategy. These are detailed in Section 7 and include:

Design requirements for Industrial Development:

1. Retain and protect GGE and WBC habitat within Open Space within the development and installing appropriate buffers (30 m)
2. Protect and Maintain hydrological processes of the waterways and floodplain habitat around the colonies identified (requires engagement of hydrologist)
3. Revegetation and use of public open space recommendations.
4. Design proposed wetland using crayfish friendly features (Van Praagh 2015)

Offset

Offsets are considered to compensate unavoidable development impacts on biodiversity when all reasonable attempts have been made to avoid or reduce impacts. Where appropriate, offsets are considered during the assessment phase of an environmental impact assessment under the *EPBC Act 1999*. It is unlikely that a referral for GGE will be required for the proposed action and therefore no offset is required under this Act. Potential requirements for GGE offsets are included within BBSC Environmental Significance Overlay (ESO4).

DESIGN RESPONSE

A new concept plan has been designed taking into account the findings of this report. The Hazel Creek realignment to the south of the land will incorporate crayfish friendly features into the constructed waterway design. A WBC translocation program will be undertaken to move the crayfish colonies impacted by the proposal into the new habitat surrounding the wetland. As discussed with BBSC, this project will serve as a demonstration model to inform future projects where new wetlands are created within WBC habitat and when WBC colonies cannot be protected during developments.

To assess the outcomes of the wetland design and translocation of the WBC, a minimum five year monitoring regime will be undertaken.

1 INTRODUCTION

INVERT-ECO was engaged by Planning Central on behalf of Freeway Business Park Pty Ltd to undertake a targeted survey for the Giant Gippsland Earthworm (GGE) and Warragul Burrowing Crayfish (WBC) at the site of proposed Industrial development on the corner of King St and Wills St, Warragul.

The land is zoned Industrial and partially covered by the Baw Baw Shire Council's (BBSC) Environmental Significance Overlay Schedule 4 –Giant Gippsland Earthworm (ESO4). In addition, there are a number of local planning provisions that include the consideration of species of local and regional significance such as those listed under the *Victorian Flora and Fauna Guarantee Act 1988* (FFG Act). This includes the Warragul Burrowing Crayfish *Engaeus sternalis* (WBC) which is endemic to the region.

As a consequence, GGE and WBC assessments are required to support a permit application. The aim of the assessment is to facilitate the design of the proposed industrial development to avoid or minimise potential impacts to GGE and WBC habitat.

Background information on the two species targeted during this assessment is provided in Appendix 1 & 2.

The objectives of this proposal are to:

- Undertake targeted field assessments of the subject lands, targeting areas of potential habitat for the GGE and WBC and:
- Provide mitigation measures to protect GGE & WBC colonies should they occur within areas to be impacted by the proposed development.

2 STUDY AREA

The subject site includes 4 parcels of land with a total area of approximately 9.75 ha:

- 14-40 Wills St
- 42-69 Wills St
- 62-70 Wills St &
- 110 King St

It is situated on the corner of King St and Wills Street, Drouin (Figure 1). The Princes Freeway abuts the southern boundary with a vegetated buffer. The site is zoned Industrial Zone 1 (IN1Z) and is partially affected by the GGE Environmental Significance Overlay (ESO 4), an Urban Floodway Zone (UFZ) and Development Contributions Plan Overlay (DCPO). The proposed indicative design for the development includes 32 lots ranging in size from 1000 m² up to 4300 m². There are two existing sheds on the land (Attachment 1) and a neighbourhood factory located on the north-west corner of Wills and King St.

The site has been grazed and supports permanent pasture and swampy vegetation to the south. Hazel Creek flows east west through the land with associated tributaries and drains. The southern portion of the site is regularly inundated and considered a flood zone.

The subject site occurs within the Strzelecki Ranges Bioregion. The pre 1750s vegetation was Wet or Damp Forest Ecological Vegetation Class (EVC 29) (Nature Kit 2019).

The entire subject land has recently undergone drainage works to clear out the existing creek of silt (Plate 1A). A number of V drains have been excavated over the site to drain the paddocks and relieve the flooding (Plate 1B). The existing culvert has been replaced and relocated upstream on current waterway to maximise benefit, and reconstruct crossing for access (Plate 1C). This has resulted in major modifications to the existing hydrology of the site over the past two months. Parts of the site have also been cleared, levelled and topsoil removed.

Proposed Industrial Development

The land currently designated UFZ requires rezoning to Industrial Zone 1. The flood modelling and current development plan for the site is given in xxx

Figure 1 Location of subject site 14-40, 42-69, 62-70 Wills St and 110 King St Warragul.

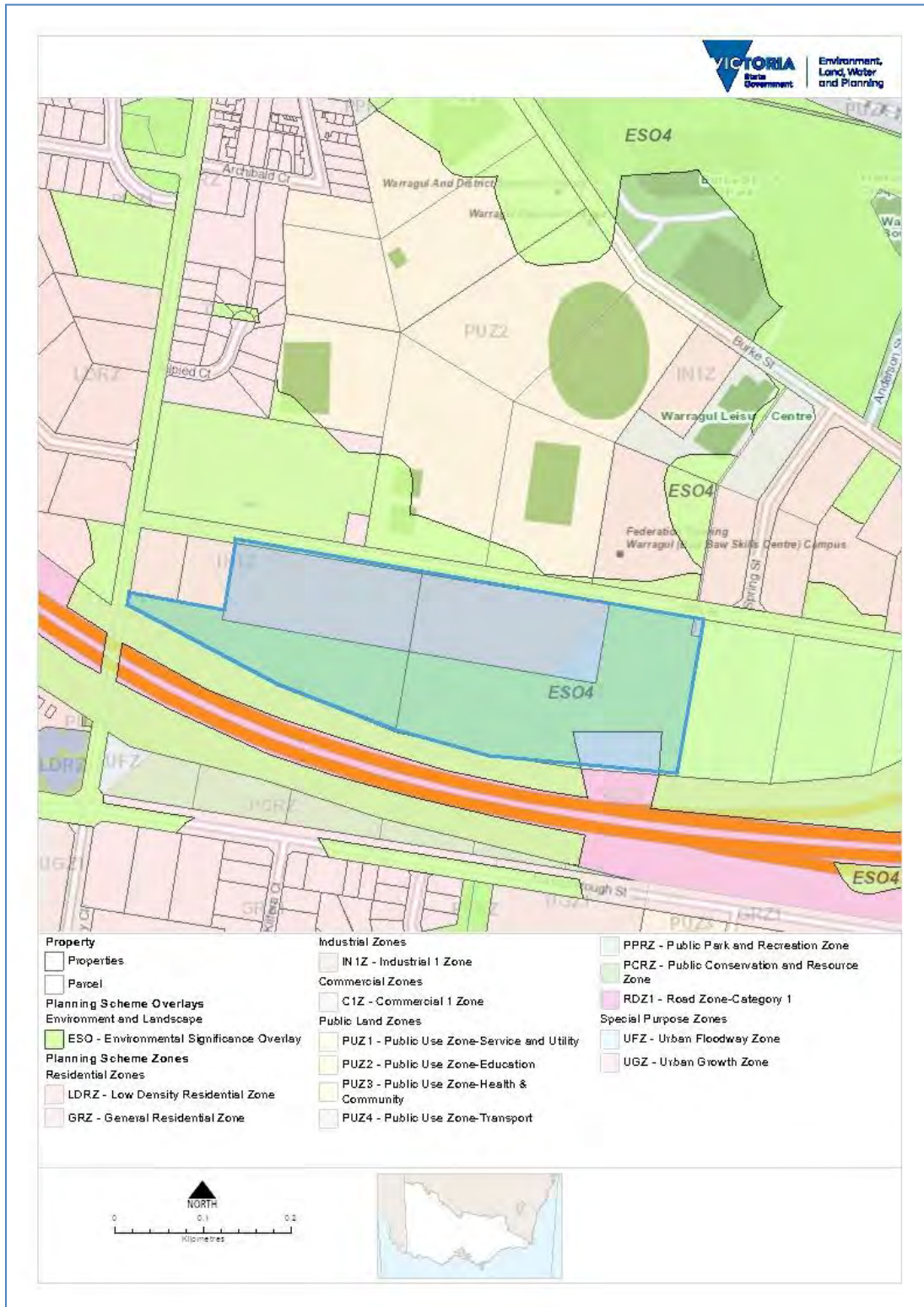




PLATE 1 Subject land at Wills St Warragul

A) Cleaning of existing creek

B) Cleaning of existing drains to manage excess water introduced off- site

C) Replace existing culvert and relocate upstream on current waterway to maximise benefit, and reconstruct crossing for access

3 METHODS

3.1 Survey Methodology

A field assessment targeting potential GGE and WBC habitat was undertaken on July 4th 2019.

3.1.1 Giant Gippsland Earthworm

A field survey involves an assessment of the subject land for the presence of suitable Giant Gippsland Earthworm habitat and targeting these areas for sampling. Suitable habitat includes blue-grey/red clay soils along creekbanks, soaks and wet south-facing slopes. As GGEs are completely subterranean, there are no above ground signs to indicate whether presence. Identification of populations involves digging soil quadrats of approximately 50 cm x 50 cm x 50 cm, looking for evidence of the worm. Evidence includes burrows and cast (waste) material. GGE can sometimes be detected. When worms move through their wet burrows in response to vibrations such as walking, a sound may be heard, similar to a gurgling noise and is described as worm “gurgles.”

