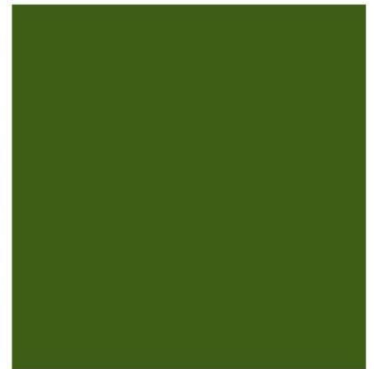


Management Guide



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I Introduction

Tasmania has five species of burrowing crayfish (*Engaeus* species) that are listed under both State and Commonwealth legislation (Table I). These species are listed due to their restricted ranges and areas of occupancy, and the presence of actively threatening processes within these areas including those that affect water quality/quantity, and soil and food (wood/plant) availability (Doran 2000). These species vary in their habitat requirements, but they all create burrows in damp areas including stream beds and banks, ditches, swampy areas, etc.

This booklet has been prepared by the Environment and Development Approvals (EDA) in the Department of State Growth (State Growth) to outline how to mitigate threats to these threatened burrowing crayfish when conducting road maintenance activities. It is intended that people who use this booklet also receive the training provided by EDA on burrowing crayfish ecology and management. This training will include presentations and field training sessions from burrowing crayfish experts. However, this booklet may also be useful to State Growth employees, local councils, ecological consultants and people interested in managing burrowing crayfish.

Table I. Listed species of burrowing crayfish in Tasmania

Common name	Scientific name	Commonwealth status	Tasmanian status
Central North burrowing crayfish	<i>Engaeus granulatus</i>	endangered	endangered
Mt. Arthur burrowing crayfish	<i>Engaeus orramakunna</i>	vulnerable	vulnerable
Scottsdale burrowing crayfish	<i>Engaeus spinicaudatus</i>	endangered	endangered
Burnie burrowing crayfish	<i>Engaeus yabbimunna</i>	vulnerable	vulnerable
Furneaux burrowing crayfish	<i>Engaeus martigener</i>	vulnerable	endangered

1.1 How to use this booklet

Section 2 of this document outlines the Commonwealth and State legislative requirements to manage these species.

Section 3 provides an overview of the range boundaries and habitat requirements for these species, including a definition of potential habitat.

Section 4 provides guidance on how to manage these species when doing road maintenance activities. A flow chart directs the user to the appropriate section of the document for their specific activity. For maintenance activities the user must fill out one table to establish the potential impacts of the operation, and then a second table to determine the appropriate mitigation strategies. Details on how to apply the mitigation strategies are provided.

Section 5 provides a list of references used in this document, and a reference list for further reading.

Section 6 provides some photos of the types of burrows that can occur.

Section 7 is a worked example of determining appropriate management actions.

2 Legislative requirements

Outlined below are the legislation, processes and policies relating to threatened species management that are relevant to road maintenance, modification and construction.

2.1 Commonwealth

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) applies nationally and provides protection to matters of national environmental significance, including nationally threatened species. Under the EPBC Act a referral to the relevant Commonwealth department is required if there is a reasonable likelihood of a significant impact on a threatened species. Under the Significant Impact Guidelines (Department of the Environment 2013), an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will: (a) lead to a long-term decrease in the size of a population; (b) reduce the area of occupancy of the species; (c) fragment an existing population into two or more populations; (d) disrupt the breeding cycle of a population; (e) modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; (f) result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat; (g) introduce disease that may cause the species to decline; or (h) interfere with the recovery of the species.

Draft referral guidelines under the EPBC Act for Tasmanian threatened burrowing crayfish have been produced (Commonwealth of Australia 2011). These draft guidelines state that a referral is required if the action to be undertaken “has, will have or is likely to have a significant impact on burrowing crayfish” (Commonwealth of Australia 2011). A referral is likely to be needed if the action impacts an “important population” or “the species as a whole”. Any activities that are anticipated to have a significant impact on this species will need to be carefully considered against the relevant criteria of these Guidelines and appropriate advice sought from State and/or Commonwealth agencies on the requirements for formal referral under the EPBCA.

Under the draft referral guidelines, for the following species an “important population” is defined as:

- Central North burrowing crayfish: any occurrence;
- Mount Arthur burrowing crayfish: any occurrence where there is a distance of 10 m or less between burrows, there are 20 or more burrows in a 10 × 10 m area, if there is evidence of fresh burrowing and it occurs in relatively undisturbed habitat;
- Scottsdale burrowing crayfish: any occurrence; and
- Burnie burrowing crayfish: any occurrence where there is a distance of 10 m or less between burrows, there are 20 or more burrows in a 10 × 10 m area, if there is evidence of fresh burrowing and it occurs in relatively undisturbed habitat.

Activities that are at high risk of having a significant impact on burrowing crayfish, and for which referral is recommended, include those that result in alterations to the water table or drainage patterns, water quality, soil compaction or ploughing where there are burrows, clearing or loss of individual burrows.

Some activities are exempt from the EPBC Act under section 43A and 43B, including:

- activities that were authorised by a specific environmental authorisation under a Commonwealth or State law before 2000;
- activities that commenced prior to 2000 and the use of land was lawful and the action has continued in the same location without enlargement, expansion or intensification (<http://www.environment.gov.au/resource/prior-authorisation-and-continuing-use-exemptions-sections-43a-and-43b>).

Activities that are listed as being potentially exempt from the EPBC Act requirements include maintenance of existing dams, roads, fences, etc. Application of the ongoing use exemption generally requires a demonstration that activities have been ongoing, but as it is commonly known that road maintenance is required so it is reasonable to assume ongoing use for existing road networks (Brendan Taylor, Department of Environment, pers. comm.).

Conclusion

- Under section 43A and 43B of the EPBC Act, EPBC referral is not required for road maintenance activities as these are considered “continuing use”.
- EPBC referral may be required for road modification or construction activities, including widening of roads, development of new drainages, etc.

2.2 State legislation

The Tasmanian *Threatened Species Protection Act 1995* (TSP Act) provides for the protection and management of threatened native flora and fauna, and to enable and promote the conservation of native flora and fauna. Under the TSP Act (Section 51), “...a person must not knowingly, without a permit – (a) take, keep, trade in or process any specimen of a listed taxon of flora or fauna...” without a permit that details the circumstances when this can occur.

Within the range of threatened burrowing crayfish it is reasonable to assume that burrows and chimneys detected in the field belong to the threatened species, and that any disturbance to such burrows (especially deeper excavations and burial) may impact on the threatened species. As such, any disturbance (used here as a generic term but related to the intent of the term “take” under Section 51) would be undertaken “knowingly” and require a permit under the TSP Act.

The recovery plan for threatened burrowing crayfish, developed under the TSP Act, applies to four of the threatened species in Tasmania (excluding the Central North burrowing crayfish) (Doran 2000). The objective of the burrowing crayfish recovery plan is “to stabilise and improve the conservation status of these species so that they may be considered for down-listing according to population sizes and trends, area and occupancy and security of habitat within or beyond the time span of this plan” (Doran 2000). Threatening processes identified in the recovery plan include those that affect water quality/quantity, soil and food (wood/plant) availability, and general roading and drainage activities (urban and non-urban) that impact on seepage/wetland/stream bank habitat quality.

The Tasmanian *Nature Conservation Act 2002* (NCA) makes provision with respect to the conservation and protection of the fauna, flora and geological diversity of the State, to provide for the declaration of national parks and other reserved land and for related purposes. Under Section 29, the Secretary may

grant a permit authorising, subject to compliance with any specified conditions and restrictions, the taking on specified lands of specified wildlife, or specified products of specified wildlife. Under the *Tasmanian Wildlife (General) Regulations 2010*, a permit is required from DPIPWWE to “take” (which includes kill, injure, catch, damage, destroy and collect) both individuals of specially protected wildlife and “products” of such species, where “products” may include parts of animals or burrows. The burrowing crayfish currently listed as “specially protected wildlife” under Schedule 1 of the Wildlife Regulations are the Mt. Arthur burrowing crayfish, Scottsdale burrowing crayfish, and Burnie burrowing crayfish (this list is due to be updated in 2014).

Conclusion

Many road maintenance activities have the potential to knowingly ‘take’ a burrowing crayfish. Therefore a permit from DPIPWWE is required for any maintenance or construction activities that may impact the burrows of threatened burrowing crayfish.

