

## 5. Aquatic results

### 5.1 Desktop results

#### **Commonwealth Environment Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool**

Aquatic Matters of National Environmental Significance (NES) listed under the EPBC Act previously identified from waterways in or adjacent to the study area were investigated using the Protected Matters Search Tool (PMST) (Aust Govt, 2014). This tool lists species, species habitat, populations and ecological communities that are likely to occur, or may occur within the assessment area. Aquatic Matters of NES identified in the search include one fish species:

- Eastern Dwarf Galaxias, Dwarf Galaxias *Galaxias pusilla* – listed as Vulnerable with habitat likely to occur within or adjacent to the study area.

#### **Victorian DEWLP Data (VBA 2014)**

The VBA was queried for accounts of aquatic flora and fauna species previously recorded as occurring from waterways in or adjacent to the study area. The taxon types included in the search are dicotyledons, monocotyledons, reptiles, fish, mussels, decapod crustacean, and aquatic invertebrates.

The listed threatened species identified from the database search included:

- Eastern Dwarf Galaxias, Dwarf Galaxias *Galaxias pusilla* – FFG Act listed as Threatened, with seven records from waterways in or adjacent to the study area.

### 5.2 Field results

A rapid field assessment of waterways was conducted at 45 locations in and adjacent to the study area. Sites inspected are shown in Figure 10, with a summary of threatened species likelihood and aquatic habitat quality.

#### 5.2.1 Aquatic habitats

Of the 45 sites assessed, ten were considered as moderate condition, and two were considered in good condition (Figure 10). The major factors affecting aquatic habitat quality were absence of water, poor riparian condition and stock access.

Yam Holes Creek and some tributaries at the western and north-western end of the study area contained some of the higher quality aquatic habitat, and this waterway often comprises a chain of pools with better riparian and aquatic habitat condition than other tributaries or streams within the study area. In general, the waterways observed were mostly ephemeral streams that were dry at the time of observation. These included simple drainage lines with a poorly defined channel, small channels running through cleared pasture, and clearly defined waterways within incised channels. Despite the absence of water at the time of observation, these waterways should be considered as potential habitat or dispersal/migration corridors for aquatic species that utilise these ephemeral channels during wetted conditions.

Key geomorphic features of these ephemeral streams are the remnant pools present. These are located typically in deep scour pools at the base of large riparian eucalypt trees. In ephemeral waterways, these scour pools provided the only in-stream water, and are likely to provide refugia for aquatic species, particularly aquatic fauna, during dry periods.

As the majority of waterways were dry during the field assessment, it is difficult to determine the significance of these channels as corridors for the movement of aquatic species during wetted conditions. The ecological significance of remnant pools acting as refugia is dependent on the network of ephemeral streams that permit dispersal during wetted periods. Even poor quality aquatic habitats may provide important passage (i.e. transient habitat) between higher quality habitats for threatened fish species (e.g. Dwarf Galaxids), and therefore the ecological significance of dry streams as aquatic corridors across the ephemeral stream network may be greater than the habitat quality at that site.

Farm dams also provide more permanent aquatic habitats in the study area. Typically, the quality of their habitat is largely dependent on connectivity with stream channel and the level of disturbance from stock access or other uses. In general, the farm dams that are located off- stream are less likely to provide habitat of significant ecological value; whereas dams located on streams are more likely have higher ecological value through their potential to act as refugia for aquatic species.

Photographs of examples of the main aquatic habitats are shown in Table 17.

Table 17 Examples of aquatic habitats within the study area

Habitat	Habitat
<p><b>Remnant pool</b></p> 	<p><b>Swampy Pond</b></p> 
<p><b>Yam Holes Creek cleared floodplain</b></p> 	<p><b>Remnant pool</b></p> 
<p><b>Farm Dam</b></p> 	<p><b>Ephemeral stream through pasture</b></p> 

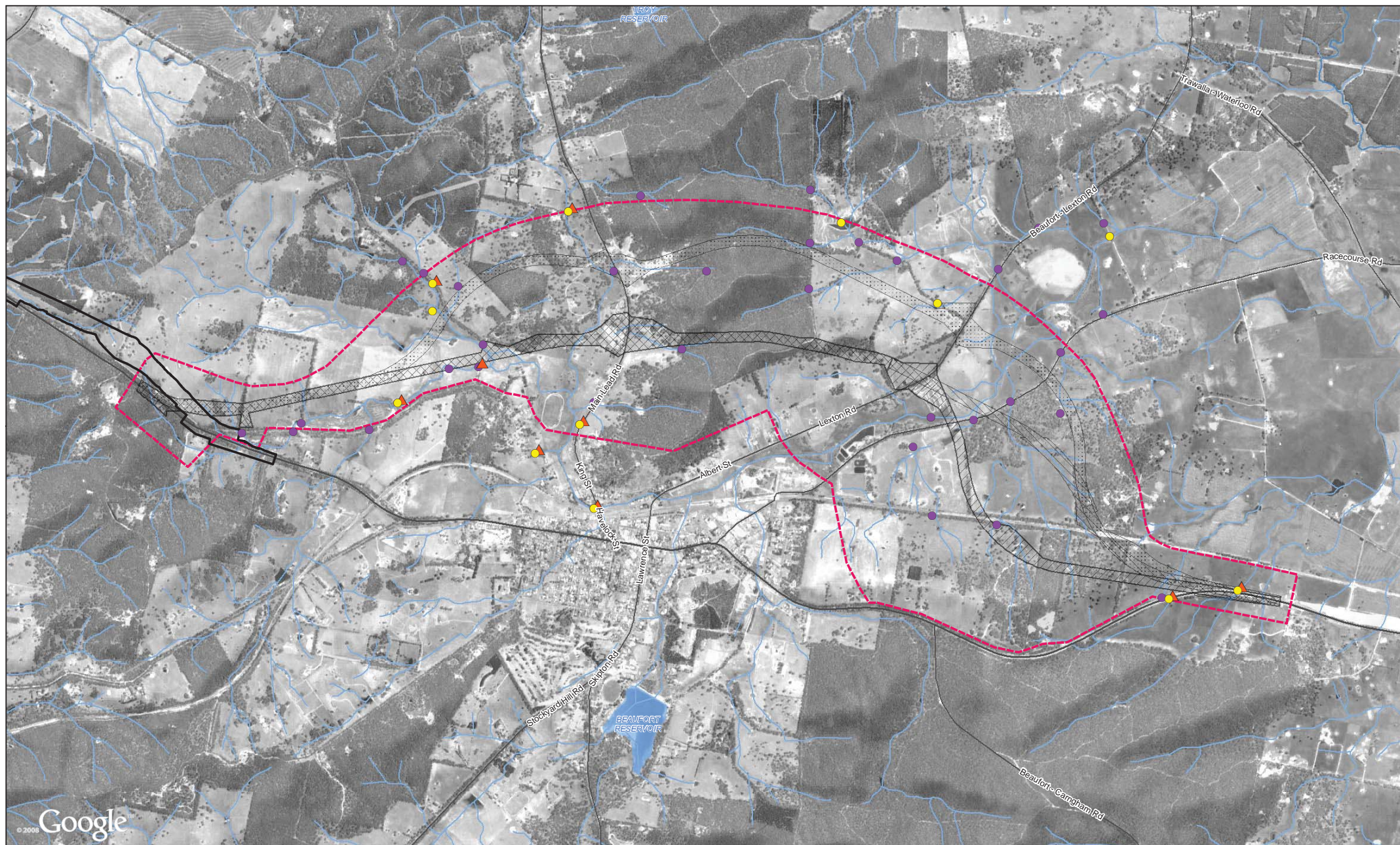
### 5.2.2 Aquatic species of conservation significance

The assessment of the habitat suitability for the listed threatened aquatic species was based on the habitat requirements outlined in the Species Profile and Threats Database (SPRAT) (DoE 2014), and a visual assessment of aquatic habitat condition.