3.1.2 Warragul Burrowing Crayfish

The presence of burrowing crayfish is determined by targeting suitable habitat and searching for the conspicuous chimneys of soil surrounding burrow entrances. Potential WBC habitat includes floodplain, soaks and riparian areas along waterways. Chimney shape, burrow structure and position in the landscape may vary between species. WBC have distinctive chimneys comprised of small, spherical balls of soil surrounding comparatively small burrow openings (Van Praagh 2015) (Plate 2). Where the presence of chimneys cannot be relied upon for detecting the species due to the timing of the survey, WBC may be detected by observing the soil in quadrats in potential habitat and removing the top layer of soil or using specially designed crayfish traps. These can only be deployed in the wetter months of the year. Their smaller tunnels can often be distinguished from the larger tunnels belonging to the more common crayfish species in the area.

AMG data was recorded using a hand held GPS (GDA 94, accuracy ± 5 m).

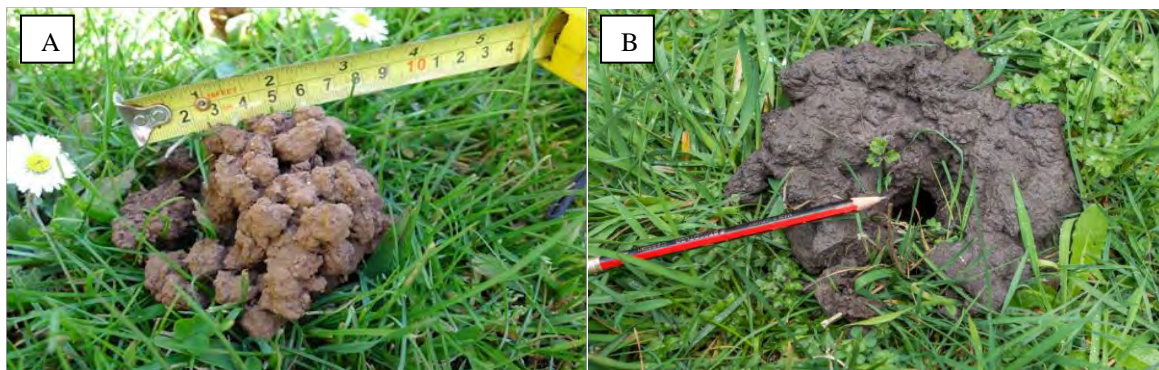


PLATE 2 Conspicuous, small chimneys made by WBC (A) compared with the chimneys of other crayfish species found within the study area (B)

3.2 Assessment Qualifications and Limitations

There were several limitations attached to this assessment due to the size of the survey area and difficulty accessing parts of the site due to water-logging.

The assessment was undertaken during optimal conditions for detecting burrowing crayfish chimneys and GGEs due to the recent rains. However, a large portion of the land, in particular the middle section, was water-logged with exposed mud. These areas could not be accessed as the mud acted like quicksand. It is difficult to detect either species in water-logged areas as identifying burrows or detecting chimneys is compromised by the amount of water present in the soil. These limitations prevented the entire subject area from being assessed.

4 RESULTS

4.1 Giant Gippsland Earthworm

One small, isolated colony of GGE was identified from the study area (Figure 2, Plate 3). The earthworm was heard and the anterior end of a large adult was uncovered (Plate 3C). The earthworm was located in a recently disturbed area of the compound of an existing shed. While the area is now very disturbed, it supported suitable habitat characteristics such as the presence of well-drained, blue grey clay on a gentle south-facing slope. Images from Google Earth (2011 imagery) indicate that a soak was present at this site (See Figure 2, Plate 4). Yabby mounds and the presence of buttercup support this. Despite further searching in the area, no other evidence of GGE was found. It is likely that this was a larger colony but has been impacted by works at the site, whether very recent or historic and it is possible the site now supports a single earthworm or very low numbers.

Little suitable habitat was observed elsewhere within the subject land. While soil moisture maintained all year round is thought to be critical for the survival of this species (Van Praagh *et. al* 2007) it is predominantly restricted to areas where there is adequate soil drainage. The majority of the southern section of the land is almost permanently water-logged. However there is potential for the species to occur in the reserve between the Princes Freeway and the southern boundary of the site.

Figure 2 Location of GGE site showing Google Earth image (2011) and current condition of GGE site (Inset).



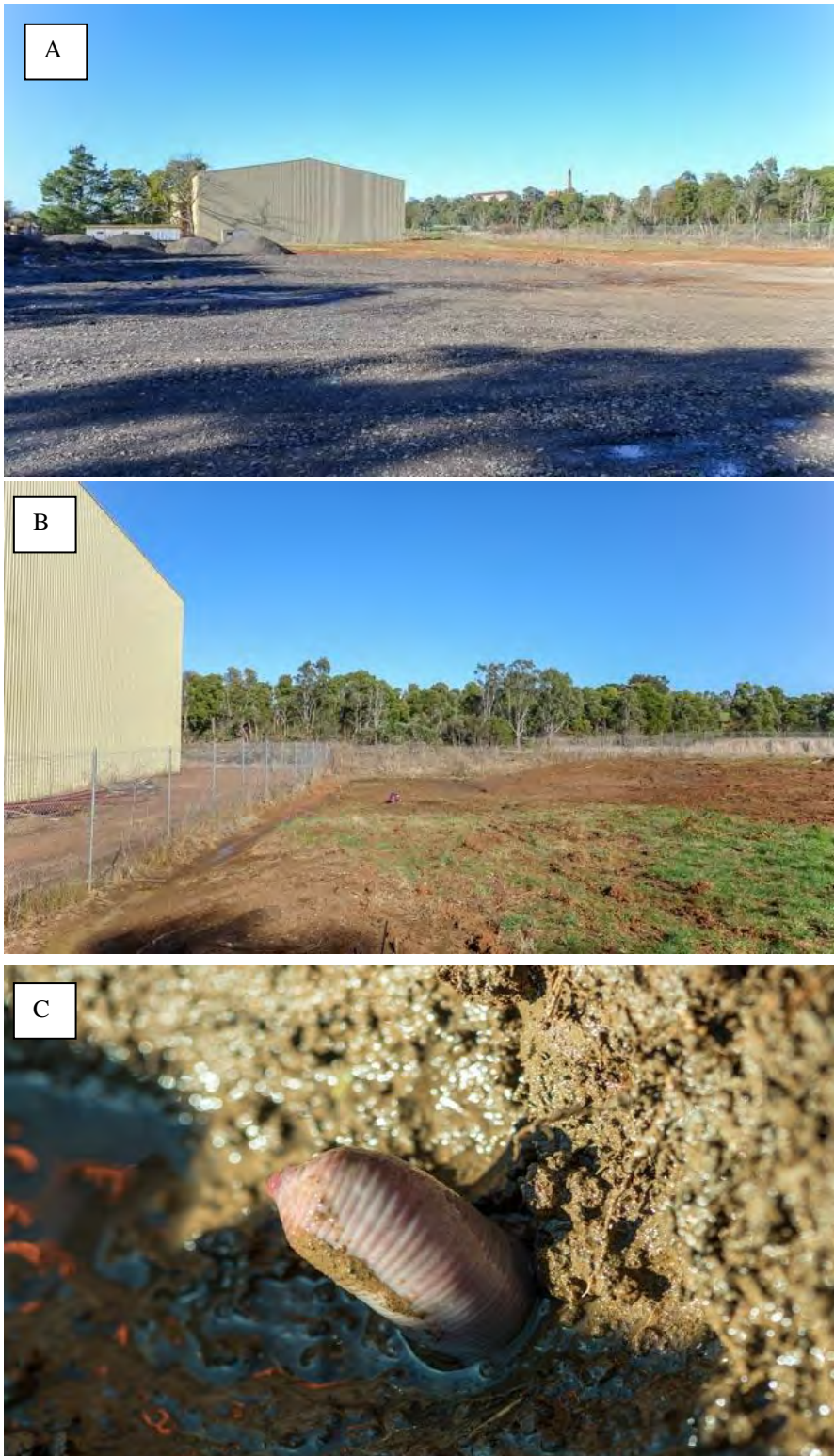


PLATE 3 A) Shed compound where GGE was located
B) GGE habitat toward corner of fence
C) Anterior of adult GGE

4.2 Warragul Burrowing Crayfish

Evidence of Warragul Burrowing crayfish, including chimneys, burrows and individuals were identified from three main areas within the subject land (Figure 3, Plates 4 & 5). Their distribution is unlikely to be limited to these areas as not all of the site could be accessed and recent disturbance of the site made assessment difficult in some areas. However, all sites exhibit the general characteristics of WBC habitat in that they are located in the better drained (historically) sections of the sites.

Site 1- A large colony was found adjacent to Wills Road in the north-east section of the subject land (Figure 3, Plate 4A). A high density of chimneys and burrows were observed, extending over an area of approximately 100m in length and 20 m in width.

Site 2- WBC were located along the eastern bank of the drainage channel (Plate 4B). Suitable habitat was found along the entire channel approximately –an area of approximately 70 m by 15m.

Site 3- WBC were identified from the two fenced off areas toward the south-east corner of the site. The enclosures supported less water-logged soils (Plate 4C).

Crayfish chimneys belonging to other species of crayfish were recorded over the study area (Plate 6). These belong to more common species of burrowing crayfish (e.g. Granular or Lowland burrowing crayfish (*Engaeus cunicularius* or *E. quadrimanus*) and the Gippsland Burrowing Crayfish (*E. hemicirratulus*).

Figure 3 Location of WBC and GGE identified at Wills St, Warragul.