3 Species range boundaries and habitat requirements

3.1 Distribution

The five species of threatened burrowing crayfish occur in the north of Tasmania, and on Flinders Island (Figure 1). The **core range** of a species is defined as the area within which the species is most likely to occur, being the area of land within a minimum convex polygon of all known localities of the species. The **potential range** of a species includes the core range, but also includes the area within which the species has not been found but may occur based on environmental conditions. For threatened burrowing crayfish the potential range includes the core range and specialist-defined extensions of the core range that may support the species but are as yet largely unsurveyed (FPA and DPIPWWE 2011). The Natural Values Atlas should be checked for the most recent range boundaries (<https://www.naturalvaluesatlas.tas.gov.au>), but information on the range boundaries as of January 2014 is provided below (Figure 1, Figure 2, and Figure 3).

- The Central North burrowing crayfish is found in a triangular area running south-west from Port Sorell to the Railton area and north to Quoiba, near Devonport. The species has a restricted, fragmented population with limited connectivity between populations.
- The Mt Arthur burrowing crayfish is known from Mt Arthur in north-east Tasmania and extending to near Lilydale, Nabowla and South Springfield and near Launceston.
- The Scottsdale burrowing crayfish has a small area of occurrence north and east of Scottsdale.
- The Burnie burrowing crayfish appears to occur in two sub-populations. The eastern, urban population is based on the city of Burnie in the Emu River, Shorewell Creek, Romaine Creek, the eastern arm of Cooee Creek and Messenger Creek. The larger western population extends westwards from Distillery Creek through Seabrook Creek to Camp Creek. The species appears to be absent from much of the Cam River catchment, with the exception of Distillery Creek, Maldon Creek and a small upper tributary.
- The Furneaux burrowing crayfish is found only on Flinders Island (Mt Strzelecki and the Darling Range) and at Mt Munro on Cape Barren Island.

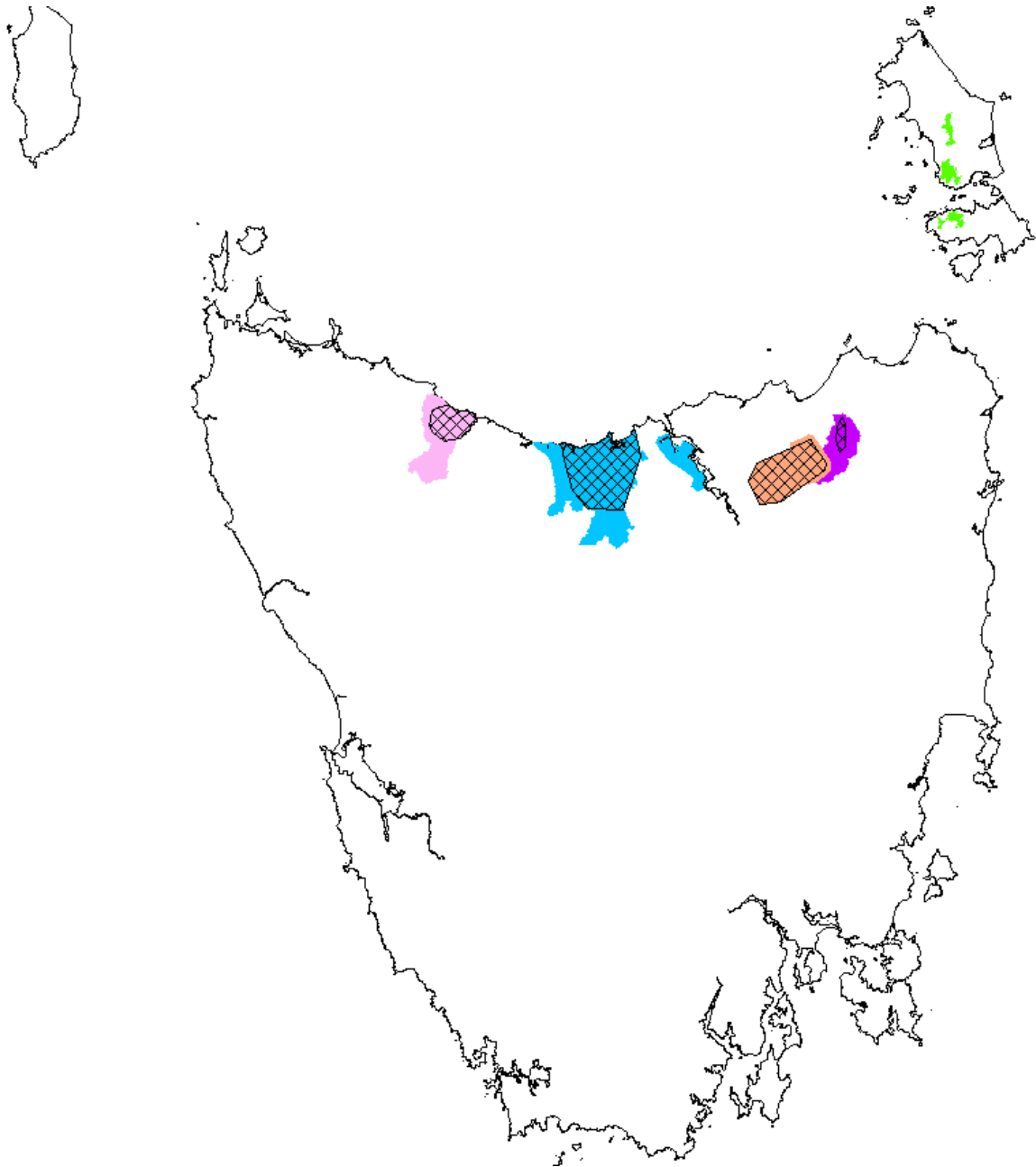
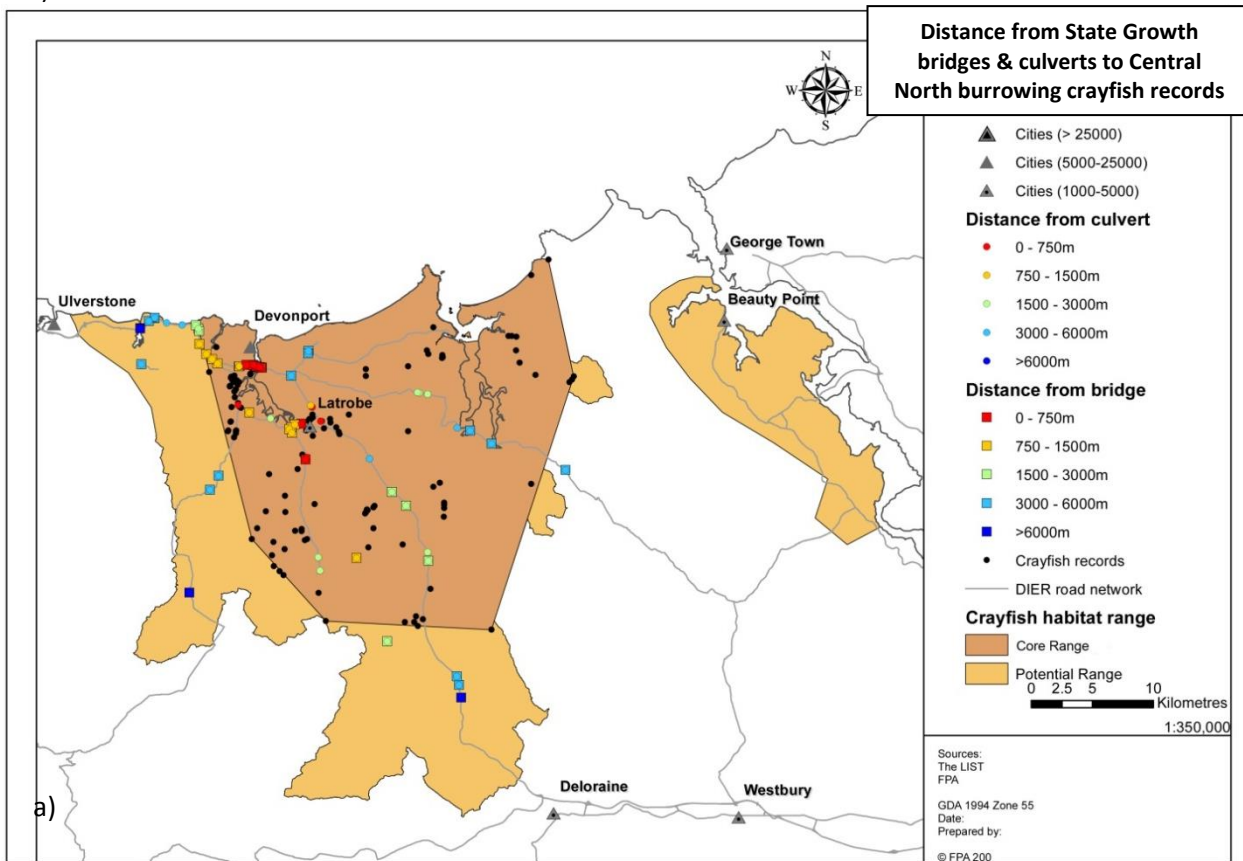