Of the 45 sites assessed, nine sites were considered to possibly contain habitat for threatened aquatic species.

Based on the aquatic habitats observed, it is considered likely that habitat for Dwarf Galaxids occurs within the study area. These small fish are found in small, slow flowing streams in temporary and permanent freshwater habitats. Dwarf Galaxids are known to inhabit wetlands that completely dry up in summer, and rely on seasonal flooding and connectivity to refuge populations for recolonising ephemeral waterways. It is likely that transient habitat, spawning habitat, short term refuge habitat and potentially long term refuge habitat could be present in the study area.







## 6. Impacts and mitigation

An assessment of potential high level impacts associated with the project is provided within Table 18. In the absence of appropriate mitigation measures, this project could result in some or all of the following impacts listed below on ecological values within and surrounding the study area with associated variation in the severity and extent of these impacts. These impacts are based on, but not limited to, listed Key Threatening Processes published by the Commonwealth DoE and Potentially Threatening Processes in accordance with Section 10 of the Victorian *Flora and Fauna Guarantee Act 1988*.

The mitigation measures provided below are intended as a summary of the primary measures that are considered likely to reduce the impact of the project on ecological values. This is not an exhaustive list and more detailed mitigation measures will need to be developed, including specific measures relevant to the final alignment.

It is likely that an Environmental Management Plan (EMP) will be required for the project. If an EMP is required then these measures should be incorporated, along with other environmental protection measures not necessarily related to ecology. The EMP would be implemented before, during and after the construction phase.

At this stage the level of acceptance of the general mitigation measures provided in Table 18 by VicRoads is unknown. It is considered unlikely that all impacts will be avoided though the use of mitigation measures. Resultant impacts post mitigation have been provided. The use of particular mitigation measures is likely to result in the lessening of impacts rather than their complete avoidance. The resultant impacts are based on an assumption that there is likely to be a reduction in the severity of impacts through the use of mitigation measures, but it is recognised that some impacts will be necessary to undertake the project.

Table 18 Impacts and Mitigation

Impacts	Mitigation	Resultant Impacts
Clearance of native vegetation	<p>Select an alignment that minimises native vegetation clearance.</p> <p>Restrict vegetation clearance to that strictly necessary for the project.</p> <p>Utilise areas of non-native vegetation for vehicle and equipment laydown.</p> <p>Where the removal of native vegetation is unavoidable, where possible utilise areas of previously disturbed or poor quality vegetation before impacting undisturbed/high quality vegetation.</p> <p>Fence off native vegetation to be retained as 'no go' areas for the duration of construction.</p>	<p>If mitigation measures are followed there is the potential for minimised clearance of native vegetation.</p>
Clearance of EPBC and FFG Act listed flora threatened vegetation communities	<p>Select an alignment that minimises impacts to areas mapped as potentially containing EPBC Act listed flora communities.</p> <p>Restrict the clearance of threatened vegetation communities to that strictly necessary for the project.</p> <p>Fence off areas classified as threatened vegetation communities to be retained as 'no go' areas for the duration of the construction.</p>	<p>If mitigation measures are followed there is the potential for minimised loss of native vegetation classified as an EPBC Act or FFG Act listed vegetation community.</p>
Clearance of vegetation modelled under DEWLP's Native Vegetation Location Risk mapping	<p>Select an alignment that minimises clearance of native vegetation mapped as Location Risk C and B.</p> <p>Where the removal of native vegetation is unavoidable, where possible utilise areas of native vegetation mapped as Location Risk A before impacting areas mapped as Location Risk C or B.</p> <p>Fence off native vegetation to be retained as 'no go' areas for the duration of construction, particularly areas mapped as Location Risk C and B.</p>	<p>If mitigation measures are followed there is the potential for minimised loss of native vegetation mapped as Location Risk A.</p> <p>If mitigation measures are followed there is the potential for minimised loss of native vegetation mapped as Location Risk C and B.</p>

Impacts	Mitigation	Resultant Impacts
Removal of habitat of listed flora species, potentially including threatened species	<p>Select an alignment that minimises native vegetation clearance.</p> <p>Restrict vegetation clearance to that strictly necessary for the project.</p> <p>Utilise areas of non-native vegetation for vehicle and equipment laydown.</p> <p>Fence off native vegetation to be retained as 'no go' areas for the duration of construction.</p>	If mitigation measures are followed there is the potential for minimised loss of habitat for threatened flora species
Potential spread and/or introduction of weeds and disease	<p>Weed management and hygiene protocols should be incorporated into the Construction Environmental Management Plan (CEMP).</p> <p>Undertake weed control of infestations prior to construction.</p> <p>Washdown stations at strategic locations during construction.</p> <p>Follow-up weed control works at completion of construction.</p>	If mitigation measures are followed there is the potential for reduced spread of weeds, and unlikely introduction of new weeds and/or disease
Removal of habitat for listed fauna species, potentially including threatened species	<p>Select an alignment that minimises fauna habitat loss.</p> <p>Restrict habitat clearance to that strictly necessary for the project.</p> <p>Utilise areas of non-native vegetation that provide poor fauna habitat for vehicle and equipment laydown.</p> <p>Fence off fauna habitat to be retained as 'no go' areas for the duration of construction.</p>	If mitigation measures are followed there is the potential for minimised loss of habitat for threatened fauna species
Severing of wildlife corridors, leading to further isolation and fragmentation of habitats	<p>Avoid major corridors.</p> <p>Minimise gap in corridor.</p> <p>Align the road parallel to a corridor (and offset as far from corridor as possible) rather than removing the corridor habitat.</p> <p>Consider broad habitat culverts where roadway severs watercourse corridors</p> <p>Consider bridges/elevated roads where over woodland wildlife corridors, to allow small fauna to cross beneath.</p>	If mitigation measures are followed there is the potential for minimised impacts to wildlife corridors.



Impacts	Mitigation	Resultant Impacts
Increased risk of fauna road kill in new areas, particularly where road severs movement corridors or runs through or near larger patches of remnant habitat (including grassland).	<p>Consider broad habitat culverts where roadway severs watercourse corridors.</p> <p>Consider bridges/elevated roads where over woodland wildlife corridors, to allow small fauna to cross beneath.</p> <p>Align road to stay well clear of large intact fauna habitat patches.</p>	It is possible to largely reduce this risk if mitigation measures are employed.
Possible disturbance to native fauna during the construction phase (e.g. depart local area due to visual and/or acoustic disturbance);	<p>Select an alignment that minimises fauna habitat loss.</p> <p>Remove fauna from construction footprint prior to construction where practicable (e.g. clearance of hollows).</p> <p>Restrict habitat clearance to that strictly necessary for the project.</p> <p>Utilise areas of non-native vegetation that provide poor fauna habitat for vehicle and equipment laydown.</p> <p>Fence off fauna habitat to be retained as 'no go' areas for the duration of construction.</p>	If mitigation measures are followed there is a largely reduced chance of disturbance to fauna, though some disturbance still likely.
Possible injury to, or death of, ground-dwelling fauna species by earth-moving equipment, vehicles or other activities during the construction process;	<p>Select an alignment that minimises fauna habitat loss.</p> <p>Remove fauna from construction footprint prior to construction where practicable (e.g. clearance of hollows).</p> <p>Restrict habitat clearance to that strictly necessary for the project.</p> <p>Utilise areas of non-native vegetation that provide poor fauna habitat for vehicle and equipment laydown.</p> <p>Fence off fauna habitat to be retained as 'no go' areas for the duration of construction.</p>	Largely reduced chance of injury or death to ground dwelling fauna, though some injury or death may still occur.