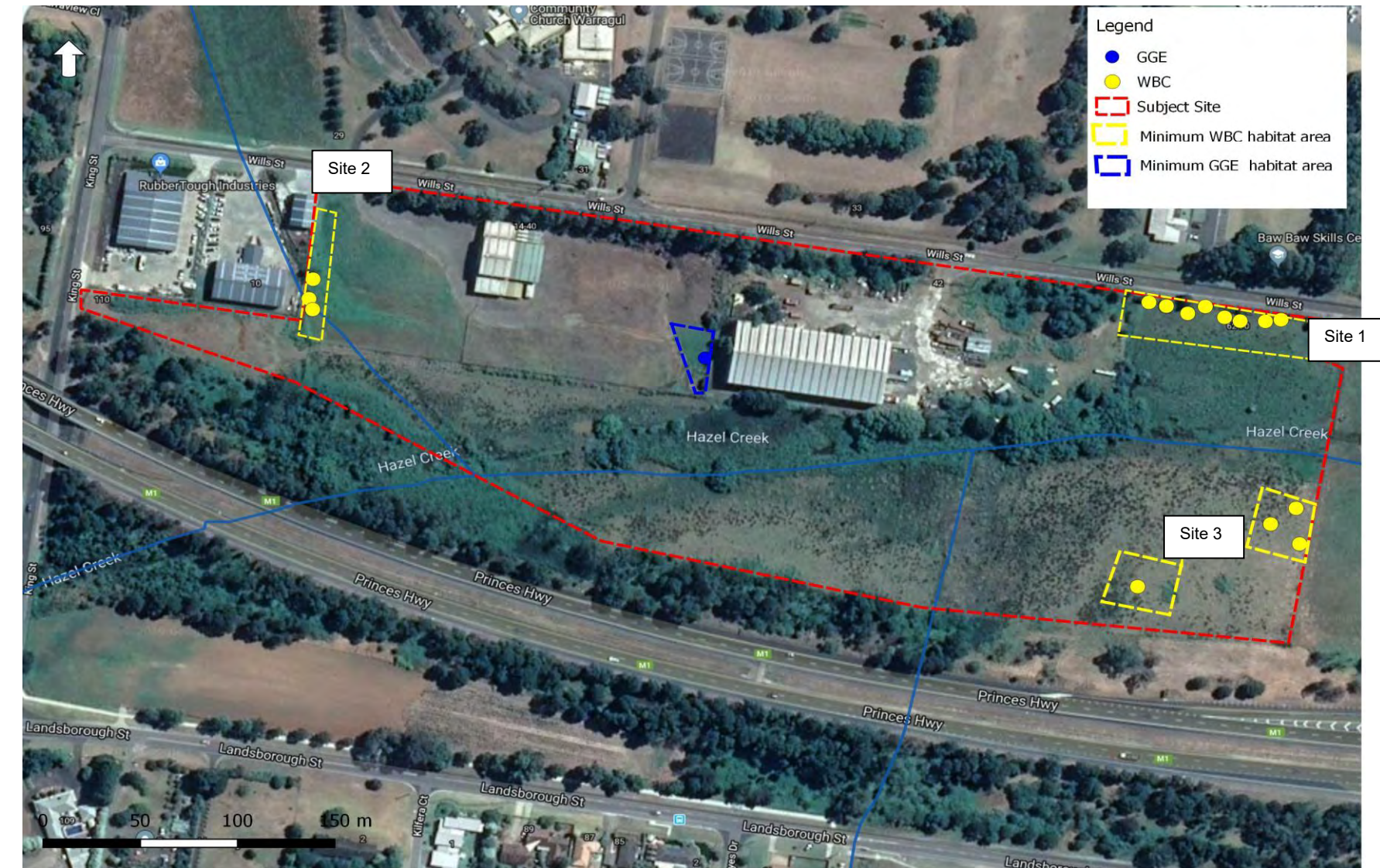




PLATE 4 A) Site 1 WBC located along banks of drainage channel
B) Site 2 WBC located adjacent to northern-east boundary
C) Site 3 WBC habitat within the two fenced off paddocks

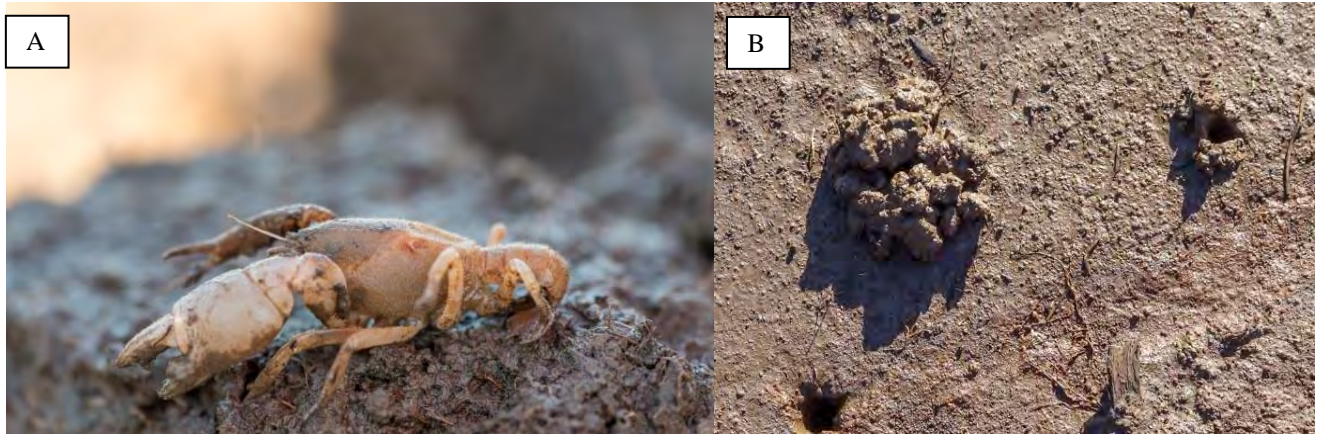


PLATE 5 A) Adult WBC
B) WBC chimney and burrow openings

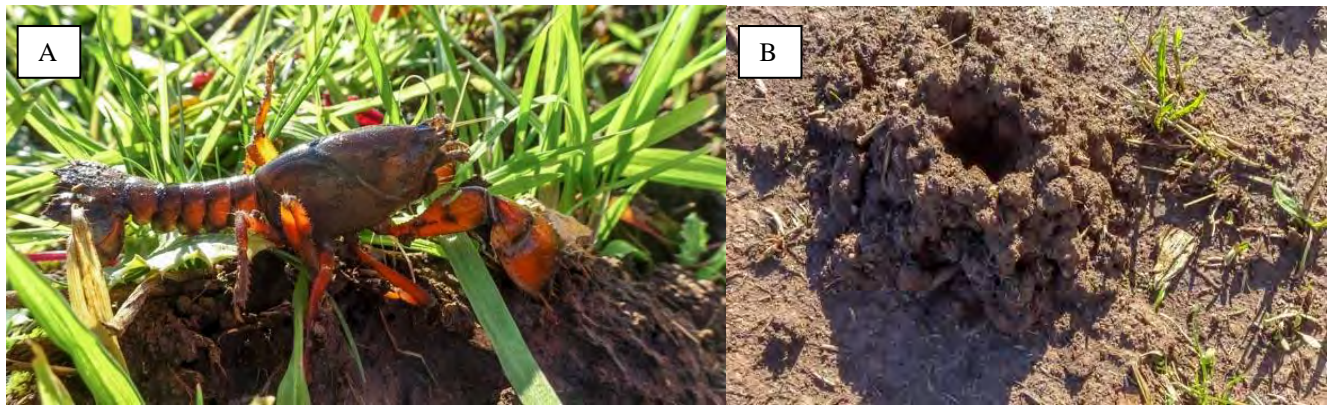


PLATE 6 A) Common Species of burrowing crayfish found at the site
B) Large Chimney of common species of burrowing crayfish

5 POTENTIAL IMPACTS

Threatening processes associated with the construction of Industrial developments have the potential to substantially modify GGE and WBC habitat from both direct and indirect impacts (See Table 1). Without mitigation, the construction of the proposed industrial development will significantly impact on the available habitat for the GGE and WBC through altered hydrology and construction of infrastructure. This will result in the loss of the GGE colony and the entire WBC habitat identified from within the 9.75 ha site. It is likely that WBC are more widespread at the site than identified from this assessment.

The original and updated design plan for the proposed industrial development are shown in Attachment 1 & 4. The plan does not support the retention of the existing drainage channel running east-west through the site but partially retains the small channel on the western property boundary.

The development includes the complete modification of the hydrology of the site to lower the watertable and drain the existing water-logged areas to establish the dry conditions required for the construction of the development. Some of this hydrological modification has already occurred during the cleaning out of Hazel creek (See Section 2) and the impacts of this modification on habitat is unclear but likely to have decreased the available suitable habitat. A waterway corridor and constructed wetlands are proposed along the southern property boundary, north of the existing open wedge.

5.1 Giant Gippsland Earthworm

GGEs often live in small, isolated areas that support a complex of interrelated variables that create suitable habitat. They live entirely underground in permanent burrow systems (Kretzschmar and Aries 1992) and have very low dispersal abilities (Woods 2006). This means that they are unable to move away from threatening processes and as such are highly vulnerable to changes in their environment.

The area occupied by GGEs at the site is extremely small and vulnerable. The small colony is likely to be destroyed by the construction of the industrial development.