Figure 1. The potential (solid colour) and core (hatching) range boundaries of threatened burrowing crayfish in Tasmania:

- blue = Central North burrowing crayfish
- orange = Mt. Arthur burrowing crayfish
- purple = Scottsdale burrowing crayfish
- pink = Burnie burrowing crayfish
- green = Furneaux burrowing crayfish

a)



a)

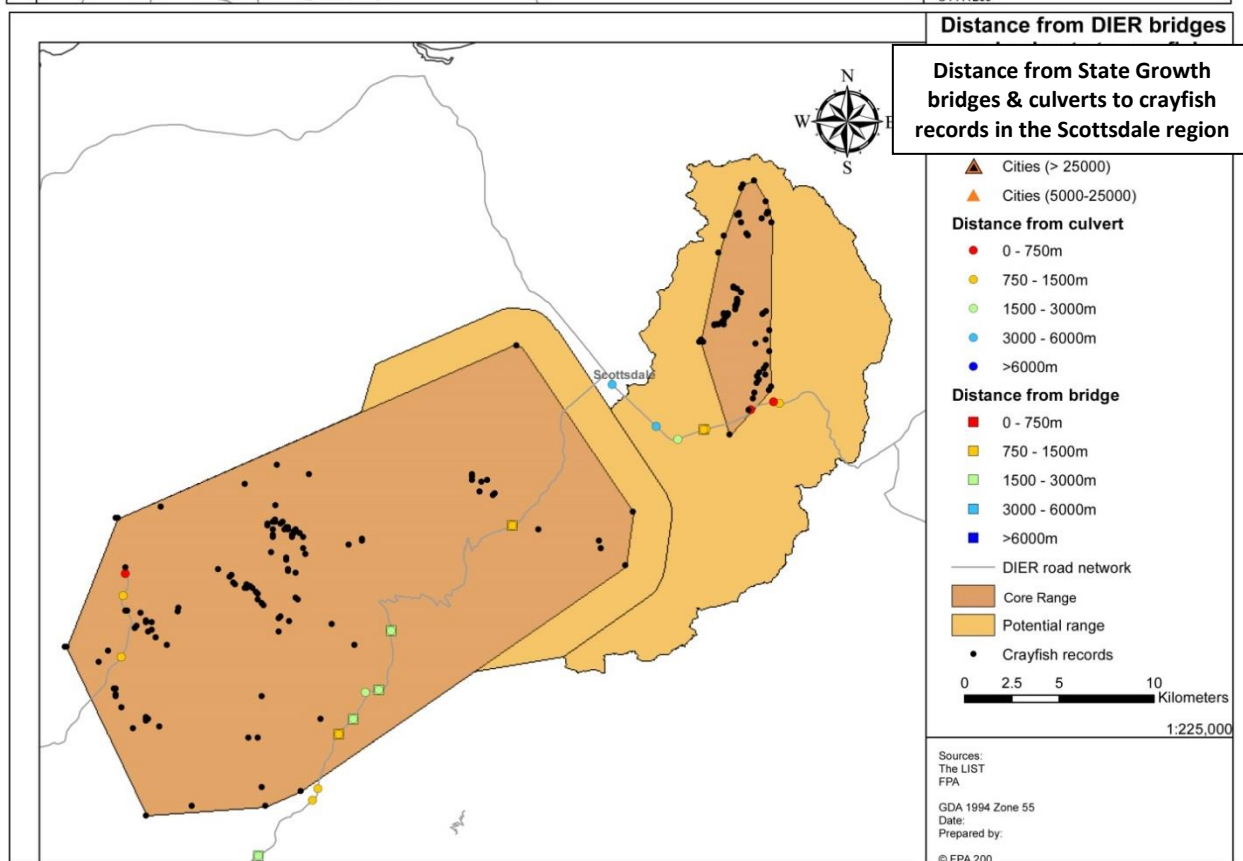


Figure 2. The known and potential range boundary and associated State Growth assets for (a) Central North burrowing crayfish and (b) Mt Arthur (left) and Scottsdale (right) burrowing crayfish.

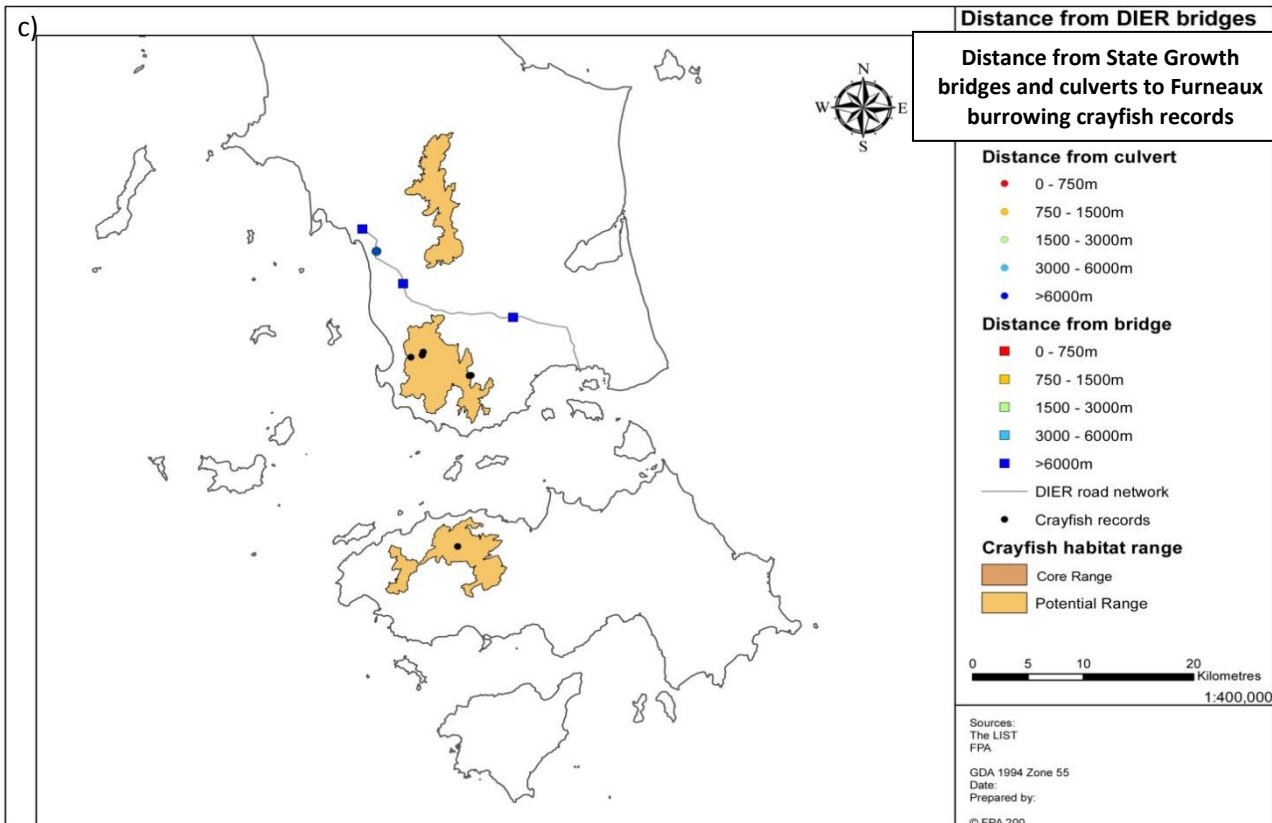
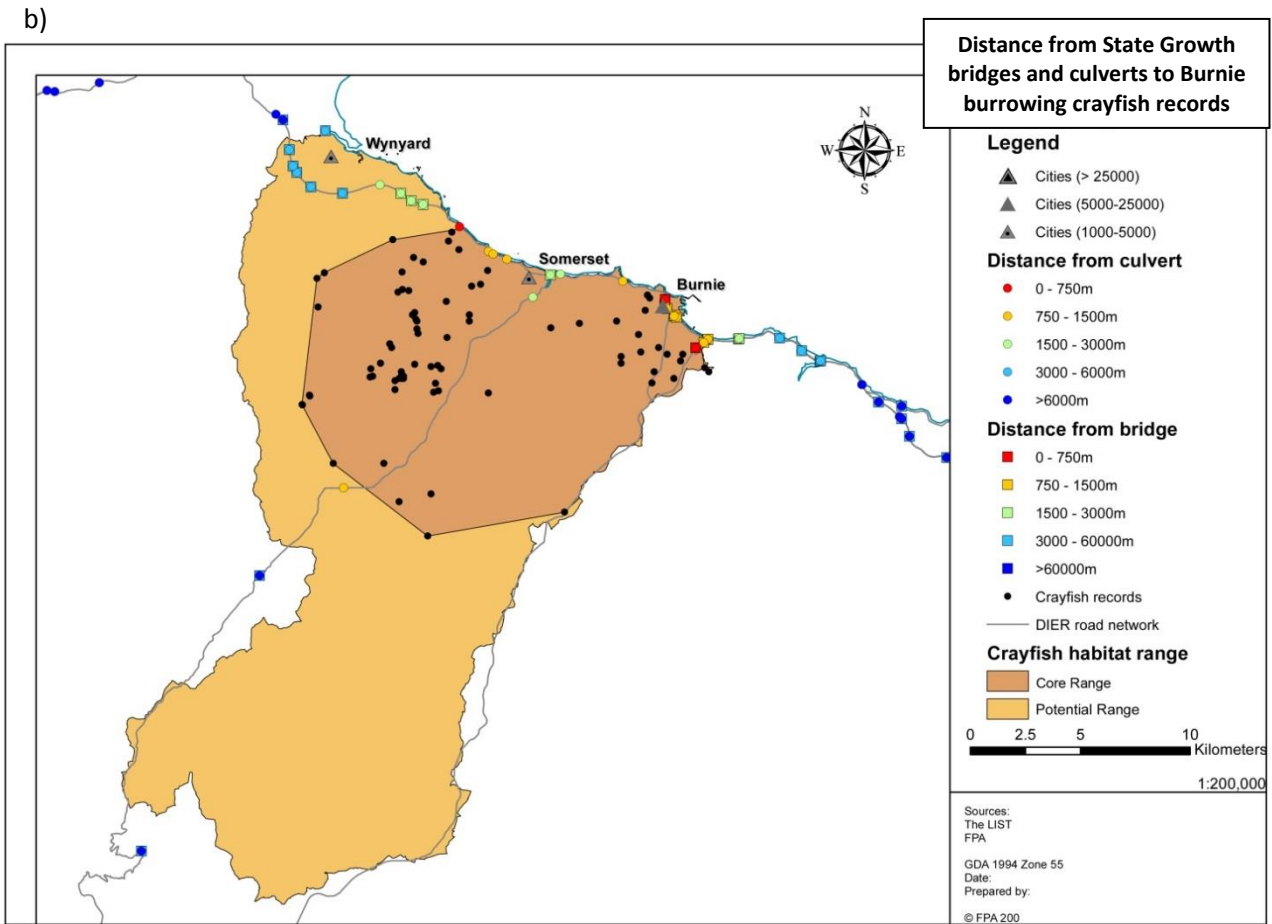