Impacts	Mitigation	Resultant Impacts
Loss of aquatic refugia in ephemeral stream network	<p>Select an alignment that avoids high quality refugia pools.</p> <p>Minimise disturbance to dry ephemeral streams and riparian zones during construction and operation.</p> <p>Prevent sedimentation and erosion.</p> <p>Salvage of aquatic fauna from impacted pools.</p> <p>Waterways to be 'no go' areas during construction.</p>	<p>If mitigation measures are followed there is the potential for minimised loss of key source habitat for aquatic fauna dispersal</p> <p>If mitigation measures are followed there is the potential for minimised loss of threatened aquatic species</p>
Loss of connectivity in ephemeral stream network	<p>Minimise number of waterway crossings.</p> <p>Identify and avoid waterways that provide key connectivity function.</p> <p>Waterway crossing design to include fish passage features.</p> <p>Construction and design of waterway crossings should include consideration for fish passage during wet periods to ensure fish dispersal is not inhibited.</p>	<p>If mitigation measures are followed there is the potential for minimised isolation of refuge population of threatened species</p>

## 7. Assessment of options

This options assessment relies primarily on information collected from field surveys conducted by GHD (2014), coupled with information contained within ecological databases, aerial photography and publications.

### 7.1 Project objectives

The overarching project objectives are:

1. Improve freight movement and efficiency;
2. Improve amenity and tourist potential of the township;
3. Improve safety within the township; and
4. To minimise impacts on the biophysical environment, particularly fauna and flora species of state and national significance.

Only project objective number 4 is addressed within this assessment of options.

### 7.2 Sub objectives

To determine the alignment options with the least ecological impact, key ecological values were identified. These were then used to develop sub objectives for the options assessment. The key ecological values identified were:

- Area and condition of native vegetation loss;
- Flora species of conservation significance;
- Fauna species and communities of conservation significance;
- Impacts to aquatic fauna species; and
- Fauna habitat and wildlife corridors – Impacts to a major wildlife corridor and or habitat linkages severed.

#### 7.2.1 Assessment criteria

A number of assessment criteria have been developed for each sub objective in order to support the assessment of the objectives. The following assessment criteria were used:

- Loss (hectares) of native vegetation (EVCs) from each alignment option;
- Loss (hectares) of Endangered conservation status vegetation (EVCs) from each alignment option;
- Loss of Scattered Native Trees from each alignment option;
- Loss (hectares) of native vegetation mapped within DEWLP modelled Location Risk A/B/C;
- Loss (hectares) of native vegetation of varying conditions (Good/Moderate/Poor);
- Area (hectares) of habitat for EPBC Act or FFG Act listed flora species that has a medium or high likelihood of occurrence;
- Area (hectares) of suitable habitat for FFG Act listed vegetation communities of moderate or high vegetation condition;



- Area (hectares) of suitable habitat for EPBC Act listed vegetation communities of moderate or high vegetation condition;
- Area (hectares) of habitat for EPBC Act listed fauna species that has a medium or high likelihood of occurrence;
- Area (hectares) of habitat for FFG Act listed fauna species that has a medium or high likelihood of occurrence;
- Area (hectares) of suitable habitat for FFG Act listed fauna communities of medium or high likelihood of occurrence;
- Number of waterways with habitat for EPBC Act listed aquatic fauna species that have a medium or high likelihood of occurrence;
- Number of waterways with habitat for FFG Act listed aquatic fauna species that have a medium or high likelihood of occurrence;
- Terrestrial – Loss (hectares) of terrestrial corridors or number of patches of fragmentation of existing terrestrial corridors in which threatened fauna have a high likelihood;
- Waterways - Fragmentation of aquatic corridors or creation of a barrier to aquatic corridors; and
- Number of waterway crossings with good or medium habitat quality.

### 7.3 Assessment of alignment options

In order to answer the question “How well does the proposal meet each nominated project objective” each assessment criterion was rated on a scale of Very Poor to Very Well (see Table 19). The defined value for each rating indicates a range from “major negative” impact through to a “major positive” impact. It is not expected that any alignment will have either a “major positive” or a “positive” ecological impact; however, alignments may fall into these categories as they have no to little impact on an ecological value within the study area.

Table 20 displays the rating of each assessment criterion for each alignment option. It is important to note that not all assessment criteria are equal. For example, a “Poor” rating against the “Loss of Endangered conservation status vegetation” assessment criterion does not necessarily equate to a “Poor” rating against the “Loss of native vegetation assessed as being in poor condition” assessment criterion.

Two of the more important categories for comparison are the likelihood of presence of threatened species and communities. However, given the high level nature of the assessment these criteria should be used cautiously as many areas require additional assessment to confirm the presence or absence of listed communities and or threatened species. The most accurate assessment criteria is the “Loss of native vegetation (EVCs) from each alignment” and can help guide alignment selection which will minimise impacts to terrestrial and aquatic ecological values within the study area.

### 7.3.1 Flora rating assessment summary

The most accurate measure for interpreting impacts to flora for each alignment at this stage is the amount of native vegetation within each of the alignment corridors. Alignment option B4-A and B4-B contain similar areas of native vegetation (46 and 48 ha respectively) and option B5 contains significantly less native vegetation (36 ha). The area of loss of native vegetation mapped by DEWLP as Location Risk C (the highest risk rating) is 6 ha for both option B4-A and B4-B and only 3 ha for option B5.

### 7.3.2 Fauna rating assessment summary

The B4-A alignment option potentially impacts on 45 and 76 hectares of habitat that is suitable for EPBC and FFG species respectively. It also potentially impacts on 31 hectares of suitable habitat for the FFG Act listed VTWBC. Alignments B4-A and B4-B rate fairly equally against fauna focused assessment criteria.

The B4-B alignment option potentially impacts on 43 and 78 hectares of habitat that is suitable for EPBC and FFG species respectively. It also potentially impacts on 35 hectares of suitable habitat for the FFG Act listed VTWBC. Alignments B4-A and B4-B rate fairly equally against fauna focused assessment criteria.

While the B5 alignment option potentially impacts on 35 and 62 hectares of habitat that is suitable for EPBC and FFG species respectively. It also potentially impacts on 26 hectares of suitable habitat for the FFG Act listed VTWBC. This alignment impacts on the least amount of threatened fauna species and community habitat of the three alignment options, however it still potentially impacts on large amount of fauna habitat.