The area occupied by GGEs at the site is extremely small and vulnerable. The small colony is likely to be lost without the appropriate mitigation to protect their habitat from the impacts of the development.

5.2 Warragul Burrowing Crayfish

The major threats to WBC relate to changes in the quality and quantity and seasonal regime of water, soil and food availability (Doran 1999; Horwitz 1990, March and Robson 2006, O'Brien 2007, Honan 2010). Significant impacts to WBC colonies are likely to occur where there is alteration to the water table, drainage patterns or surface flows: permanent or long-term change

(increase or decrease) outside of the natural annual variation, In addition to removing habitat via construction of buildings and infrastructure over habitat.

WBCs have the potential to be severely impacted by the proposed development without the appropriate mitigation to protect their habitat

TABLE 1 Summary of threats to GGE & WBC

THREATS	IMPACT
<p>Direct Disturbance and fragmentation</p> <p>Direct disturbance of habitat: Excavation for housing, dams, pipes and road construction Addition of fill resulting in alteration to natural topography and removal of wetlands Soil compaction and churning from machinery</p> <ul style="list-style-type: none"> - Removal of existing vegetation - Destruction of stream bank integrity 	<p>Loss and degradation of habitat</p> <p>Loss of colonies -death and injury of individuals and egg cocoons</p> <p>Fragmentation of colonies & reduced gene flow</p> <p>Compaction and churning of soil resulting in loss of burrows</p> <p>Exposing burrows, changing hydrology and causing drying out of sites</p>
<p>Hydrological Disturbance -alteration in flows</p> <ul style="list-style-type: none"> -Changes in surface and subsurface flows -Changes to water table -Dense revegetation within or adjacent to habitat -Storm water diversion and increased inflow -Clearing of riparian vegetation 	<p>Direct loss of habitat by drying or flooding soils/wetlands</p> <p>Loss of colonies</p> <p>Fragmentation of colonies & reduced gene flow</p>
<p>Hydrological Disturbance - Reduced Water quality</p> <ul style="list-style-type: none"> -sedimentation from soil disturbance activities (e.g. Road construction, trenching) -Increased nutrient loads from fertilisers -Chemical pollutants from chemicals e.g biocides and hydrocarbons 	<p>Degradation of habitat through reduced water quality</p>

6 ENVIRONMENTAL POLICY AND LEGISLATION

This section explores environmental policy and legislation most pertinent to the Giant Gippsland Earthworm and Warragul Burrowing Crayfish. However, it is not a comprehensive list of all legislation and the guidance provided does not constitute legal advice.

6.1 *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) establishes a process for assessment of proposed actions that are likely to have a significant impact on Matters of National Environmental Significance (MNES). It applies to both public and private land. Matters of National Environmental Significance include nationally threatened species and ecological communities.

A person who proposes to take an action that will have, or is likely to have, a significant impact on a matter of national environmental significance must refer that action to the minister for a decision on whether assessment and approval is required under the EPBC Act.

A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.

As the Giant Gippsland Earthworm is listed as **Vulnerable** under the EPBC Act, a referral to the Commonwealth Minister for DEWHA may be necessary if the works are deemed to have a **significant impact** on an **important population**. The criteria to consider in determining an important population under the Act are outlined below.

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

At present, there is insufficient information available to determine 'important' populations. However, the loss of any GGE colonies should be viewed in the context of overall incremental habitat loss. The majority of known colonies are small and isolated and therefore highly vulnerable to disturbance. However, the following factors that could be considered when assessing whether or not a GGE population/colony is "important":

The majority of known colonies are small and isolated and therefore highly vulnerable to disturbance. The loss of any GGE colonies should be viewed in the context of overall

incremental habitat loss. However, the following factors that could be considered when assessing whether or not a GGE population/colony is “important”:

- » Relationship of colony to known distribution (outliers may have higher conservation significance)
- » Size of the area occupied by the colony.
- » Density of colony.
- » Long term viability of the colony.
- » Evidence of recent activity (e.g. wet burrows and gurgles).
- » Evidence of breeding (e.g. cocoons or breeding adults).
- » Area of impact in relation to colony size.
- » Has been the subject of long-term monitoring.

Implications

The proposed construction of the industrial development is likely to result in the loss of GGE habitat primarily through excavation works and changes in the hydrology. While the impact is likely to be significant in that it will result in the loss of this colony without mitigation, the recent works at the site in addition to those historically have already reduced the suitable habitat and significantly altered the drainage of the site, compromising the long-term viability of the colony. At present, there is insufficient information available to determine ‘important’ populations. However, in relation to the criteria given under the Act for the assessment of impacts to listed “vulnerable” species, it is unlikely that this very small colony can be considered an “important” population. .

A referral under the *EPBC Act 1999* is unlikely to be triggered as the GGE colony is not considered “important” under the Criteria for a Significant Impact to an important population.

A ‘self-assessment’ guide to decide whether or not your action is likely to have a significant impact on any matters of national environmental significance:

<http://www.environment.gov.au/epbc/publications/significant-impact-guidelines-11-matters-national-environmental-significance>).

6.2 Flora and Fauna Guarantee Act 1988

The Giant Gippsland Earthworm and Warragul Burrowing Crayfish are both listed under the *Flora and Fauna Guarantee Act 1988* (FFG Act) which is the key piece of Victorian legislation for the conservation of threatened species and communities and for the management of potentially threatening processes. The FFG Act has limited direct application to private land. The local planning authority is likely to consider impacts on FFG Act-listed species and communities under the Planning Scheme when deciding on planning permit applications.

Further information on the FFG Act can be found at:

<http://www.depi.vic.gov.au/environment-and-wildlife/threatened-species-and-communities/flora-and-fauna-guarantee-act-1988>

Implications

A permit is required from DELWP if an action on public land proposes to collect, kill, injure or disturb protected flora and fauna and ecological communities. An FFG Act permit is generally not required for private land.

A permit under the *FFG Act 1999* is not required as the proposal is on privately owned land.

6.3 Wildlife Act 1975

This Act forms the procedural, administrative and operational basis for the protection and conservation of native wildlife, specific use of, and prescriptions for access, prohibition and regulation of associated activities involving native wildlife within Victoria. This Act is the basis for the majority of wildlife permit/licensing requirements within the state. All terrestrial invertebrates listed under the *FFG Act 1988* are considered “wildlife”.

Implications

Both the GGE and WBC are listed under the *FFG Act* and are thus considered “wildlife” for the purposes of this Act. A license is required under this Act to take or destroy wildlife. This includes any handling, salvage and translocation of wildlife and a permit may be required if these activities are undertaken as a result of this proposal.

A permit under the *Wildlife Act* is required if any of the above activities are undertaken as result of the proposed industrial development.

6.4 Victorian Planning Provisions

A number of state and local planning provisions require that local planning authorities give due consideration to the conservation requirements of threatened species and those listed under the FFG Act. The relevant provisions include:

- *Planning and Environment Act 1987 (Victoria)*,

- *State Planning Policy Framework (SPPF)* - Clause 12.01-1, 15.09-Protection of habitat includes the following objectives:
 - *Assist with the conservation of the habitats of threatened and endangered species and their communities*
 - *Address threatening processes identified under the Flora and Fauna Guarantee Act 1988*
- *Local Planning Policy Frame Work- Baw Baw Shire Planning Scheme* -Clause 21.03-2 Environmental Management and Values & Clause 21.07-2 -Biodiversity
 - To protect and manage native flora, fauna and habitats across the Shire

Implications

The proposed development will impact on a FFG Act 1999 listed species which should be considered in line with the biodiversity objectives of the planning provisions. Results of this assessment must be presented in a planning permit application to Baw Baw Shire Council indicating how negative impact on GGE and WBC have been avoided, minimized or offset

6.5 Significance Overlays

Each municipality in Victoria is covered by a planning scheme, which sets out policies and provisions for the use, development and protection of land (zones and overlays). An overlay is a planning provision intended to ensure that important aspects of the land are recognised. Overlays indicate the type of development and/or protection, which may be appropriate in that area. Baw Baw Shire Council (BBSC) has incorporated an Environmental Significance Overlay Schedule 4 (ESO) – Protection of Giant Gippsland Earthworm.

Development applications for land covered by GGE ES04 must be accompanied by an assessment of the potential impact on GGE habitat and must indicate how negative impact on GGE habitat has been avoided, minimised or offset.

Implications

An assessment of the potential impact on GGE habitat, indicating how this impact has been avoided, minimised or offset, must be provided in a permit application to BBSC.

7 IMPACT ASSESMENT AND MITIGATION OPPORTUNITIES

Threatening processes associated with the construction of Industrial developments have the potential to substantially modify GGE and WBC habitat from both direct and indirect impacts (Refer to Table 1). Without mitigation, the construction of the proposed industrial development will significantly impact on the available habitat for the GGE and WBC through altered hydrology and construction of infrastructure.

Mitigation has the principle aim of avoiding significant impacts to threatened species that might arise from proposed works and should be applied in a hierarchical order:

1. **Avoid** adverse impacts-avoid habitat loss
2. **Minimise and/or mitigate** impacts-minimise habitat loss through appropriate consideration in planning processes and expert input to project design construction and management
3. **Offset** Identify appropriate offset options if avoidance or minimisation is not achievable.

. There are various mechanisms that can be explored to achieve this.

The following section explores preliminary recommendations that can be considered during the planning process in order to protect both GGE and WBC habitat or compensate for loss using the criteria of avoid, minimise and offset. These can be further detailed when the appropriate pathway for action is determined.