Figure 3. The known and potential range boundary and associated State Growth assets for (a) Burnie burrowing crayfish and (b) Furneaux burrowing crayfish.

3.2 Habitat requirements

Potential habitat is all habitat types within the potential range of a species that are likely to support that species in the short and/or long term. Potential habitat is determined from published and unpublished scientific literature and/or expert opinion, and is agreed by the Threatened Species and Marine Section (DPIPWE) in consultation with species' specialists.

Potential habitat for each species of threatened burrowing crayfish (except the Furneaux burrowing crayfish) is defined as:

“any poorly-drained habitats such as streams (of any class [order] and disturbance history), seepages (e.g. springs in forest or pasture, outflows of farm dams), low-lying flat swampy areas and vegetation (e.g. buttongrass and heathy plains, marshy areas, boggy areas of pasture), drainage depressions, ditches (artificial and natural, including roadside ditches, pasture drains, etc.)” (FPA and DPIPWE 2011).

Potential habitat for the Furneaux burrowing crayfish is defined as:

“boggy areas and small clear water creeks in high altitude wet ferny gullies. These areas appear to be the stronghold of the species, although recent survey work has also located populations at lower altitudes, and in a poorly-drained mossy tea-tree bog and a small grassy spring/soak in open dry eucalypt forest” (FPA and DPIPWE 2011).

All five species build burrows that extend down to the water table, and spend most of their lives in these burrows. Burrows can be complex and extensive and may often be the product of several generations of crayfish activity (Doran and Richards 1996). These burrows may or may not be associated with, or at the edge of, standing water. Burrows can be found in poorly-drained swampy areas, in ditches and at the side of small creeks. The Mt Arthur burrowing crayfish is unusual in that some burrows are perched above the water table and collect water from surface run-off. Some burrows of Mt Arthur burrowing crayfish can be found in creek gullies several metres above the water.

All five species are strong burrowers with the capacity to respond to and repair damage to their burrows. Pictures of some of the types of areas in which burrowing crayfish can be found are provided in Figure 4 and Figure 5, including pristine and highly modified areas, areas with permanent or intermittent surface water, areas heavily covered in weeds and other vegetation or areas without any vegetation, and large and small areas of potential habitat. Images of some crayfish burrows are provided in Section 6.

Burrowing crayfish appear on the surface only occasionally, generally at night and in damp conditions. The breeding season for most species is thought to start in mid to late spring. The adults lay eggs and carry eggs and hatched juveniles under their tails. The juveniles generally hatch in summer and are released from the burrow when water levels are high. The breeding season of the Mt Arthur burrowing crayfish may be slightly earlier, with breeding starting in late winter and juveniles occurring in early summer. The breeding season of the Scottsdale burrowing crayfish may be slightly later, starting in late spring and early summer and with juveniles in early autumn.



Figure 4. Examples of burrowing crayfish potential habitat, including intact native vegetation, permanent streams, areas of intermittent waterflow and weedy areas.



Figure 5. Examples of burrowing crayfish potential habitat, including low lying areas with a shallow watertable, modified areas such as drains and culverts, and small remnants of habitat in highly modified areas.

3.3 Threats

These species are listed due to their restricted ranges and areas of occupancy, and the presence of actively threatening processes within these areas. Threatening processes include those that affect water quality/quantity, and soil and food (wood/plant) availability, such as:

- removal of vegetation can lead to drying out of soil, erosion, sediment input into waterways, changes in water table levels and drainage;
- activities that can affect water quality include drainage works, earthworks, roading and stock access (all of which can lead to increased sediment reaching waterways), and the entry of chemicals into the waterway (for example fertilizer, herbicides and pesticides);
- use of heavy machinery (cars, trucks, earth-moving equipment, etc) within burrowing crayfish habitat can crush burrows and crayfish, and lead to severe degradation of habitat through damaging vegetation and compaction of soil;
- livestock (for example cattle) can compact and degrade areas of suitable habitat;
- the establishment of weeds such as gorse (*Ulex europaeus*) and blackberries (*Rubus* species) in waterways and seeps can lead directly to habitat degradation and can lead to weed management actions that degrade suitable habitat;
- frequent high intensity fires can have negative long term effects on soil and vegetation;
- Scottsdale burrowing crayfish tend to have shallower burrows than many other species and so may be more sensitive to siltation, trampling, changes in hydrology etc;
- the freshwater yabby (*Cherax destructor*) is regarded as an introduced pest which may compete for food and habitat with the Central North burrowing crayfish.

4 Management recommendations

Management for these species has been established in an adaptive management framework. Threat mitigation strategies have been developed using available data for the species, scientific literature and expert opinion. Monitoring the impact of the mitigation strategies is essential to allow the effectiveness of management to be assessed periodically, and revised as necessary.

Use the flow diagram in Figure 6 to determine whether action is required to mitigate the impacts of a proposed road maintenance activity on threatened burrowing crayfish.

If the activity is classified as a 'maintenance activity' that may impact a species of threatened burrowing crayfish, the flow diagram will direct you to Section 4.1 to determine the appropriate mitigation response. This is done by filling out Table 2 to determine the impact of the particular operation, then filling out Table 3 to determine the appropriate mitigation response. Greater detail on how to implement these mitigation responses is provided in Section 4.2.

A worked example is provided in Section 7. If users have any difficulty interpreting any parts of this document, they should refer to the Environment and Development Approvals at the Department of State Growth.