### 7.3.3 Aquatic rating assessment summary

Based on the rapid field assessment of selected points within the study area, there is not a clear difference in the likely ecological impact on aquatic ecosystems between the three alignment options being considered, and thus each alignment is likely to require comparable additional aquatic habitat consideration and planning.

All alignments are likely to impact on three aquatic habitats that are considered likely to contain EPBC listed fish species. The number of waterway corridor crossings that could impact on dispersal of these threatened fish is also similar between all alignments, with alignments B4-B having ten waterway crossings and alignments B4-A and B5 each having eleven waterway crossings.

Alignments B4-A and B4-B contained two waterway sites considered likely to contain moderate or good quality aquatic habitat. Alignment B5 contained three moderate or good quality aquatic habitat sites.

Table 19 Assessment Criteria Defined Values

Impact Rating	Very Well	Well	Moderately Well	Poor	Very Poor
Assessment Criteria	Best practice, major positive impact	Improved practice, positive impact	No distinct positive or negative impact	Negative impact	Major negative impact
Loss (hectares) of native vegetation (EVCs) from each alignment option	No measurable impact on the extent of native vegetation	Loss of <20 ha of native vegetation	Loss of 20≥ and <30 ha of native vegetation.	Loss of 30≥ of native vegetation and <40 ha.	Loss of ≥40 ha of native vegetation.
Loss (hectares) of Endangered conservation status vegetation (EVCs) from each alignment option	No loss of an EVC of Endangered conservation status.	Loss of <1 ha of an EVC of Endangered conservation status.	Loss of ≥1 ha and <5 ha of an EVC of Endangered conservation status.	Loss of ≥5 ha and <10 ha of an EVC of Endangered conservation status.	Loss of ≥10 ha of an EVC of Endangered conservation status.
Loss of Scattered Native Trees from each alignment option	No measurable impact on number of scattered trees present	Likely loss of <20 scattered trees.	Likely loss of 20≥ and <40 scattered trees.	Likely loss of ≥40 and <50 scattered trees.	Likely loss of ≥50 scattered trees.
Loss (hectares) of native vegetation mapped within DEWLP modelled Location Risk A	No measurable impact on the extent of native vegetation mapped in Location A	Loss of <20 ha of native vegetation	Loss of 20≥ and <30 ha of native vegetation.	Loss of 30≥ of native vegetation and <40 ha.	Loss of ≥40 ha of native vegetation.
Loss (hectares) of native vegetation mapped within DEWLP modelled Location Risk B	No measurable impact on the extent of native vegetation mapped in Location B	Loss of <0.5 ha of native vegetation mapped as Location B	Loss of ≥0.5 ha and <1 ha of native vegetation mapped as Location B	Loss of ≥1 ha and <5 ha of native vegetation mapped as Location B	Loss of ≥5 ha of native vegetation mapped as Location B
Loss (hectares) of native vegetation mapped within DEWLP modelled Location Risk C	No measurable impact on the extent of native vegetation mapped in Location C	Loss of <1 ha of native vegetation mapped as Location C	Loss of ≥1 ha and <3 ha of native vegetation mapped as Location C	Loss of ≥3 ha and <5 ha of native vegetation mapped as Location C	Loss of ≥5 ha of native vegetation mapped as Location C
Loss (hectares) of native vegetation of varying conditions (Good/Moderate/Poor)	No measurable impact on the extent of native vegetation	Loss of <5 ha of good quality native vegetation; or Loss of <5 ha of moderate quality native vegetation; or Loss of <5 ha of poor quality native vegetation.	Loss of ≥5 ha and <10 ha of good quality native vegetation; or Loss of ≥5 ha and <10 ha of moderate quality native vegetation; or Loss of ≥5 ha and <10 ha of poor quality native vegetation.	Loss of ≥10 ha and <20 ha of good quality native vegetation; or Loss of ≥10 ha and <20 ha of moderate quality native vegetation; or Loss of ≥10 ha and <20 ha of poor quality native vegetation.	Loss of ≥20 ha of good quality native vegetation; or Loss of ≥20 ha moderate quality native vegetation; or Loss of ≥20 ha of poor quality native vegetation.
Area (hectares) of habitat with a medium likelihood of occurrence for FFG or EPBC Act listed flora species.	No detectable impact on habitat for an EPBC or FFG Act listed flora species with a medium likelihood of occurrence	Loss of <5 ha of habitat with a high likelihood of occurrence of an FFG or EPBC Act listed flora species	Loss of ≥5 ha and <10 ha of habitat with a high likelihood of occurrence of an FFG or EPBC Act listed flora species;	Loss of ≥10 ha and <15 ha of habitat with a high likelihood of occurrence of an FFG or EPBC Act listed flora species	Loss of ≥15 ha of habitat with a high likelihood of occurrence of an FFG or EPBC Act listed flora species
Area (hectares) of habitat with a high likelihood of occurrence for FFG or EPBC Act listed flora species.	No detectable impact on habitat for an EPBC or FFG Act listed flora species with a high likelihood of occurrence	Loss of <5 ha of habitat with a medium likelihood of occurrence of an FFG or EPBC Act listed flora species	Loss of ≥5 ha and <10 ha of habitat with a medium likelihood of occurrence of an FFG or EPBC Act listed flora species;	Loss of ≥10 ha and <15 ha of habitat with a medium likelihood of occurrence of an FFG or EPBC Act listed flora species	Loss of ≥15 ha of habitat with a medium likelihood of occurrence of an FFG or EPBC Act listed flora species
Area (hectares) of suitable habitat for FFG Act listed vegetation communities of moderate or high vegetation condition.	No detectable impact on an FFG Act listed community	Loss of <1 ha of habitat potentially suitable for an FFG Act vegetation community of high vegetation condition; or Loss of <1 ha habitat potentially suitable for an FFG Act vegetation community of moderate vegetation condition	Loss of ≥1 ha and <5 ha of habitat potentially suitable for an FFG Act vegetation community of high vegetation condition; or Loss of ≥1 ha and <5 ha of habitat potentially suitable for an FFG Act vegetation community of moderate vegetation condition	Loss of ≥5 ha and <10 ha of habitat potentially suitable for an FFG Act vegetation community of high vegetation condition; or Loss of ≥5 ha and <10 ha of habitat potentially suitable for an FFG Act vegetation community of moderate vegetation condition	Loss of ≥10 ha of habitat potentially suitable for an FFG Act vegetation community of high vegetation condition; or Loss of ≥10 ha of habitat potentially suitable for an FFG Act vegetation community of moderate vegetation condition
Area (hectares) of habitat for EPBC Act listed vegetation communities of moderate or high vegetation condition.	No detectable impact on an EPBC Act listed community	Loss of <1 ha of habitat potentially suitable for an EPBC Act vegetation community of high vegetation condition; or Loss of <5 ha habitat potentially suitable for an EPBC Act vegetation community of moderate vegetation condition	Loss of ≥1 ha and <5 ha of habitat potentially suitable for an EPBC Act vegetation community of high vegetation condition; or Loss of ≥5 ha and <10 ha of habitat potentially suitable for an EPBC Act vegetation community of moderate vegetation condition	Loss of ≥5 ha and <10 ha of habitat potentially suitable for an EPBC Act vegetation community of high vegetation condition; or Loss of ≥10 ha and <20 ha of habitat potentially suitable for an EPBC Act vegetation community of moderate vegetation condition	Loss of ≥10 ha of habitat potentially suitable for an EPBC Act vegetation community of high vegetation condition; or Loss of ≥20 ha of habitat potentially suitable for an EPBC Act vegetation community of moderate vegetation condition