1. Design development to avoid habitat and maintain hydrological processes
2. Offset habitat loss
3. Create new wetland and translocate colonies to new or established wetland habitat

7.1 Project Design to avoid or minimise habitat destruction

One of the most important considerations for the protection of earthworm and crayfish habitat is maintaining the existing (pre-development) hydrological conditions. A major requirement for habitat protection is designing a development that includes the protection of these hydrological processes.

Design requirements include:

- » Retain and protect GGE and WBC habitat within Open Space with appropriate buffers (30 m offsets around habitat)
- » Retain drainage channel at site 1
- » Maintain hydrological processes of waterway and associated riparian habitat around the colonies identified
- » Engage hydrologist to advise on the protection or re-establishment of hydrological processes that support the GGE and WBC habitat.

- » Retain existing soil topography or disturb soil profile as this can play an important role in maintaining hydrological conditions
- » Revegetation habitat according to recommendations for both species (attachment).
- » Prepare a site specific Environment Management Plan that includes construction phase control actions
- » The proposed wetland in the southeast corner of the subject land as part of BBSC future stormwater strategy should be is constructed using crayfish friendly design features as outlined in the Draft Warragul Burrowing Crayfish Habitat Protection and Disturbance Mitigation for Planned Wetlands and Retardation Basins (Van Praagh 2015) (Attachment 5).
- » Implement rescue and release guidelines for the accidental unearthing of GGE or WBC, and ensure all personal working on the project are familiar with the procedure (Attachment 2 and 3).

7.2 Offsets

Due to the low-lying topography, parts of site are subject to seasonal flooding, providing habitat for the WBC. Avoiding or mitigating impacts to GGE and WBC from the proposed development would require protection of the habitat within a reserve system and maintenance of the current hydrological regimens across the site. This may not be possible within the context of the industrial development.

Offsetting is increasingly used as a mechanism to compensate unavoidable development impacts on biodiversity. However offsets should only be considered when all reasonable attempts have been made to avoid or reduce impacts. They do not reduce the likely impacts of a proposed action but instead compensate for any residual impact. Offset requirements for GGE under the EPBC Act or *Victorian Government's Planning and Environment Act 1987* have not yet been determined but have been under discussion with DEWLP and BBSC.

Where appropriate, offsets are considered during the assessment phase of an environmental impact assessment under the EPBC Act. It is unlikely that a referral for GGE will be required for the proposed action and therefore no offset required under this Act. Potential requirements for GGE offsets are included within BBSC Environmental Significance Overlay (ESO4), although there are no current mechanisms available to calculate the requirements.

While the recommendations under the EPBC Act for offsets do not apply to the Warragul Burrowing Crayfish, there are various mechanisms within the local planning scheme (see Section 6.4) that require the consideration of listed species within the planning application process. The following may provide some guidance for either species if deemed appropriate by BBSC.

Further information can be found at: (<http://www.environment.gov.au>):

DoE Offsets --Suitable offsets must include:

- » Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action
- » be built around direct offsets but may include other compensatory measures
- » be in proportion to the level of statutory protection that applies to the protected matter
- » be of a size and scale proportionate to the residual impacts on the protected matter
- » effectively account for and manage the risks of the offset not succeeding
- » be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action, see section 7.6)
- » be efficient, effective, timely, transparent, scientifically robust and reasonable
- » have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

Direct offsets provide on-ground protection and improved conservation out-comes for the impacted matter. Indirect offsets may be measures that improve our knowledge, understanding and management leading to improved conservation outcomes for the impacted protected species.

Offset measures that might be considered include:

Direct Offsets

- Provision of additional conservation security to a population of GGE and WBC via a conservation covenant or ontitle agreement.
- Creation and protection of habitat for a translocated WBC colony.

Translocation opportunities may include:

- 1) Translocation of GGE and WBC colony (before construction) and salvage and release (during construction) to nearby suitable habitat and/or
- 2) Creation of suitable WBC habitat for translocated crayfish or resident crayfish within a wetland reserve system using crayfish friendly design as outlined in Warragul Burrowing Crayfish Habitat Protection and Disturbance Mitigation for Planned Wetlands and Retardation Basins (Van Praagh 2015). There may be opportunities for the proposed wetland in the southeast corner of the subject land as part of BBSC future stormwater

strategy. This site may have potential to support a translocated WBC colony and could form part of a mitigation/offset proposal.

If translocation or salvage and release are considered, detailed protocols would require development with consultation with DELWP and appropriate authorities with subsequent monitoring of project outcomes recommended.

Indirect Offsets -Provision of research funding to:

- » Improve knowledge of the distribution, habitat and conservation requirements of the species
- » Evaluate the effectiveness of current WBC and GGE protection measures in urban developments
- » Review the implementation of Council approval conditions for protection of WBC and GGE habitat
- » Provide recommendations to improve conservation outcomes from protection measures
- » Development of education programs for landowners to manage their land for WBC and GGE conservation

8 DESIGN RESPONSE

A new concept plan has been designed around the Hazel Creek realignment to the south of the land. This incorporates crayfish friendly features and WBC habitat from Site 3 (Attachment 4) into the constructed waterway design. WBC from sites 1 and 2 will be translocated into the new habitat surrounding the wetland. As discussed with BBSC, this project will serve as a demonstration model to inform future projects where new wetlands are created within WBC habitat and when WBC colonies cannot be protected during developments.

To assess the outcomes of the wetland design and translocation of the WBC, a minimum five year monitoring regime will be undertaken.

Specifically,

- A WBC translocation plan must be developed to determine the methodology required to move the crayfish;
- The development of the wetland must follow the design outlined in Warragul Burrowing Crayfish Habitat Protection and Disturbance Mitigation for Planned Wetlands and Retardation Basins (Van Praagh 2015) (Attachment 5).
- A minimum five year monitoring plan must be developed and implemented
- A site induction will ensure all personnel working on site are familiar with the rescue and release guidelines for the accidental unearthing of GGE or WBC (See Attachment 2)..
- Particular care should be taken around the excavation of the site supporting GGE. A spotter could be considered when works in this area are undertaken so that any GGE unearthed might be rescued and translocated to south of the property (See Attachment 2).

9 REFERENCES

- Doran, N. 1999. Burrowing Crayfish (Engaeus) Group Recovery Plan 2001-2005. [Online]. Parks and Wildlife Service, TAS DPIWE. Available from: <http://www.environment.gov.au/biodiversity/threatened/publications/recovery/burrowing-crayfish/index.html>.
- Honan, J. 2010. Draft Guidelines for management of burrowing crayfish in south-west Victoria. Biodiversity Services, DSE Warrnambool (unpublished report).
- Horwitz, P. 1990. A taxonomic revision of species in the freshwater crayfish genus *Engaeus* Erichson (Decapoda: Parastacidae). *Invertebrate Taxonomy* 4: 427-614
- IUCN (International Union for Conservation of Nature) 2014. *Megascolides australis*. The IUCN Red List of Threatened Species. Version 2015.2
- March, T.S. and Robson, B.J. 2005. Association between burrow densities of two Australian freshwater crayfish (*Engaeus sericatus* and *Geocharax gracilis*:Parastacidae) and four riparian land uses. *Aquatic conservation: Marine and Freshwater Ecosystems*. 16, 181–191
- NatureKit 2019 <https://www.environment.vic.gov.au/biodiversity/naturekit>
- Van Praagh, B. D. 1992. The Ecology, Distribution and Conservation of the Giant Gippsland Earthworm *Megascolides australis* McCoy 1878. *Soil Biology and Biochemistry* 24(12): 1363-1368.
- Van Praagh, B. D. 1996. Reproductive biology of *Megascolides australis* McCoy (Oligochaeta: Megascolecidae). *Australian Journal of Zoology* 43:489-507
- Van Praagh, B.D., Yen, A.L., and Rosengren, N. 2007. The Conservation of the Giant Gippsland Earthworm *Megascolides australis* in relation to its distribution in the landscape. *The Victorian Naturalist* 124(4): 249-253.
- Van Praagh, B. D. 2011 Preliminary Assessment for Giant Gippsland Earthworm and Warragul Burrowing Crayfish at 45 Dyall Rd, Drouin. March 2011. Unpublished report prepared for C. Morris and Associates.
- Van Praagh, B. D. 2015 Warragul Burrowing Crayfish Habitat Protection and Disturbance Mitigation for Planned Wetlands and Retardation Basins. Draft report prepared for Baw Baw Shire Council August 2015.
- Victorian Department of Sustainability and Environment. 2009. Advisory List of Threatened Invertebrate Fauna in Victoria - 2009. Department of Sustainability and Environment, East Melbourne, Victoria.

APPENDIX 1 - Giant Gippsland Earthworm *Megascolides australis*

EPBC Act 1999 Conservation Status: Vulnerable
FFG Act 1988 Conservation Status: Threatened
IUCN Red List of Threatened Species (2015): Endangered
DEPI Advisory List of Threatened Invertebrates
(2009): Listed



Description

The Giant Gippsland Earthworm is one of the largest species of earthworm in the world, with adults reaching lengths of over 1.5 m and weights of up to 400 g (Van Praagh 1992).

Distribution

The species is restricted to south and west Gippsland, Victoria with Warragul and Drouin representing the north of its range and Almurta and Korumburra in the south. Mt Worth represents the most easterly point of distribution. The closest GGE records occur within 70 m to the south and 350 m to the west (Victorian Biodiversity Atlas Records).