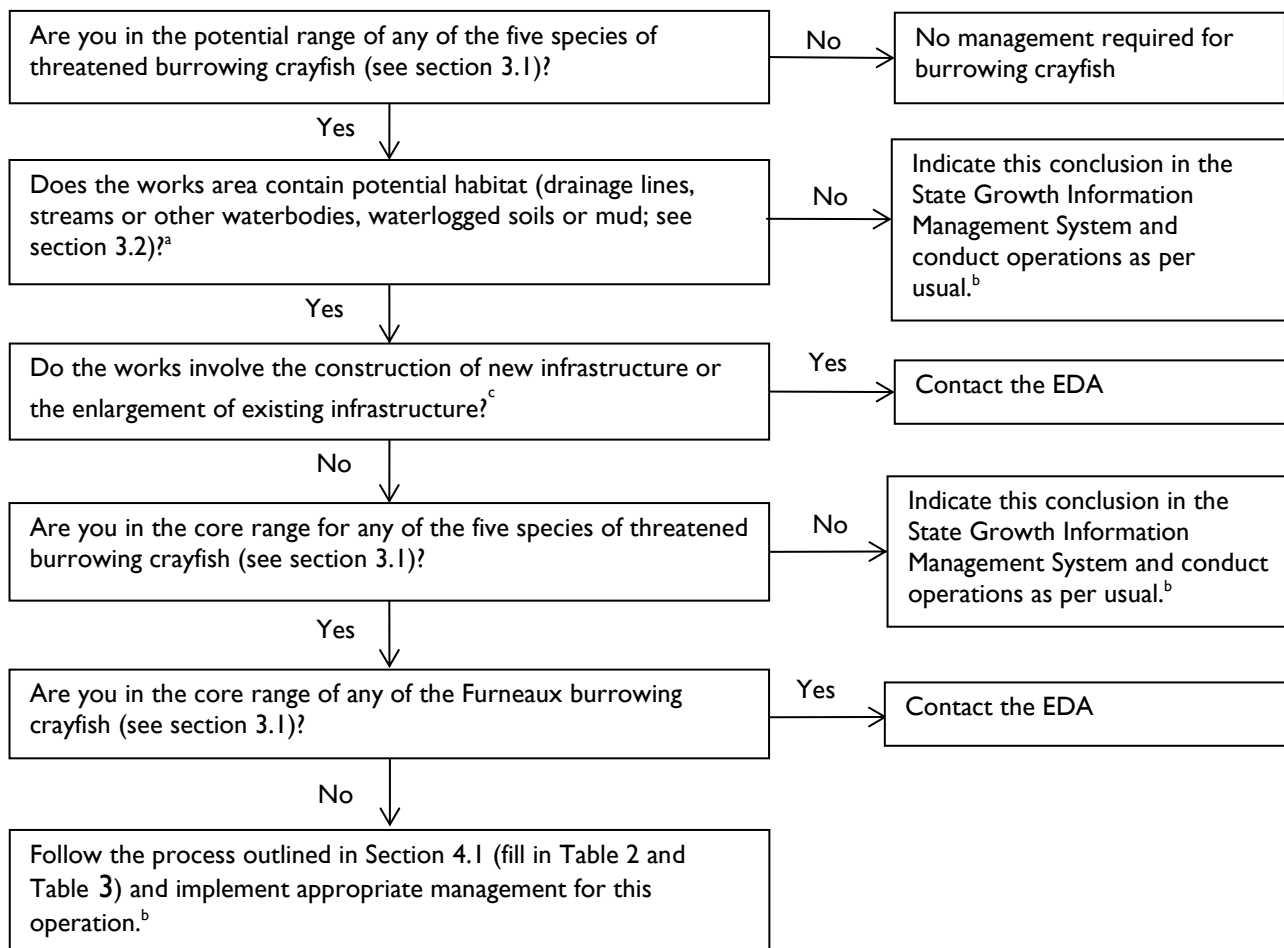


Figure 6. Flow diagram indicating if management for threatened burrowing crayfish is needed. EDA is the Environment and Development Approvals in the Department of State Growth.

^a Only people who have received suitable training should be searching for potential habitat.

^b Operators should be aware of and implement as required the unanticipated finds procedures for threatened burrowing crayfish.

^c Construction activities include road widening, re-alignment, major bridge replacement. If uncertain how to answer this question, contact EDA.

4.1 Determining recommended mitigation responses for maintenance activities conducted within the core range of threatened burrowing crayfish

If Figure 6 has directed the reader to Section 4.1, follow steps 1-5 below.

1. Assess the potential impacts of the operation on threatened burrowing crayfish: Answer each of the questions in Table 2 by marking a tick in either the 'yes' or 'no' column (as appropriate).
2. Fill in the 'Required' column of Table 3: In the 'Required' column of Table 3, make a tick next to each Code for which you have marked 'yes' in Table 2. Highlight each row that has a tick in the 'Required' column.
3. Fill in the 'Overall' row of Table 3: For all cells in the 'mitigation response required' section, place an 'X' if there is an 'X' in any of the highlighted rows above.
4. Determine the recommended mitigation response: The mitigation responses marked in the 'Overall' row indicate the management action recommended for this operation. For each of these mitigation responses, refer to the relevant heading in Section 4.2 for details on how to implement this action. If the actions cannot be implemented as stated, contact the Environment and Development Approvals in the Department of State Growth for advice.
5. Implement and report on mitigation response adopted: The outcome of the decision making process and mitigation responses adopted should be recorded in the Department of State Growth Information Management System (which allows the Department of State Growth to monitor and report on mitigation strategies implemented). If the Information Management System is not available then a report should be provided to the Environment and Development Approvals within 1 month of the operation finishing (see page 33). This information recording is critical for monitoring purposes.

Table 2. Impact of operation.

This table should be used to determine the impacts that a particular operation may have on threatened burrowing crayfish. Answer each of the questions by putting a tick in either the 'yes' or the 'no' column. If unsure how to answer the question, contact the Environment and Development Approvals at the Department of State Growth. Some questions require further clarification (for example is the excavation shallow or deep), in these cases if you indicate 'yes' for the broader question all rows relating to the overarching question should be filled by filled out.

Question	Examples	Code	Yes	No
Does the operation involve excavation?	<ul style="list-style-type: none"> • Earthworks and foundations • Maintenance of pipelines and related structures • Clearance of waterways, culverts and drains 	A		
1. Shallow (≤ 30 cm)		A1		
2. Deep (> 30 cm)		A2		
Does the operation involve soil compaction in an area of potential habitat?	<ul style="list-style-type: none"> • Presence of heavy machinery or equipment on potential habitat 	B		
1. Light (affects top 15 cm)	<ul style="list-style-type: none"> • Unloaded car or ute, truck up to 3 tonne 	B1		
2. Heavy (affects > 15 cm deep)	<ul style="list-style-type: none"> • Excavator, vehicle loaded with heavy equipment or material 	B2		
Does the operation involve deposition of material at the site, including soil, gravel, and material excavated from the site?	<ul style="list-style-type: none"> • Earthworks and foundations 	C		
1. Does the material to be deposited consist only of material excavated from an area of potential habitat?	<ul style="list-style-type: none"> • Clearance of waterways, culverts and drains 	C1		
2. Does the material to be deposited consist of material other than that excavated from an area of potential habitat?	<ul style="list-style-type: none"> • Maintenance of pipelines and related structures 	C2		
Might the operation affect drainage patterns?	<ul style="list-style-type: none"> • Drainage clearing • Maintenance of subsoil drains, or open drains and channels 	D		
1. Minimal	<ul style="list-style-type: none"> • Clearance of previously existing drain 	D1		
2. Significant	<ul style="list-style-type: none"> • Creation of new drainage lines or diversion of water from existing drainage lines • Creation of impermeable drain lining (for example concreting existing drain) 	D2		
Might the operation affect soil water levels?	<ul style="list-style-type: none"> • Some drainage or piping works, major earthworks 	D2		
Might the operation result in large increases in sediments in the water for more than 2 days?	<ul style="list-style-type: none"> • Major excavation works 	E		
Does the operation involve the application of chemicals that may enter areas of potential habitat or waterways?	<ul style="list-style-type: none"> • Weed spraying • Cleaning and painting bridges 	E		
Does the operation involve the physical clearance of vegetation?	<ul style="list-style-type: none"> • Road verge maintenance, installation of new infrastructure 	F		
1. Removal of above-ground vegetation with no disturbance to the soil	<ul style="list-style-type: none"> • Slashing, mowing, cutting trees down 	F1		
2. Vegetation removal that will result in soil disturbance	<ul style="list-style-type: none"> • Pulling out trees with their roots, scraping the soil to remove weeds 	F2		

Table 3. Mitigation response

This table provides a summary of the potential impacts that may occur during road maintenance operations, and an overview of the mitigation responses required to ameliorate that impact. This table should be used in conjunction with Table 2. The mitigation responses are identified below, and greater detail on how these mitigation responses should be implemented is provided in Section 4.2. If the advice provided in this document conflicts with any other legislative requirements (for example safety) contact EDA for advice. All operators should be aware of and implement as required the unanticipated finds procedures for threatened burrowing crayfish.