Impact Rating	Very Well	Well	Moderately Well	Poor	Very Poor
Assessment Criteria	Best practice, major positive impact	Improved practice, positive impact	No distinct positive or negative impact	Negative impact	Major negative impact
Area (hectares) of habitat for EPBC Act listed fauna species that has a medium or high likelihood of occurrence.	No detectable impact on an EPBC Act listed fauna species	Loss of <10 ha of habitat with a medium or high likelihood of occurrence of an EPBC Act listed fauna species	Loss of ≥10 ha and <15 ha of habitat with a medium or high likelihood of occurrence of an EPBC Act listed fauna species	Loss of ≥15 ha and <25 ha of habitat with a medium or high likelihood of occurrence of an EPBC Act listed fauna species	Loss of ≥25 ha of habitat with a medium or high likelihood of occurrence of an EPBC Act listed fauna species
Area (hectares) of habitat for FFG Act listed fauna species that has a medium or high likelihood of occurrence.	No detectable impact on a FFG Act listed fauna species	Loss of <10 ha of habitat with a medium or high likelihood of occurrence of an FFG Act listed fauna species	Loss of ≥10 ha and <20 ha of habitat with a medium or high likelihood of occurrence of an FFG Act listed fauna species	Loss of ≥20 ha and <40 ha of habitat with a medium or high likelihood of occurrence of an FFG Act listed fauna species	Loss of ≥40 ha of habitat with a medium or high likelihood of occurrence of an FFG Act listed fauna species
Area (hectares) of habitat for EPBC Act listed fauna species that has a medium or high likelihood of occurrence.	No detectable impact on an EPBC Act listed fauna species	Loss of <20 ha of habitat with a medium or high likelihood of occurrence of an EPBC Act listed fauna species	Loss of ≥20 ha and <30 ha of habitat with a medium or high likelihood of occurrence of an EPBC Act listed fauna species	Loss of ≥30 ha and <40 ha of habitat with a medium or high likelihood of occurrence of an EPBC Act listed fauna species	Loss of ≥40 ha of habitat with a medium or high likelihood of occurrence of an EPBC Act listed fauna species
Area (hectares) of habitat for FFG Act listed fauna species that has a medium or high likelihood of occurrence.	No detectable impact on a FFG Act listed fauna species	Loss of <20 ha of habitat with a medium or high likelihood of occurrence of an FFG Act listed fauna species	Loss of ≥20 ha and <40 ha of habitat with a medium or high likelihood of occurrence of an FFG Act listed fauna species	Loss of ≥40 ha and <60 ha of habitat with a medium or high likelihood of occurrence of an FFG Act listed fauna species	Loss of ≥60 ha of habitat with a medium or high likelihood of occurrence of an FFG Act listed fauna species
Area (hectares) of suitable habitat for FFG Act listed fauna communities of medium or high likelihood of occurrence	No detectable impact on a FFG Act listed fauna community	Loss of <10 ha of habitat with a medium or high likelihood of occurrence of an FFG Act listed fauna community	Loss of ≥10 ha and <20 ha of habitat with a medium or high likelihood of occurrence of an FFG Act listed fauna community	Loss of ≥20 ha and <30 ha of habitat with a medium or high likelihood of occurrence of an FFG Act listed fauna community	Loss of ≥30 ha of habitat with a medium or high likelihood of occurrence of an FFG Act listed fauna community
Number of waterways with habitat for EPBC Act listed aquatic fauna species that has a medium or high likelihood of occurrence.	No detectable impact on an EPBC Act listed aquatic fauna species	Loss of 1 aquatic habitat site with a high or medium likelihood of occurrence of an EPBC Act listed aquatic fauna species.	Loss of 2 aquatic habitat site with a high or medium likelihood of occurrence of an EPBC Act listed aquatic fauna species.	Loss of 3 aquatic habitat site with a high or medium likelihood of occurrence of an EPBC Act listed aquatic fauna species.	Loss of >3 aquatic habitat site with a high or medium likelihood of occurrence of an EPBC Act listed aquatic fauna species.
Number of waterways with habitat for FFG Act listed aquatic fauna species that has a medium or high likelihood of occurrence.	No detectable impact on an FFG Act listed aquatic fauna species	Loss of 1 aquatic habitat site with a high or medium likelihood of occurrence of an FFG Act listed aquatic fauna species	Loss of 2 aquatic habitat site with a high or medium likelihood of occurrence of an FFG Act listed aquatic fauna species	Loss of 3 aquatic habitat site with a high or medium likelihood of occurrence of an FFG Act listed aquatic fauna species	Loss of >3 aquatic habitat site with a high or medium likelihood of occurrence of an FFG Act listed aquatic fauna species
Terrestrial – Loss (hectares) of terrestrial corridors or number of patches of fragmentation of existing terrestrial corridors in which threatened fauna have a high likelihood (whichever rates higher)	No measurable impact on the extent of terrestrial corridors. Alignment does not create a new barrier to the movement of terrestrial fauna.	Loss of <10 ha of a terrestrial corridor; or Alignment creates barrier to ≤1 patch of habitat that is a corridor	Loss of ≥10 ha and <20 ha of a terrestrial corridor; or Alignment creates barrier to >1 and <4 patches of habitat that is a corridor	Loss of ≥20 ha and <35 ha of a terrestrial corridor; or Alignment creates barrier to ≥4 and <7 patches of habitat that is a corridor.	Loss of ≥35 ha of a terrestrial corridor; or Alignment creates barrier to ≥7 patches of habitat that is a corridor.
Waterways - Fragmentation of aquatic corridors or creation of a barrier to aquatic corridors.	No measurable impact on the extent of aquatic corridors. Alignment does not create a new barrier to the movement of aquatic fauna.	Loss of <1 aquatic corridor	Loss of ≥1 and <5 aquatic corridors	Loss of ≥5 and <20 aquatic corridors	Loss of ≥20 aquatic corridors
Number of waterway crossings with good or medium habitat quality	No waterways crossed	≤1 waterway crossed	≥1 and <3 waterways crossed	≥3 and <6 waterways crossed	≥6 waterways crossed