Habitat

The majority of habitat occupied by this species occurs on private land used for agriculture. GGE colonies are most commonly found along clayey creek banks and drainage lines, usually above the areas prone to flooding. Away from waterways, they occur near underground springs and soaks, either in gullies or on south-facing slopes with terracettes. The species is generally found in the deep blue-grey or red clayey soils. While the species occurs over an area of approximately 40,000 ha, suitable habitat within its range is patchy leading to small, fragmented populations. A combination of many interrelated factors such as slope, micro-topography, nature and depth of the soil and hydrological processes determine suitable habitat (Van Praagh *et.al.* 2007).

Biology

GGEs live in complex, permanent burrows that extend to around 1.5 m in depth. Worms remain underground, feeding on the root material and organic matter ingested in the soil. They breed in spring and summer when they lay large, amber coloured egg cocoons (Van Praagh 1996).

Aspects of the biology and ecology of the GGE such as long lifespan, low reproductive and recruitment rates, and poor dispersal ability render the fragmented populations particularly vulnerable to threatening processes (Van Praagh 1992).

Threats

There are a range of processes that threaten GGE colonies. The most widespread and serious are the physical disturbance and compaction of soils, alterations to water tables and drainage patterns at the local and regional level.

Further information can be found at www.giantearthworm.org.au

APPENDIX 2- Warragul Burrowing Crayfish *Engaeus sternalis*

EPBC Act 1999 Conservation Status: Not Listed

FFG Act Conservation Status (1988): Threatened

IUCN Red List of Threatened Animals (IUCN 2010) Critically Endangered (CR)

DEPI Advisory List of Threatened Invertebrates (2009): Listed



Warragul Burrowing Cray (L) blue form (R) Pale cream adult

Description

The Warragul Burrowing Crayfish is a small burrowing crayfish, with adults having a carapace length of about 20 mm and a total length of about 70 mm (Horwitz 1990). The species is characterised by its very small eyes and fine downy hairs covering its carapace. It is usually a pale, cream colour but may also present in shades of blue and grey.

Distribution

The WBC is restricted to a very small area of South Gippsland, along Labertouche and Wattle Creek in Labertouche, West Gippsland and waterways (Hazel, King Parrot and Moe River tributaries) and floodplains around Drouin and Warragul to the south (Figure 2).

Habitat

Crayfish habitat at Labertouche is along the clay creekbanks in remnant Ecological Vegetation Class (EVC) Damp Heathy Woodland (EVC 793). This contrasts with the species habitat in Warragul and Drouin where it is found within open pasture along edges of creek banks, drainage lines and within floodplains. However the original vegetation in these areas (pre 1750) was predominantly Swampy Riparian Complex EVC 126 (Nature Kit 2019). The crayfish can be found some distance from open waterways where floodplains are present. It tends to be found in the less saturated areas of flood zones.

Biology

The crayfish builds small chimneys, composed of small, spherical balls of soil and small openings. Several adults and young can be found in the same burrow system. While the specific life-cycle of WBC is unknown, in most burrowing crayfish, breeding occurs over spring and summer (Doran 1999).

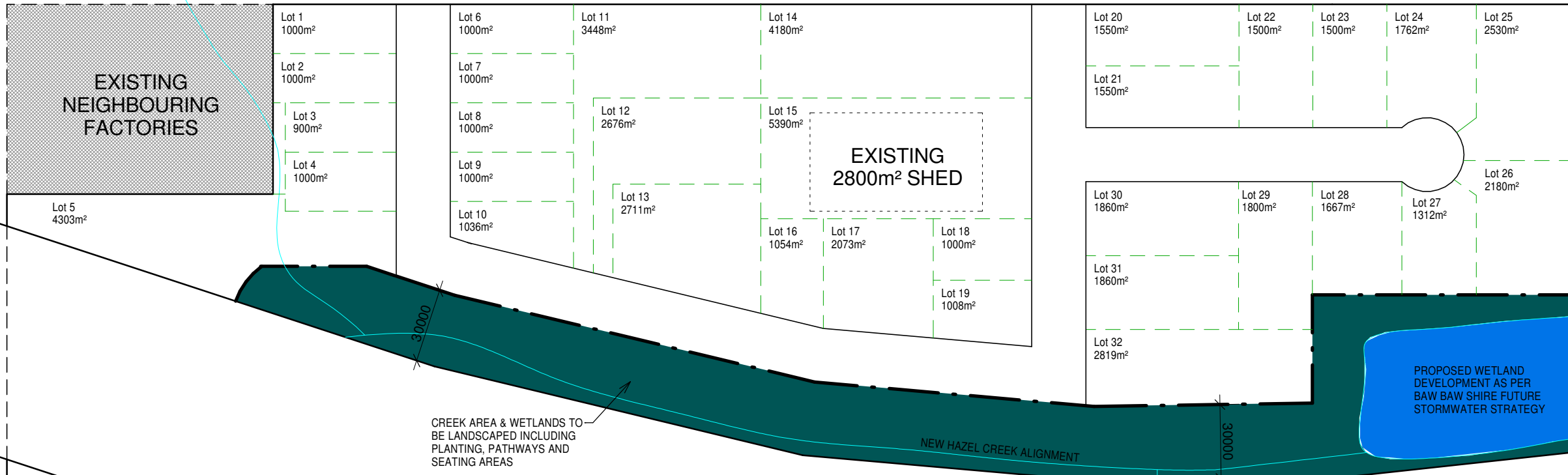
Threats

Many burrowing crayfish are relatively sedentary with poor powers of dispersal, relatively long life cycles and maturation rates leading to narrow endemic ranges, rendering them highly vulnerable to threatening processes. Key threats relate to changes in the quality and quantity and seasonal regime of water, soil and food availability (Doran 1999, March and Robson 2006, Honan 2010).

Further information can be found at <http://www.burrowingcrayfish.com.au/>

KING STREET

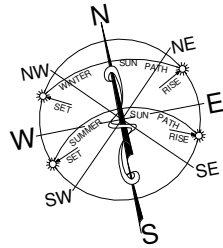
WILLS STREET



CREEK AREA & WETLANDS TO BE LANDSCAPED INCLUDING PLANTING, PATHWAYS AND SEATING AREAS

PRINCES FREEWAY

PROPOSED SUBDIVISION
1 : 2000



9.75ha Approx.
OVERALL SITE AREA

Date of Signing: / /

BUILDER: _____

SIGNATURE 1: _____

SIGNATURE 2: _____

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Wills Street, Warragul, 3820

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Freeway Business Park P/L

BB

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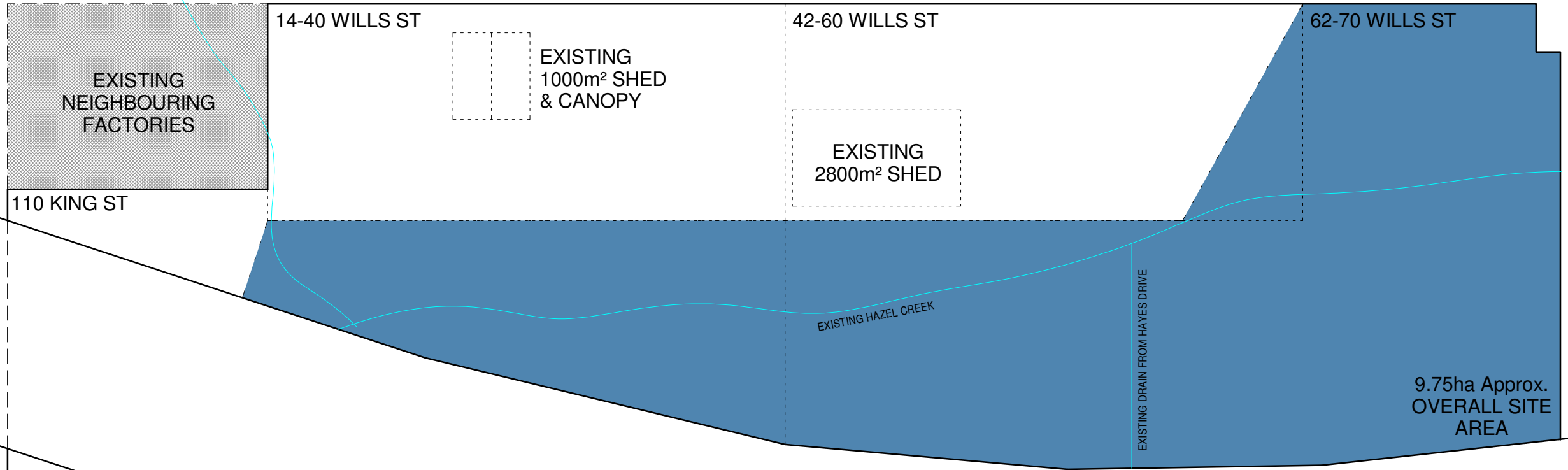
Ph: 0356 333311 0402 834 311
Email: lincolnweymouth@bigpond.com
DP-AD 37734 ABN: 93877626344

DRAWN: LMHW
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SHEET (A3): BB
ISSUE: V1

DESIGN TYPE: Subdivision Plan
DRAWING: Proposed Subdivision

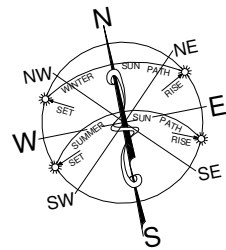
WILLS STREET



PRINCES FREEWAY

EXISTING SUBDIVISION

1 : 2000



Date of Signing: / /

BUILDER: _____

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Ph: 0356 333311 0402 834 311
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DRAWN: LMHW

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SCALE: 1 : 2000 ISSUE: V1

DESIGN TYPE: Subdivision Plan

DRAWING: Existing Subdivision

GUIDELINES FOR THE ACCIDENTAL UNEARTHING OF GIANT GIPPSLAND EARTHWORMS JULY 2014

Even after appropriate survey, assessment and planning have been undertaken at a site, undetected populations of the Giant Gippsland Earthworm may be accidentally unearthed during project works. The following guidelines have been produced to manage these incidents.