MR1.	Requires crayfish survey prior to works commencing	Page 18
MR2.	Requires crayfish survey after completion of works	Page 19
MR3.	Restrictions to timing of activity	Page 19
MR4.	Trained person required on-site during operations to search for and translocate individuals found	Page 20
MR5.	Trained person required on-site to guide works	Page 21
MR6.	Minimise sediment and chemical contamination	Page 21
MR7.	Requires monitoring of water table	Page 22
MR8.	This work may require specialist advice	Page 22
MR9.	Contact the State Growth Environment and Development Approvals	Page 22
MR10.	Miscellaneous further strategies	Page 22

Code	Required	Activity/impact	Mitigation response (MR) required										
			1	2	3	4	5	6	7	8	9	10	
A1		Shallow excavation (≤ 30 cm)	X	X	X	X		X					X
A2		Deep excavation (>30 cm)	X	X	X	X	X	X			X	X	X
B1		Light soil compaction	X	X	X								
B2		Heavy soil compaction	X	X	X		X				X	X	X
C1		Deposition of material from area of potential habitat	X	X		X	X						
C2		Deposition of other materials	X	X			X	X					
D1		Some but minimal alteration to drainage patterns ^a	X	X									
D2		Significant alteration to drainage patterns	X	X			X	X	X	X	X		
E		Impact on water quality	X	X				X				X	
F1		Above-ground vegetation clearing											
F2		Vegetation clearing with soil disturbance	X	X						X			X
		OVERALL											

^a An example of an activity that has some but minimal alteration to drainage patterns is where the existing drainage line is modified by excavating a shallow channel along a pre-existing drainage line. If uncertain about whether proposed works would be considered to have minimal impact on drainage patterns, contact the Environment and Development Approvals.

4.2 Details of how to conduct the mitigation activities

Provided below is greater guidance on how the mitigation strategies should be implemented. It is intended that this information is used by someone who has received training from State Growth Environment and Development Approvals on burrowing crayfish ecology and management. If the reader has any uncertainty about the intent or how to apply these guidelines, or if they are unable to apply the guidelines as stated, then the Environment and Development Approvals at the Department of State Growth should be contacted. A record of the decision-pathway to reach the recommended mitigation response, and the outcomes of the management actions should be recorded in the Information Management System or provided as a report to the Environment and Development Approvals (see page 33). EDA will use this information to provide DPIPWVE with an annual report on activities conducted and the results of crayfish surveys, as per the permit requirements.

MRI Requires crayfish survey prior to works commencing

Surveys for crayfish burrows conducted before the works will help guide management of the works. When combined with post-works surveys, crayfish burrow surveys will provide important information on the effectiveness of management strategies, facilitating adaptive management and continual improvement. Surveys should be conducted by a person who has received training from a crayfish expert (for example training facilitated by the State Growth Environment and Development Approvals) or has relevant ecological expertise. Surveys can be done in any season, but are best done in spring or autumn. Where possible surveys should be avoided during very dry conditions as it can be difficult to identify potential habitat and crayfish burrows. Surveys should also be avoided during very wet conditions as areas of suitable habitat can be inundated with water and crayfish burrows can be missed. Surveys should be done no more than 1 year before the operation commences.

Surveys for burrowing crayfish should focus on the presence and abundance of burrows. Any burrow found within the core range of a species of threatened burrowing crayfish should be assumed to be a burrow of that threatened species (taking a precautionary approach to these listed species).

The following approach should be used when conducting crayfish burrow surveys.

- a) Conduct a survey for potential habitat within the area of impact. Potential habitat is “any poorly-drained habitats such as streams (of any class [order] and disturbance history), seepages (e.g. springs in forest or pasture, outflows of farm dams), low-lying flat swampy areas and vegetation (e.g. buttongrass and heathy plains, marshy areas, boggy areas of pasture), drainage depressions, ditches (artificial and natural, including roadside ditches, pasture drains, etc.)” except for the Furneaux burrowing crayfish for which potential habitat is defined as “boggy areas and small clear water creeks in high altitude wet ferny gullies. These areas appear to be the stronghold of the species, although recent survey work has also located populations at lower altitudes and in a poorly-drained mossy tea-tree bog and a small grassy spring/soak in open dry eucalypt forest”. Further details on identifying potential habitat are provided in Section 3.2.
- b) GPS or map the extent of potential habitat within the area of impact.
- c) Visually search all areas of potential habitat for the presence of burrows. Care should be taken to look for burrows under draping vegetation, or hidden by logs or other debris (heavy gloves can be useful when doing crayfish surveys). Examples of the range of burrows that may be observed can be found in Section 6. Consider taking photographs of any potential habitat found as a record of the survey, to facilitate monitoring and auditing.
- d) Counts of crayfish burrow density should be done in areas of potential habitat. For example, counts can be recorded for five metre lengths of linear habitat (for example drainage line). A record should be made of whether there was any evidence of fresh diggings at the entrance of the burrow.

- e) The information on potential habitat and burrows found should be recorded in the State Growth Information Management System within one month of the survey being completed, along with details of how the impacts have been mitigated. The activity should avoid, as much as possible, areas of potential habitat and areas where burrows have been located.

MR2 Requires crayfish survey after completion of works

When surveys for crayfish burrows are done both before and after the works, they will provide important information on the effectiveness of management strategies, facilitating adaptive management and continual improvement. For some operations of lower perceived impact, only a single survey is required within 12 months of the works being completed. For operations of higher impact, a greater degree of population monitoring is required.

Post-works surveys should be conducted by a person who has received training from the State Growth Environment and Development Approvals on crayfish ecology and management, or who has received similar training or has relevant ecological expertise. The steps required to do this are outlined below.

- a) Survey the area for crayfish burrows prior to the works commencing, as outlined in Section 0.
- b) When a survey for crayfish burrows is required after completion of works - excluding those that involve deep excavation, heavy soil compaction, significant alteration to drainage patterns or vegetation clearing with soil disturbance – a post-works survey should be done within 12 months after the operation has been completed. For works that involve deep excavation, heavy soil compaction or significant alteration to drainage patterns, the surveys should be done at approximately 1 month (or after rain), six months and 12 months after the impact has occurred. For works that involve vegetation clearing, only a single post-works crayfish burrow survey is required unless the area of vegetation to be cleared contains shrubs and/or trees and is larger than 5m², in which case the series of three post-works surveys is required. Ideally, all surveys should be done by the same observer.
- c) A brief report on the monitoring results should be provided to State Growth EDA. This report should detail (a) the type of operation that has occurred, (b) the area of potential habitat that was impacted, (c) the number and locality of crayfish burrows observed prior to disturbance, including an indication of how many showed signs of fresh burrowing, (d) similar results for the three survey periods after disturbance, (e) a conclusion about the severity of the impact of the proposed operation on the species, based on the change in the number of burrows observed and any trends in the number of 'active' burrows observed over time. This information can be provided via the State Growth Information Management System, or a separate report can be provided to State Growth Environment and Development Approvals.

MR 3 Restrictions to timing of activity

1.1.1.1 Works that involve excavation

- Should be avoided during hot weather (i.e. summer). These works should be conducted when the weather is relatively dry so crayfish are deeper in their burrows, but not so dry that the burrows are at risk of drying out. The best time to do these works is between April and November. If the works involve only shallow excavation (<30 cm) and a thorough survey has been conducted but no burrows are located, then there is no restriction on the timing of the activity.

1.1.1.2 Works that involve compaction

- Should be conducted between November and April because dry soils compact less than wet soils. However, soil types differ in how prone they are to compaction. If the works need to be done outside of summer, contact EDA for guidance on whether the soil types in the area can withstand compaction.

If works cannot be done within these time periods, contact the Environment and Development Approvals at State Growth for advice.

MR 4 Trained person required on-site to search for and translocate individuals found

A 'trained person' is someone who has received training from the State Growth Environment and Development Approvals on crayfish ecology and management, or who has received similar training or has relevant ecological expertise. A trained person should be on-site when relevant activities are being conducted. The trained person should search the soil spoils and translocate any individuals found.

1. Upon discovery, all reasonable effort must be made to safely excavate/remove the threatened species from within the works footprint. Excavation and handling of crayfish is to be undertaken by, or under the direct supervision of, a trained person.
2. Each crayfish is to be examined for damage. Loss of claws, legs or damage to the tail fan is not critical as the animals can regenerate these, but crushing damage to the carapace (front section of the exoskeleton/shell) or tail is likely to be fatal.
3. If the works activity is of a nature whereby crayfish can be immediately returned/released *in situ* (as impacts have passed or ceased) or in nearby habitat, then return animals as close to the point of capture as possible in one of the following ways:
 - place tail first in an existing burrow opening (try to select a burrow without signs of recent digging); or
 - create an artificial burrow (a hole at least 15 cm deep, with water at the bottom, created using a crowbar or similar) then release the animal into the hole tail first.
4. If the crayfish can't be released immediately and needs to be held for a period, check to ensure the animal has no life threatening injuries (see above), then wash off any dirt by rinsing in clean water (use water from the site or dechlorinated potable water). Place the animal in a clean container with about 10 mm depth of clean water (plastic takeaway containers are ideal). Each container should contain one animal but if it becomes necessary to store more than one in a container they should be separated by a wall of clean vegetation. Containers must be placed with a little ice in an insulated cooler and held onsite. If works are completed within the same day, animals can be returned/released on completion of works to suitable habitat at or as close to their site of excavation as possible. Each animal should be released into an existing or newly created artificially burrow as outlined above.
5. If works are not completed within the same day, the containers with the animals are to be held with a small amount of ice in an insulated cooler. The aim is just to keep the animals cool and care should be taken not to freeze them. They can then be returned to the site and released (in the manner described above) when the works are completed. Refer to Step 3.
6. Excavated animals that have been compromised and/or have injuries from which they are unlikely to recover (for example injury to head or thorax) are to be euthanized (note that injuries to claws, limbs and the fan of the tail are not an issue). Ideally this is done by placing any animal in a separate container, put on plenty of ice in an insulated cooler, or placed in a refrigerator, for 2 hours to chill them into immobility. Animals can then be euthanized in the freezer compartment of a refrigerator or in an ice slurry for 30 minutes. If this approach is not possible, then an alternative method that results in a quick and painless death should be used.
7. If more than five animals are killed during the operation, contact the State Growth EDA as soon as possible to notify them of the impact of the operation. A request may be made to send the animals to the Queen Victoria Museum for future research opportunities. Animals to be transported to the museum should be kept frozen or placed in methylated spirits.