Table 20 Alignment Option Ratings against Assessment Criteria

Sub Objective: Area and condition of native vegetation loss								
Assessment Criteria: <b>Loss (hectares) of native vegetation</b> (EVCs) from each alignment option			Assessment Criteria: <b>Loss (hectares) of Endangered conservation status vegetation</b> (EVCs) from each alignment option			Assessment Criteria: <b>Loss of Scattered Native Trees</b> from each alignment option (Assume on average 10 scattered trees per ha)		
Option	Rating	Comment	Option	Rating	Comment	Option	Rating	Comment
B4 - A	Very Poor	Loss of 46 ha of native vegetation	B4 - A	Poor	Loss of 5 ha of EVCs mapped as endangered	B4 - A	Well	Loss of 1 ha of paddocks containing scattered trees / Loss of 3 additional Scattered Trees (approx. 13 Trees)
B4 - B	Very Poor	Loss of 48 ha of native vegetation	B4 - B	Poor	Loss of 9 ha of EVCs mapped as endangered	B4 - B	Well	Loss of 1 ha of paddocks containing scattered trees / Loss of 3 additional Scattered Trees (approx. 13 Trees)
B5	Poor	Loss of 36 ha of native vegetation	B5	Poor	Loss of 5 ha of EVCs mapped as endangered	B5	Moderately Well	Loss of 2 ha of paddocks containing scattered trees / Loss of 4 additional Scattered Trees (approx. 24 Trees)
Assessment Criterion: <b>Loss (hectares) of native vegetation mapped within DEWLP modelled Location Risk A</b>			Assessment Criterion: <b>Loss (hectares) of native vegetation mapped within DEWLP modelled Location Risk B</b>			Assessment Criterion: <b>Loss (hectares) of native vegetation mapped within DEWLP modelled Location Risk C</b>		
Option	Rating	Comment	Option	Rating	Comment	Option	Rating	Comment
B4 - A	Very Poor	Loss of 40 ha of vegetation mapped as being Location Risk A	B4 - A	Moderately Well	Loss of <1 ha of vegetation mapped as being Location Risk B	B4 - A	Very Poor	Loss of 6 ha of vegetation mapped as being Location Risk C
B4 - B	Very Poor	Loss of 41 ha of vegetation mapped as being Location Risk A	B4 - B	Moderately Well	Loss of <1 ha of vegetation mapped as being Location Risk B	B4 - B	Very Poor	Loss of 6 ha of vegetation mapped as being Location Risk C
B5	Poor	Loss of 32 ha of vegetation mapped as being Location Risk A	B5	Well	Loss of <1 ha of vegetation mapped as being Location Risk B	B5	Poor	Loss of 3 ha of vegetation mapped as being Location Risk C
Assessment Criteria: Loss (hectares) of <b>native vegetation assessed as being in poor condition</b>			Assessment Criteria: Loss (hectares) of <b>native vegetation assessed as being in moderate condition</b>			Assessment Criteria: Loss (hectares) of <b>native vegetation assessed as being in good condition</b>		
Option	Rating	Comment	Option	Rating	Comment	Option	Rating	Comment
B4 - A	Moderately Well	Loss of 5 ha of vegetation mapped as being in poor condition	B4 - A	Very Poor	Loss of 24 ha of vegetation mapped as being in moderate condition	B4 - A	Poor	Loss of 17 ha of vegetation mapped as being in good condition
B4 - B	Poor	Loss of 7 ha of vegetation mapped as being in poor condition	B4 - B	Poor	Loss of 17 ha of vegetation mapped as being in moderate condition	B4 - B	Very Poor	Loss of 23 ha of vegetation mapped as being in good condition
B5	Moderately Well	Loss of 5 ha of vegetation mapped as being in poor condition	B5	Poor	Loss of 11 ha of vegetation mapped as being in moderate condition	B5	Very Poor	Loss of 20 ha of vegetation mapped as being in good condition

Sub Objective: Flora Species and Communities of Conservation Significance								
Assessment Criteria: <b>Area (hectares) of habitat with a medium likelihood of occurrence for FFG or EPBC Act listed flora species.</b>			Assessment Criteria: <b>Area (hectares) of habitat with a high likelihood of occurrence for FFG or EPBC Act listed flora species.</b>			Assessment Criteria: <b>Area (hectares) of suitable habitat for FFG Act listed vegetation communities of moderate condition</b>		
Option	Rating	Comment	Option	Rating	Comment	Option	Rating	Comment
B4 - A	Poor	Loss of 12 ha of habitat	B4 - A	Very Poor	Loss of 15 ha of habitat	B4 - A	Very Well	No detectable impact on an FFG Act listed community
B4 - B	Poor	Loss of 13 ha of habitat	B4 - B	Very Poor	Loss of 16 ha of habitat	B4 - B	Very Well	No detectable impact on an FFG Act listed community
B5	Moderately Well	Loss of 9 ha of habitat	B5	Poor	Loss of 13 ha of habitat	B5	Very Well	No detectable impact on an FFG Act listed community
Assessment Criteria: <b>Area (hectares) of suitable habitat for FFG Act listed vegetation communities of high condition</b>			Assessment Criteria: <b>Area (hectares) of suitable habitat for EPBC Act listed vegetation communities of moderate condition</b>			Assessment Criteria: <b>Area (hectares) of suitable habitat for EPBC Act listed vegetation communities of high condition</b>		
Option	Rating	Comment	Option	Rating	Comment	Option	Rating	Comment
B4 - A	Very Well	No detectable impact on an FFG Act listed community	B4 - A	Moderately Well	Loss of 6 ha of habitat	B4 - A	Moderately Well	Loss of 3 ha of habitat
B4 - B	Very Well	No detectable impact on an FFG Act listed community	B4 - B	Well	Loss of 3 ha of habitat	B4 - B	Poor	Loss of 6 ha of habitat
B5	Very Well	No detectable impact on an FFG Act listed community	B5	Moderately Well	Loss of 6 ha of habitat	B5	Moderately Well	Loss of 4 ha of habitat
Sub Objective: Terrestrial Fauna Species and Communities of Conservation Significance								
Assessment Criteria: <b>Area (hectares) of habitat for EPBC Act listed fauna species that has a medium or high likelihood of occurrence.</b>			Assessment Criteria: <b>Area (hectares) of habitat for FFG Act listed fauna species that has a medium or high likelihood of occurrence.</b>			Assessment Criteria: <b>Area (hectares) of suitable habitat for FFG Act listed fauna communities of medium or high likelihood of occurrence</b>		
Option	Rating	Option	Rating	Option	Rating	Rating	Rating	Comment
B4 - A	Very Poor	Loss of 45 ha of habitat	B4 - A	Very Poor	Loss of 76 ha of habitat	B4 - A	Poor	Loss of 31 ha of habitat
B4 - B	Poor	Loss of 43 ha of habitat	B4 - B	Very Poor	Loss of 78 ha of habitat	B4 - B	Poor	Loss of 35 ha of habitat
B5	Poor	Loss of 35 ha of habitat	B5	Very Poor	Loss of 62 ha of habitat	B5	Moderately Well	Loss of 26 ha of habitat
Sub Objective: Impacts to Aquatic Fauna Species								
Assessment Criteria: Number of <b>waterways with habitat for EPBC Act listed aquatic fauna species that has a medium or high likelihood of occurrence.</b>			Assessment Criteria: Number of <b>waterways with habitat for FFG Act listed aquatic fauna species that has a medium or high likelihood of occurrence.</b>					
Option	Rating	Comment	Option	Rating	Comment			
B4 - A	Poor	Three waterways	B4 - A	Poor	Three waterways			
B4 - B	Poor	Three waterways	B4 - B	Poor	Three waterways			
B5	Poor	Three waterways	B5	Poor	Three waterways			



Sub Objective: Fauna Habitat and Wildlife Corridors – Impacts to a major wildlife corridor and or habitat linkages severed

Assessment Criterion: Terrestrial - Loss (hectares) of <b>terrestrial corridors</b> or <b>number of patches of fragmentation of existing terrestrial corridors</b> in which threatened fauna have a high likelihood			Assessment Criteria: <b>Waterways - Fragmentation of aquatic corridors or creation of a barrier to aquatic corridors.</b>			Assessment Criteria: <b>Number of waterway crossings with good or medium habitat quality</b>		
Option	Rating	Comment	Option	Rating	Comment	Option	Rating	Comment
B4 - A	Moderately Well	Loss of 10 ha of habitat and fragmentation of 2 patches with a high likelihood of threatened woodland species	B4 - A	Poor	Eleven crossings of aquatic corridors	B4 - A	Moderately well	Two crossings
B4 - B	Moderately Well	Loss of 12 ha of habitat and fragmentation of 2 patches with a high likelihood of threatened woodland species	B4 - B	Poor	Ten crossings of aquatic corridors	B4 - B	Moderately well	Two crossings
B5	Well	Loss of 8 ha of habitat and fragmentation of 1 patches with a high likelihood of threatened woodland species	B5	Poor	Eleven crossings of aquatic corridors	B5	Moderately well	Three crossings

## 8. Legislative implications

In an effort to avoid and minimise potential impacts to ecological values within the study area VicRoads has already reduced the proposed level of infrastructure (and therefore on ground disturbance) associated with the Ararat Bypass. Numerous on-ramps and extensions have been removed from the original alignment options assessment (Appendix F).