IN THE EVENT OF THE ACCIDENTAL UNEARTHING OF GIANT GIPPSLAND EARTHWORMS THE FOLLOWING ACTIONS SHOULD BE IMPLEMENTED IMMEDIATELY.

1. All works must cease within a 50m diameter AREA around the location of the incident.
2. The Site Supervisor must be alerted to the incident
3. The Site Supervisor must establish the AREA as an INCIDENT SITE by securing the boundary and preventing any movement of machinery into the site or any further disturbance to the soil.
4. The Site Supervisor must ensure that any earthworms left exposed in the soil are left in situ and covered with a 10cm layer of moist soil.
5. The Site Supervisor must ensure that any earthworms unearthed and appearing uninjured must be collected and relocated according to the instructions provided.
6. The Site Supervisor must ensure that any dead or fatally injured animals are collected and put in **95 % alcohol in sealed glass jar or plastic container or frozen storage** as soon as possible after unearthing for collection by DSE or deposit at Museum Victoria. All specimens must be accompanied by appropriate label with date, precise locality and organisation details.
7. The Site Supervisor must ensure that the Biodiversity Unit, DSE Office, Traralgon (Ph: 03 51722111) is contacted within 24 HOURS regarding earthworms that required collection.
8. The Site Supervisor must ensure that an INCIDENT REPORT is completed in the format provided and sent to the Agency responsible for authorizing the works (e.g. DPI, shires, DSE) within 24 HOURS OF THE INCIDENT.

AN ASSESSMENT OF THE IMPACT OF WORKS ON THE GIANT GIPPSLAND EARTHWORM POPULATION MAY BE REQUIRED BY THE AUTHORISING AGENCIES. ADVICE WILL BE GIVEN ON HOW TO PROCEED WITH WORK ACTIVITIES AS QUICKLY AS POSSIBLE.

The Giant Gippsland Earthworm has been officially listed under both Victorian and Federal legislation as a threatened species. As a result, permits from both levels of government may

be required to either remove animals or interfere with their habitat. Substantial penalties may apply for non-adherence.

INCIDENT REPORT FOR THE ACCIDENTAL UNEARTHING OF GIANT GIPPSLAND EARTHWORMS

Name of company/organisation:

.....

Name of contact:

.....

Contact details:

.....

Location of Incident:

.....

Date of Incident:

.....

Size of area from which earthworms unearthed.....

Estimate of numbers of worms unearthed.....

Number of earthworms recovered in situ.....

Number of earthworms taken for relocation.....

Description of Incident

.....
.....
.....
.....
.....
.....
.....
.....
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.....

Attach **photograph** of habitat/incident

This Incident Report must be sent to the authorizing agency within 24 hours

INSTRUCTIONS FOR RELOCATING GIANT GIPPSLAND EARTHWORMS

It is important that the following instructions are followed in order to ensure the best possible chance of survival for Giant Gippsland Earthworms that have been accidentally unearthed and need to be placed back into the soil.

1. Collect all uninjured earthworms. Giant Gippsland Earthworms are fragile and must be handled with great care. They cannot support their own weight out of their burrows. They must ALWAYS be carried in a HORIZONTAL position. They should NEVER be held vertically and allowed to dangle. This always results in DEATH.
2. If more than one earthworm is unearthed, they can be kept in plastic box or esky with moist soil with either wet hessian or newspaper over the top for up to ONE HOUR while the relocation site is prepared. If the WEATHER is VERY WARM, earthworms must be relocated as SOON AS POSSIBLE.
3. Earthworms must be kept in a shaded location while being kept for relocation.
4. Relocate uninjured earthworms to a nearby site that will not be subject to any earthworks. This site should have a moist, predominantly clay soil.
5. Dig a small trench to a depth of approximately 30 cm. The length of the trench should be at least as long as the earthworm. The earthworm should be placed in the trench and gently covered with loose moist soil and the removed clods of pasture placed on top.
6. Up to two earthworms can be placed in a single trench.
7. If the soil is dry, wet the trench. Watering may also be required in the following days, particularly in summer. Expert advice is available from the Biodiversity Unit, DSE Office, Traralgon (Ph: 03 51722111) any on-going need for watering of relocation sites.

Identification of Giant Gippsland Earthworms



Adult : 80-150 cm long x 2 cm diameter

Colour: Dark purple head grading into pink-flesh colour

Distinguishing Marks: 3 bands positioned about 1/3 down the body on the ventral side (underneath) the adult worm



Identification of Giant Gippsland Earthworms *Cont-*

Egg Cocoons



Egg Cocoons:

Large (5-9 cm), amber coloured deposited within the burrow system and are found at an average depth of around 20 cm. They can be found all year round due to their long incubation period.



This drawing is confidential and shall only be used by Incitus. Client for which it was prepared.

No.	BY	DATE	REVISION
A	NB	22/12/20	ISSUED FOR NEGOTIATION
B	NB	17/01/21	MINOR AMENDMENTS
C	NB	27/01/21	MINOR AMENDMENTS

APPD	DOC NUMBER	DOCUMENT TITLE
	REFERENCE DOCUMENTS	

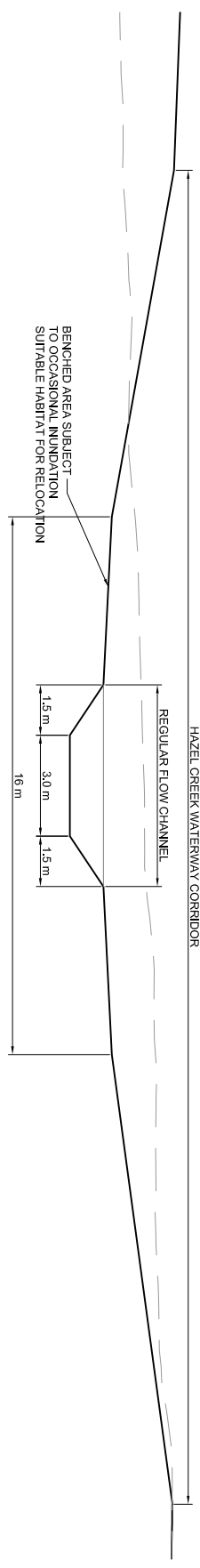
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APPROVED		DATE



14 - 70 WILLS STREET & 110 KING STREET WARRAGUL
 HAZEL CREEK REALIGNMENT
 WATERWAY CONCEPT INCORPORATING
 WARRAGUL BURROWING CRAYFISH HABITAT

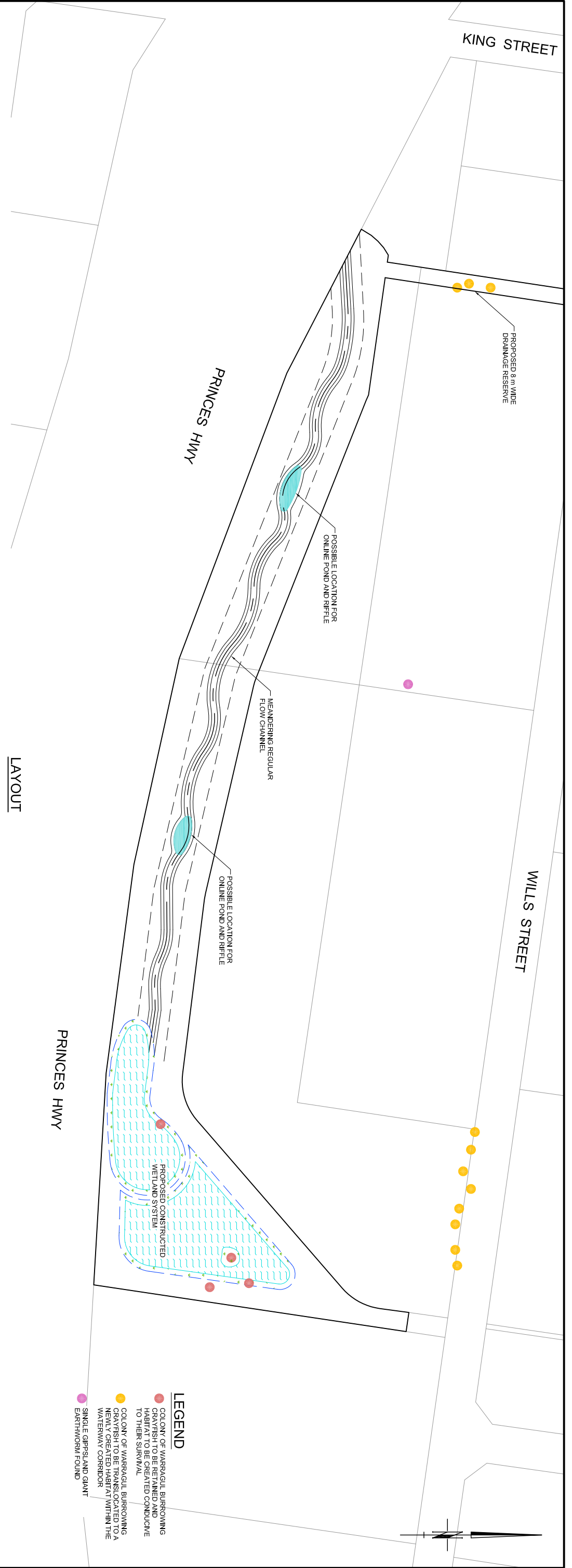
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Rev	C