8. Whether the crayfish is released unharmed or preserved, details of the number of animals translocated or killed and details on how the translocation was done, need to be provided to EDA, ideally via the Information Management System but if this is not available then via the form provided on page 33.
9. Monitoring of the translocated burrows needs to be done approximately 12 months after translocation and the results provided to EDA.

MR 5 Trained person required on-site to guide works

A 'trained person' is someone who has received training from the State Growth Environment and Development Approvals on crayfish ecology and management, or who has received similar training or has relevant ecological expertise. A trained person should be on-site when relevant activities are being conducted. However, if the trained person has clearly identified areas of potential and important habitat at the site, appropriate management of these areas has been incorporated into the management plan for the works and the trained person is confident they will be implemented appropriately, then the trained person does not have to be on site while the works are being conducted.

1.1.1.1.3 Significant alteration to drainage patterns

- If the works involve substantial alteration of drainage patterns, then advice should be sought from an ecological or hydrological consultant to determine how the impact of the works on the crayfish could be minimised. A person who has received training from the State Growth Environment and Development Approvals on crayfish ecology and management, or who has received similar training or has relevant ecological expertise, should be on-site when relevant activities are being conducted to ensure this specialist advice is implemented correctly.

1.1.1.1.4 Deposition of materials

- If material to be deposited is the sediment excavated from an area of potential habitat, the sediment should be left adjacent to the area of potential habitat for at least a one week period. This will help allow any animals that were not found to make their way back into an area of suitable habitat. After this time the excavated sediment can be moved off-site.
- Works involving deposition of other material should avoid depositing material onto existing crayfish habitat. If deposition onto an area of potential habitat cannot be avoided, the deposited material should be less than 10–20 cm deep. Material that can be deposited includes topsoil, subsoil, vegetation, fine sands, and rocks that have gaps of 2–3 cm between them (to fit crayfish). Deposition of gravel and fluid sediments should be avoided. If deposition of gravel or fluid sediment onto existing habitat is required, EDA need to be contacted for advice. If deposition of material cannot meet these requirements then a trained person should be on-site to guide works such that impacts on the crayfish are minimised. If the work will involve deposition of material more than 50 cm deep for more than 2 days then EDA must be contacted for advice.

1.1.1.1.5 All other operations that require this mitigation strategy

- A trained person should be on-site when relevant activities are being conducted to guide the operation and ensure that any impacts on crayfish are minimised.

MR 6 Minimise sediment and chemical contamination

All works should minimise sediment and chemical contamination. Where possible, slashing or mechanical removal of vegetation should be used in preference to spraying chemicals. Works that will result in a high level of sediments entering the water system should preferably be done in drier weather. Works using chemicals should only use chemicals approved for use near waterways, should be used as indicated in the instructions for that chemical, and ideally should be used in drier weather when chemicals will be slow to enter the water system.

Glyphosate has low toxicity to crustaceans and so should be selected if a range of chemicals are available. If uncertain about whether a particular chemical can be used near waterways, contact State Growth EDA.

Any oil or chemicals spills from machinery must be dealt with immediately, contained and removed from the site. State Growth EDA and the Policy and Conservation Assessment Branch of DPIPWVE must be advised of any such incidents if they occur. Contact: ConservationAssessments@dipwve.tas.gov.au and/or phone 03 6165 4381.

MR 7 Requires monitoring of water table

Some works may impact the hydrology of the area and so the water table will need to be monitored to assess any unintended impacts. This monitoring may need specialist input, so contact the Environment and Development Approvals at State Growth for further guidance.

Works involving vegetation clearing

- Works involving vegetation clearing will only require monitoring of the water table if areas of forest are harvested. A forest is defined as an area containing trees at least 0.1 ha in size.

MR 8 This work will require specialist advice

This activity will require specialist input beyond the training provided by the Environment and Development Approvals. Advice on the project will need to be sought from a consultant with relevant experience (for example a hydrologist or crayfish specialist). If uncertain about a suitable consultant, contact the Environment and Development Approvals for advice.

Significant alteration to drainage patterns

- If the works involve substantial alteration of drainage patterns, then advice should be sought from an ecological or hydrological consultant to determine how the impact of the works on the crayfish could be minimised.

MR 9 Contact State Growth Environment and Development Approvals

The Environment and Development Approvals at the Department of State Growth need to be contacted for further guidance on how to conduct this operation. Staff at EDA will liaise with threatened species specialists to negotiate a suitable management strategy. Potential advice from EDA may be:

- no additional actions are required;
- the works may require a special permit (for example under the EPBC Act or the TSP Act);
- non-standard specialist advice is required (a species expert or a hydrologist may need to provide advice);
- an offset may be required;
- further monitoring of the population or water table may be required.

MR 10 Miscellaneous further strategies

Excavations

- If areas of potential habitat are to be excavated and the excavated material is soft and wet (for example silt), the sediment that is removed should be left adjacent to the area of potential habitat for about a one week period. This will help allow any animals that were not found to make their way back into an area of suitable habitat. After this time the excavated sediment can be moved off-site. If the excavated material is firm and rigid (for example clay), the animals are unlikely to move out of the excavated material so after the material has been searched for crayfish the material can be taken off-site.

- If the work involves excavation depths >30 cm and operational requirements mean these excavation depths are necessary, then surveys of burrow depth and water table depth may be needed to establish whether works will leave enough burrow undisturbed for animals to survive. Advice will need to be sought from a suitably qualified ecological consultant.

Soil compaction

- Machinery, equipment and materials are not to be stored on sites known or likely to support the threatened crayfish species.

Vegetation clearing

- Where vegetation clearing must occur, slashing is preferred to the use of herbicides. If herbicides must be used, then they must be applied in the way indicated by the application guidelines. For further details on chemical application requirements see <http://dpiwve.tas.gov.au/agriculture/agvet-chemicals/licences-and-certificates/ground-spraying-and-pest-management-licences>.

5 References

Commonwealth of Australia 2011, *Draft referral guidelines for four threatened Tasmanian burrowing crayfish: Burnie burrowing crayfish (vulnerable), Central North burrowing crayfish (endangered), Mount Arthur burrowing crayfish (vulnerable), Scottsdale burrowing crayfish (endangered)*, Commonwealth of Australia, ACT.

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Doran, NE, and Richards, K 1996, *Management Requirements for Rare and Threatened Burrowing Crayfish in Tasmania*, Report to the Tasmanian RFA. Environment and Heritage Technical Committee, Hobart.

FPA and DPIWVE 2011, *Review of Threatened Fauna Adviser: Background Document 2, Review of Information on Species, Draft Decision Pathways and Recommended Actions*, Forest Practices Authority, Hobart.

6 Appendix I: Photos of crayfish burrows



Figure 7. Examples of the types of burrowing crayfish burrows that can occur.



Figure 8. Further examples of the types of burrowing crayfish burrows that can occur.

7 Appendix 2: Worked example of determining management recommendations

Scenario

Some drainage clearing is being proposed within the range of the Central North burrowing crayfish. The work will result in shallow excavation of a pre-existing drainage line. There is only occasional flow in the drainage line and the work is planned for dry weather. This is expected to result in a negligible to short-term increase in sediment levels in the water table.

Following the flow diagram on page 14, it is clear that this work is classified as a maintenance activity, contains potential habitat and is in the known range of a listed species. The impact of operation table is reproduced below.

Table 4. Impact of operation.