The implications of environmental legislation and guidelines relating to the protection of flora and fauna that need to be considered by VicRoads for this project have been summarised below in Table 21. This information is not intended to provide an exhaustive list, but rather a summary of the key ecological requirements for the project. Other permits and legislation not outlined below may be required for the project.

The information below is based upon GHD's understanding of the legislation and policy, and the GHD consultants' experience with their implementation. There is a possibility that regulatory authorities may interpret and/or implement the legislation and policy differently.

Once the preferred alignment has been chosen, the construction footprint determined, the extent of native vegetation and fauna habitat removal has been calculated; the following table will require revision. However at this stage each alignment option is likely to require the following approvals and permits.

Table 21 Legislation relating to impacts to flora and fauna

Act/Guideline	Summary	Comment	Conclusion
Federal			
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	<p>The Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999 promotes the conservation of biodiversity by providing protection for threatened species, threatened ecological communities, migratory and marine species and other protected matters. The Australian Government Department of the Environment (DOE) administers the EPBC Act.</p> <p>There are nine Matters of National Environmental Significance (MNES) identified in the EPBC Act. Certain actions – in particular, actions that are likely to have a significant impact on any MNES – are subject to a rigorous assessment and approval process (DOE 2013), with a referral required where ‘significant’ impacts on MNES are expected or possible. The referral application generally takes 20 business days to process, after which the Commonwealth Minister makes a determination on the need or otherwise for approval under the EPBC Act. If approval is deemed necessary a formal assessment and approval process commences.</p>	There is potential for EPBC listed vegetation communities and EPBC listed flora to be impacted by the project.	More detailed field surveys are required to determine whether a significant impact is possible and therefore whether a referral is required for impacts to EPBC listed vegetation communities and/or EPBC listed flora or fauna species.
State			
<i>Environmental Effects Act 1978</i>	<p>The Ministerial guidelines for assessment of environmental effects under the Environment Effects Act 1978 (EE Act) provide a range of criteria that can be used to determine whether an Environmental Effects Statement (EES) would be required for a project (page 7; DSE 2006). Many of the listed potential effects that may warrant referral of a project are related to flora and fauna. There are also other triggers not related to flora and fauna such as social, economic and environmental triggers that may need to be considered for the project. There are two types of referral criteria: 1) individual potential environmental effects and 2) a combination of potential environmental effects.</p> <p>It should be noted that not all of the criteria are considered here. There are also other triggers not related to flora and fauna such as social, economic and environmental triggers (other than ecology) that will need to be considered for the Project.</p> <p><b>Referral criteria: Individual potential environmental effects</b></p> <p>According to DSE (2006a), a referral under the Environment Effects Act 1978 would be warranted if this Project were to result in any individual potential environmental effects that might be of regional or state significance (see p.7, DSE 2006). The following individual potential effects relating to terrestrial flora and fauna were considered for this Project<sup>4</sup>:</p>	No one alignment is estimated to potentially clear more than 10 ha of an endangered EVC but each alignment may impact on a combination of potential environmental effects.	This project may require a referral to the Minister for Planning under the Environment Effects Act based on a combination of potential environmental effects. Targeted surveys for threatened fauna will help to determine this.

<sup>4</sup> Note that there are other potential referral criteria that are not related to flora and fauna.



Act/Guideline	Summary	Comment	Conclusion
	<ul style="list-style-type: none"> <li>Potential clearing of 10 ha or more of native vegetation from an area that: <ul style="list-style-type: none"> <li>Is of an Ecological Vegetation Class identified as endangered by the Department of Sustainability and Environment (in accordance with Appendix 2 of Victoria's Native Vegetation Management Framework); or</li> <li>Is, or is likely to be, of very high conservation significance (as defined in accordance with Appendix 3 of Victoria's Native Vegetation Management Framework); and</li> <li>Is not authorised under an approved Forest Management Plan or Fire Protection Plan.</li> </ul> </li> <li>Potential long-term loss of a significant proportion (e.g. 1 to 5 percent depending on the conservation status of the species) of known remaining habitat or population of a threatened species within Victoria.</li> </ul> <p><b>Referral criteria: A combination of potential environmental effects</b></p> <p>A referral under the Environment Effects Act 1978 would be warranted if this project were to result in the combination of two or more listed types of potential effects on the environment that might be of regional or state significance (see p.7, DSE 2006a). The following potential effects relating to terrestrial flora and fauna were addressed for this project:</p> <ul style="list-style-type: none"> <li>Potential clearing of 10 ha or more of native vegetation, unless authorised under an approved Forest Management Plan or Fire Protection Plan;</li> <li>Matters listed under the Flora and Fauna Guarantee Act 1988:</li> <li>Potential loss of a significant area of a listed ecological community; or</li> <li>Potential loss of a genetically important population of an endangered or threatened species (listed or nominated for listing), including as a result of loss or fragmentation of habitats; or</li> <li>Potential loss of critical habitat.</li> </ul>		

Act/Guideline	Summary	Comment	Conclusion
<i>Planning and Environment Act 1987</i>	<p>Unless particular exemptions apply under Clause 52.17 of the relevant planning scheme, a planning permit under the Victoria Planning Provisions (made pursuant to the Planning and Environment Act 1987) is required to remove, destroy or lop native vegetation. This includes scattered native plants within areas mapped as non-native vegetation, remnant patches, scattered trees and impacts to TRZs (refer DSE 2011). A permit may also be required for impacts on planted native vegetation depending on the policies of the local government authority (LGA), or if vegetation has been planted or maintained using public funds.</p>	Native vegetation will need to be removed for the project, and is likely to include remnant patches, scattered trees and scattered native plants.	<p>A permit will be required, and offsets are also expected to be required for the project (refer below).</p> <p>There may be other triggers for a Planning Permit requirement, besides Clause 52.17 of the Planning Scheme.</p>
<i>Flora and Fauna Guarantee Act 1988</i>	<p>The Flora and Fauna Guarantee Act 1988 (FFG Act) 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 seeks to put in place preventative management mechanisms to ensure no biota or ecological communities become extinct within Victoria, and to ensure that the processes that threaten biodiversity are identified and addressed. The FFG Act is far broader than 'endangered species' legislation, covering ecological communities; potentially threatening processes; community involvement in conservation; and a strategic approach to biodiversity conservation and sustainable use.</p> <p>Under the FFG Act, a permit is required from DEWLP for impacts to protected flora, threatened flora, and/or threatened communities. The FFG Act applies to public land and to projects undertaken by State Government authorities, even if on private land.</p>	<p>There is potential for flora species listed as threatened and protected under the FFG Act to be impacted by the project.</p> <p>There is potential for fauna species and communities listed as threatened under the FFG Act to be impacted by the project.</p>	<p>More detailed field surveys are required to determine whether any flora species listed under the FFG Act will be impacted by the project.</p> <p>The FFG Act will apply to this project regardless, as works are proposed to occur on public land (within a road reserve). Therefore, as a minimum, the project should aim to meet the stated objectives of the FFG Act. This would involve demonstrating to DEWLP that measures have been taken to avoid impacts upon FFG Act listed species and communities (DEPI 2014d, DEPI 2014e, DSE 2013, DSE 2009, DSE 2005), and that potentially threatening processes (DSE 2012) have been avoided or minimised. For listed items where Action Statements have been prepared, the project must be undertaken in accordance with those Action Statements.</p>