NOTES:
 POTENTIAL HABITAT WITHIN THE WATERWAY CORRIDOR AND SURROUNDING THE WETLANDS TO BE RELOCATED TO THE HEALTHY WOODLANDS (EVC 793) OR SWAMPY RIPARIAN COMPLEX (EVC 126) IN ACCORDANCE WITH THE GIANT GRIPSLAND EARTHWORM AND WARRAGUL BURROWING CRAYFISH ASSESSMENT AT A PROPOSED INDUSTRIAL DEVELOPMENT, INCLUDING FOUR PARCELS OF LAND CORNER OF KING ST AND WILLS ST, WARRAGUL (DR BEVERLEY VAN PRAAGH)

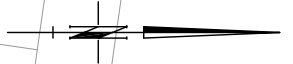


TYPICAL SECTION
 SCALE 1:100 (HORIZONTAL ALL LAY)
 SCALE 1:50 (VERTICAL ALL LAY)
 SCALE BEFORE REDUCTION

LAYOUT
 SCALE 1:1000 (A1)
 SCALE BEFORE REDUCTION



- LEGEND**
- COLONY OF WARRAGUL BURROWING CRAYFISH TO BE RETAINED AND HABITAT TO BE CREATED CONDUCTIVE TO THEIR SURVIVAL
 - COLONY OF WARRAGUL BURROWING NEWLY CREATED HABITAT LOCATED TO A WATERWAY CORRIDOR
 - SINGLE GRIPSLAND GIANT EARTHWORM FOUND



DRAFT

Salvage and Release Protocols for the accidental unearthing of Warragul Burrowing Crayfish December 2015

Even after appropriate survey, assessment and planning have been undertaken at a site, undetected populations of the Warragul Burrowing Crayfish may be accidentally unearthed during project works. The following guidelines have been produced to manage these incidents.

Translocation of crayfish may be to receptor sites elsewhere on the existing activity site that will be unaffected by works (preferable) or to a new site that includes habitat protection, improvement or habitat creation (requires extensive consultation with DELWP).

1. When a WBC is discovered, all reasonable effort must be made to safely excavate or remove the crayfish from within the works footprint.
2. Each crayfish should be assessed for damage. Crayfish with loss of claws, legs or damage to the tail fan can be released as the animals can regenerate these. However, damage such as crushing to the carapace (front section of shell) or tail is likely to be fatal and will require euthanization (see section on Euthanasia).
3. If crayfish can be immediately returned *in situ* or into nearby habitat, then individuals should be released as close to the point of capture as possible as follows:
 - An existing, unoccupied (no signs of recent activity) WBC crayfish burrow by placing tail first into an existing burrow opening, or preferably,
 - Create an artificial burrow by using a crowbar or similar to make a hole at least 25 mm wide and at least 15 cm deep but preferably to the water table and release the crayfish as above. Any juvenile (<15 mm) should be placed in holes that go into the ground diagonally to give them some support. Site should support wet clay soil or filled with dechlorinated water. Dechlorinated water is water left in a vented container for 72 hours.
 - If crayfish are released in summer or under very dry conditions, once an animal is released into a created burrow, the entrance should be blocked with stone, or wood
 - Created burrows should be no closer than 30 cm from another burrow

6. If the crayfish cannot be released immediately and needs to be held for a period of time, wash off any dirt using onsite water or dechlorinated portable water and check for damage.

- Place the animal in a clean container (e.g. clear takeaway container) with small amount of clean water (10 mm).
- Adults should be kept in separate containers
- Several juveniles (less than 15 mm) can be placed together.
- Containers should be placed in an insulated cooler/esky with a small amount of ice and held on site.

If works are completed within the same day, animals can be released into suitable habitat as close to their site of excavation as possible.

7. If works are not completed within the same day, animals should be held in insulated cooler and released when works are completed as described in step 5.

Information on number of crayfish collected, released and/or euthanized and where animals were released should be recorded and submitted to the referring authority.

EUTHANASIA

Excavated animals that have been fatally damaged should be euthanized in the following manner:

Place animal in separate container in an insulated cooler with ice or a refrigerator for 2 hours to chill them so they are immobile. Animals can then be placed in the freezer or an ice-slurry for 30 minutes. They should then be placed in 70% alcohol and deposited at Museum Victoria.

IDENTIFICATION OF WARRAGUL BURROWING CRAYFISH AND THEIR HABITAT

What is a burrowing crayfish?

Burrowing crayfish of the genus *Engaeus* are known as “land crayfish” as they live their entire life within their burrow systems, only venturing out occasionally at night. They live in and around creek banks and seepages and can be found some distance from a watercourse. The entrances to their burrows are surrounded by characteristic mounds of soil. Those belonging to the Warragul Burrowing Crayfish are usually small with narrow openings and composed of small, spherical balls of soil. They are usually observed in winter and spring and may be difficult to detect at the surface at other times of the year.



What do they look like?

The Warragul Burrowing Crayfish is quite small, with adults having a carapace of about 20 mm and a total length of about 70 mm. The species is characterised by its very small eyes and fine downy hairs covering its carapace.

It is usually a pale, cream colour but may also present in shades of blue and grey (Plate 1).



Small eyes and fine hairs



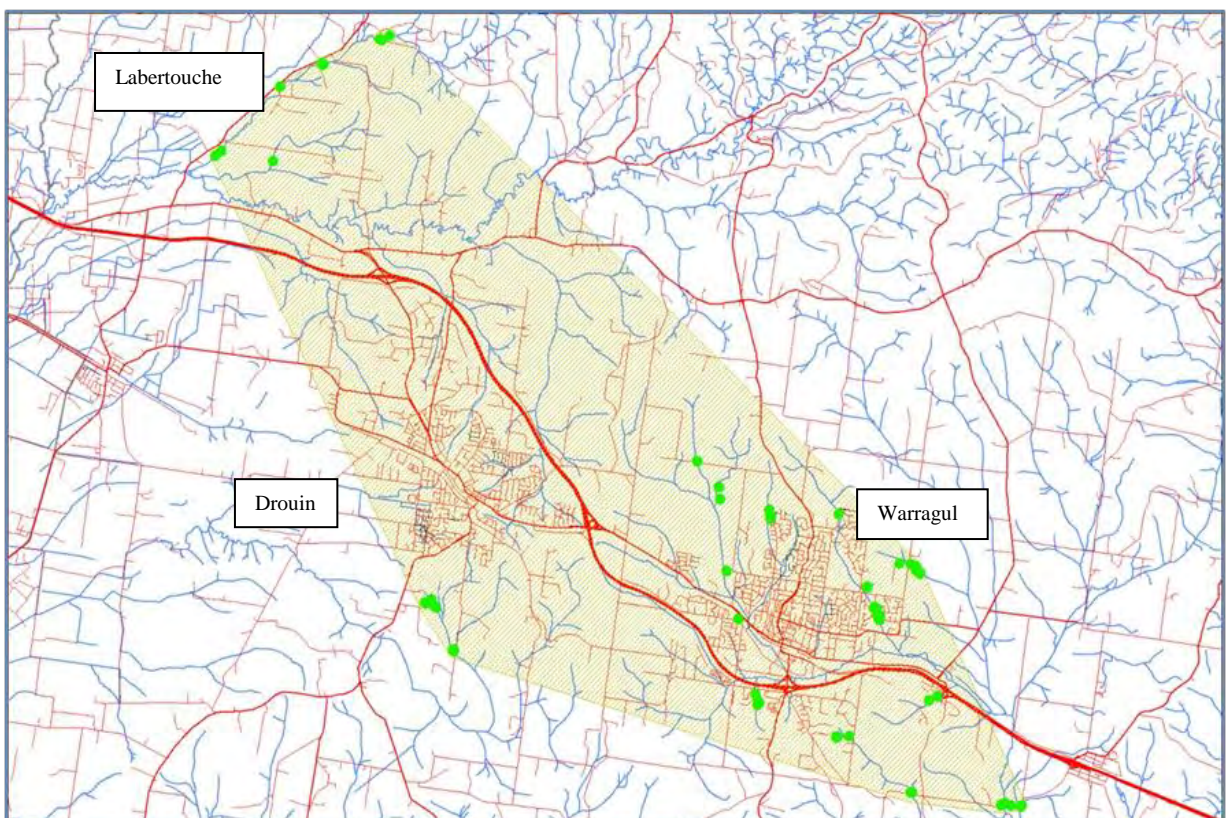
Plate 1 Warragul Burrowing Crayfish (L) pale cream (R) blue form

Where are they found?

All currently known localities of WBC are shown in Figure 1 and encompass an area of approximately 20 square km.

In addition to the Labertouche creek system, WBC have been recorded from creeks and drainage lines in the Hazel and Spring Creek catchments of Warragul and Gum Scrub Creek and King Parrot Creek in Drouin.

Figure 1 Minimum convex polygon based on known distribution records of Warragul Burrowing Crayfish ●



What is their typical habitat ?

Typical habitat in pastures at Warragul and Drouin includes:

- Creek banks
- Banks of shallow drainage lines and seepages,
- Floodplains adjacent to streams- can be some distance from waterway
- Clay dominated soils, often blue-grey or red
- Low lying roadside reserves



At Labertouche, WBC occur primarily along the clayey creek banks within remnant Swampy Woodland.