This table should be used to determine the impacts that a particular operation may have on threatened burrowing crayfish. Answer each of the questions by putting a tick in either the 'yes' or the 'no' column. If unsure how to answer the question, contact the Environment and Development Approvals at the Department of State Growth. Some questions require further clarification (for example is the excavation shallow or deep), in these cases all rows should be filled out if you indicate 'yes' for the broader question.

Question	Examples	Code	Yes	No
Does the operation involve excavation?	<ul style="list-style-type: none"> Earthworks and foundations Maintenance of pipelines and related structures Clearance of waterways, culverts and drains 	A	√	
1. Shallow (≤30 cm)		A1	√	
2. Deep (>30 cm)		A2		
Does the operation involve soil compaction in an area of potential habitat?	<ul style="list-style-type: none"> Presence of heavy machinery or equipment on potential habitat 	B		√
1. Light (affects top 15 cm)	<ul style="list-style-type: none"> Unloaded car or ute, truck up to 3 tonne. 	B1		
2. Heavy (affects >15 cm deep)	<ul style="list-style-type: none"> Excavator, vehicle loaded with heavy equipment or material 	B2		
Does the operation involve deposition of material at the site, including soil, gravel, and material excavated from the site?	<ul style="list-style-type: none"> Earthworks and foundations 	C	√	
1. Does the material to be deposited consist only of material excavated from an area of potential habitat?	<ul style="list-style-type: none"> Clearance of waterways, culverts and drains 	C1	√	

Question	Examples	Code	Yes	No
2. Does the material to be deposited consist of material other than that excavated from an area of potential habitat?	<ul style="list-style-type: none"> Maintenance of pipelines and related structures 	C2		√
Might the operation affect drainage patterns?	<ul style="list-style-type: none"> Drainage clearing Maintenance of subsoil drains, or open drains and channels 	D	√	
1. Minimal	<ul style="list-style-type: none"> Clearance of previously existing drain 	D1	√	
2. Significant	<ul style="list-style-type: none"> Creation of new drainage lines or diversion of water from existing drainage lines 	D2		√
Might the operation affect soil water levels?	<ul style="list-style-type: none"> Some drainage or piping works, major earthworks 	D2		√
Might the operation result in large increases in sediments in the water for more than 2 days?	<ul style="list-style-type: none"> Major excavation works 	E		√
Does the operation involve the application of chemicals that may enter areas of potential habitat or waterways?	<ul style="list-style-type: none"> Weed spraying Cleaning and painting bridges 	E		√
Does the operation involve the physical clearance of vegetation?	<ul style="list-style-type: none"> Road verge maintenance, installation of new infrastructure 	F		√
1. Removal of above-ground vegetation with no disturbance to the soil	<ul style="list-style-type: none"> Slashing, mowing, cutting trees down 	F1		
2. Vegetation removal that will result in soil disturbance	<ul style="list-style-type: none"> Pulling out trees with their roots, scraping the soil to remove weeds 	F2		

The proposed works only require shallow excavation (<30 cm) and will be done with an excavator so no soil compaction is expected. The area to be cleared is currently a drainage line, so there will be no vegetation clearing with the proposed works.

The results of the mitigation response table are provided below.

MR1.	Requires crayfish survey prior to works commencing	Page 18
MR2.	Requires crayfish survey after completion of works	Page 19
MR3.	Restrictions to timing of activity	Page 19
MR4.	Trained person required on-site during operations to search for and translocate individuals found	Page 20
MR5.	Trained person required on-site to guide works	Page 21
MR6.	Minimise sediment and chemical contamination	Page 21
MR7.	Requires monitoring of water table	Page 22
MR8.	This work may require specialist advice	Page 22
MR9.	Contact the State Growth Environment and Development Approvals	Page 22
MR10.	Miscellaneous further strategies	Page 22

Code	Required	Activity/impact	Mitigation response (MR) required										
			1	2	3	4	5	6	7	8	9	10	
A1	X	Shallow excavation (≤ 30 cm)	X	X	X	X		X					X
A2		Deep excavation (>30 cm)	X	X	X	X	X	X		X	X	X	X
B1		Light soil compaction	X	X	X								
B2		Heavy soil compaction	X	X	X		X			X	X	X	
C1	X	Deposition of material from area of potential habitat	X	X		X	X						
C2		Deposition of other materials	X	X			X	X					
D1	X	Some but minimal alteration to drainage patterns ^a	X	X									
D2		Significant alteration to drainage patterns	X	X			X	X	X	X	X	X	
E		Impact on water quality	X	X				X				X	
F1		Above-ground vegetation clearing											
F2		Vegetation clearing with soil disturbance	X	X					X				X
		OVERALL	X	X	X	X	X	X					X

^a An example of an activity that has some but minimal alteration to drainage patterns is where the existing drainage line is modified by excavating a shallow channel along a pre-existing drainage line. If uncertain about whether proposed works would be considered to have minimal impact on drainage patterns, contact the Environment and Development Approvals.

Conclusion

The mitigation strategies required for this work are:

- Conduct a survey for burrows prior to works commencing and 12 months after completion.
- Conduct the works in autumn or spring to minimise impacts from excavation. If this cannot be achieved contact the Environment and Development Approvals.
- A trained person will be required on-site to search through the excavated material and guide works.
- Minimise the sediment and chemical contamination.
- If the excavated material is soft and wet it should be deposited adjacent to the area of potential habitat for one week before being removed. Material should not be deposited within drainage lines.

If these procedures are followed, then they meet the legislative requirements for the species and the works can proceed. If these procedures are not followed, then the legislative requirements may not be met and EDA should be contacted for advice.

8 Guidelines for State Growth employees when providing advice on burrowing crayfish management

The current document has been produced for practitioners who are conducting maintenance activities in the Department of State Growth roadside reserve. In a number of sections in this document practitioners are directed to discuss the operation with the State Growth Environment and Development Approvals (EDA). Outlined below are the actions that will be undertaken by EDA as part of the permit requirements.

- When this planning tool directs the planner to seek advice from EDA, EDA will request advice from the Threatened Species and Marine Section of DPIPWE and/or a species expert. Some works may require the application of a separate permit.
- EDA will notify DPIPWE if more than 50 individuals of any one species are impacted over a 12 month period.
- EDA will provide an annual report to DPIPWE, outlining the number of works that have been done in areas containing potential habitat for a species of threatened burrowing crayfish, and the number of individuals that were impacted during the operation. EDA will also report on any before and after monitoring of crayfish burrows in the operation areas, to help assess the impacts of the operations on burrowing crayfish.
- EDA will ensure that suitable training is provided to people conducting surveys for habitat and burrows of threatened burrowing crayfish. Crayfish specialists will be employed to assist with these training programs to ensure a high level of competence is achieved.

STATE GROWTH BURROWING CRAYFISH REPORTING FORM

NameDate
Project name.....
Location.....Link.....Chain.....
Operation type.....
TRIM number for this project.....

This form is to be used to report on surveys for and management of potential habitat for threatened burrowing crayfish. In most instances the information requested in this form should be reported in the Information Management System of the Department of State Growth. However, due to the importance of reporting on this information, the current form has been established in case the standard reporting system is not available. Only the relevant sections of this form need to be filled in. Once complete, this form should be sent to the Environment and Development Approvals Unit at the Department of State Growth.

Potential habitat survey

Date: _____ Surveyor: _____

Potential habitat identified: Yes/No

If yes, provide GPS coordinates and a shapefile / map of the extent of the area of potential habitat:

Describe the condition of the areas of potential habitat: _____

Crayfish burrow survey

Date: _____ Surveyor: _____

Was this survey done before or after the operation? Before / After

If after, how many weeks after the operation was complete? _____ weeks

Were crayfish burrows observed: Yes/No

Provide details of the crayfish burrow densities (i.e. indicate the number of burrows located in a unit area. For example the number located in every 5 m length of drainage channel). Indicate if there were signs of fresh diggings or not _____

Management of operation

Date: _____ Name of trained person directing operation: _____

What actions were taken to minimise the impact of this operation on threatened burrowing crayfish? _____

Were any burrowing crayfish located during the operation? Yes / No

If yes, how many? _____

If burrowing crayfish were located, what was done with the animals found?

Once this form has been completed, it should be sent to the Environment and Development Approvals Unit at the Department of State Growth.

Disclaimer

This report has been prepared by the Forest Practices Authority and the Crown as represented by the Department of State Growth. Expert advice on species ecology was provided by Alastair Richardson, Niall Doran and Mark Wapstra (Ecotas).

The information included in this report is intended as a guide, and should not be used or relied upon as the basis for any commercial, legal or regulatory decisions. Users of this report should seek independent, expert advice from a suitably qualified and experienced professional before they make any decisions or take any action.

Although all due care and attention has been taken in preparing and collating the information to ensure it is correct and accurate as possible, and subject to any limitations of liability, the Crown:

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Cover images courtesy of Dave Watts, Phil Bell and Selena Dixon.

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