Act/Guideline	Summary	Comment	Conclusion
Permitted clearing of native vegetation: Biodiversity Assessment Guidelines (DEPI, 2013).	<p><i>The Permitted clearing of native vegetation – Biodiversity assessment guidelines</i> (Victoria's Biodiversity Assessment Guidelines 2013) ('the Guidelines') were incorporated into the Victorian Planning Provisions and all planning schemes in Victoria in May 2013 (DEPI 2013).</p> <p>The purpose of the guidelines is to guide how impacts on biodiversity should be considered when assessing an application for a permit to remove, destroy or lop native vegetation. Victoria's Biodiversity Assessment Guidelines 2013 set out the rules and tools for how responsible authorities (such as Local Government Authorities and DEWLP) should consider biodiversity when assessing an application.</p>	Native vegetation will need to be removed for the project, and is likely to include remnant patches and scattered trees.	Offsets will be required for impacts to remnant patches and scattered trees, but cannot be calculated until the extent of impacts are known.
<i>Wildlife Act 1975</i>	<p>In Victoria, the legislation for protecting and managing wildlife is the Wildlife Act 1975. Under this Act, 'wildlife' is defined as including indigenous vertebrate species (except declared pest species), invertebrate species listed under the Flora and Fauna Guarantee Act 1988, and some introduced game species. This Act does not apply to fish or listed aquatic invertebrates as defined under the Fisheries Act 1995. All other native fauna (listed as threatened or not) are protected under the Wildlife Act 1975.</p> <p>Penalties for the Wildlife Act 1975 are prescribed within the Wildlife Regulations 2002. These include penalties for persons who wilfully damage, disturb or destroy wildlife habitat without appropriate authorisation (Part 2, Section 9 of the Wildlife Regulations 2002). A Management Authorisation (MA) under the Act may be required if native fauna need to be captured and/or relocated during proposed works, e.g. pre-clearance surveys of hollows.</p>	A Management Authorisation (permit) under the Wildlife Act is generally needed during the construction phase of a project if/when fauna are required to be handled or disturbed as part of the construction process (e.g., moved out of construction area).	A Management Authorisation is likely to be needed for this project, and would be obtained at the time of construction. The permit needs to be in the name of the person who handles the fauna, and that person must be suitably qualified to do so (i.e. ecologist).
<i>Catchment and Land Protection Act 1994</i>	<p>Legislative requirements must be adhered to for weed management under the Catchment and Land Protection Act 1994 (CaLP Act). For example, this legislation requires that declared noxious weeds be controlled or eradicated by the land manager. It also prohibits movement from land onto a road of:</p> <p>Vehicles and trailers used for carrying, moving or transporting machinery or equipment for road and utility building or maintenance; or</p> <p>Machinery, implements or other equipment without first taking precautions to ensure vehicle and equipment is free from noxious weed seeds and any other part of a noxious weed that is capable of growing (weed propagules).</p> <p>The CaLP Act establishes Catchment Management Authorities (CMAs) and provides for the development of Regional Catchment Strategies that must assess the nature, causes, extent and severity of land degradation of the catchments in the region and identify areas for priority attention. The project is located in the Glenelg Hopkins CMA region and therefore falls under the GHCMR Regional Catchment Management Strategy. The strategy lists objectives that are aimed at improving the condition of waterways within the region.</p>	A total of six declared noxious weeds, including three WONS have been recorded within the study area. The chosen alignment is likely to cross at least some of these infestations, and additional infestations and/or weed species may be present that were not recorded during the field survey.	Weed management and hygiene protocols should be included in the CEMP.

Act/Guideline	Summary	Comment	Conclusion
	The project should take the strategy into account. Specifically, it should avoid adding to the deterioration of river health which could decrease the likelihood of achieving the GHCMA Regional Catchment Management Strategy objectives.		
<i>Fisheries Act 1995</i>	<p>One of the objectives of the Fisheries Act 1995 is to protect and conserve fisheries resources, habitats and ecosystems including the maintenance of aquatic ecological processes and genetic diversity. One of the provisions of this Act is that a person must not, except as permitted by or under the or any other Act, create an obstruction across or within a bay, inlet, river or creek or across or around an inter-tidal flat that:</p> <ul style="list-style-type: none"> <li>(a) fish will or could be blocked and left stranded; or</li> <li>(b) immature fish will or could be destroyed; or</li> <li>(c) the free passage of fish will or could be obstructed.</li> </ul> <p>This act is relevant if there is a likelihood that land development will impact on fish habitat and aquatic ecological processes.</p> <p>Similar to the Flora and Fauna Guarantee Act 1988, action statements must outline the process that will be implemented to ensure the long-term protection of fish habitat and/or specific species</p> <p>If fish handling, capture or translocation is required (i.e. capture and release of fish in coffer dams) a 'FORM 06 – Application for a General Permit for the purpose of research (this includes capture and release or translocation) may be required from the DEWLP.</p>	Fish habitat needs to include both permanent and ephemeral waterways.	<p>Construction and road design should not inhibit the passage of fish during wet periods.</p> <p>Fish encountered during construction may require salvage and translocation.</p>
<i>Environment Protection Act 1970 and State Environmental Protection Policy (Waters of Victoria) 2003 (Victoria)</i>	<p>The Environmental Protection Act (1970) allowed for the creation of the State Environmental Protection Policy (Waters of Victoria) 2003 (SEPP WoV) (Victorian Government 2003), which applies to all surface waters of Victoria. SEPP (WoV) aims to provide a coordinated approach for the protection and, where necessary, rehabilitation of the health of Victoria's water environments.</p> <p>The SEPP (WoV) identifies 'beneficial uses' of waterways and establishes environmental quality objectives at levels that will ensure the protection of these uses. SEPPs are legally enforceable statutory instruments.</p> <p>Impacts to water quality must not exceed water quality objectives specified to protect beneficial uses, unless extensive modification or natural variation precludes this attainment. In such situations the background level becomes the objective. Relevant clauses of this policy must be adhered to. The following clauses (with a brief description of relevant aspects) are applicable to the project:</p>	<p>VicRoads standard specification for road construction generally addresses risks to water quality of surface water.</p> <p>Ephemeral streams should be considered as waterways for the purpose of protection of aquatic ecosystems and riparian zones from erosion, pollution and sedimentation.</p>	When undertaking works on or adjacent to surface water systems, the SEPP will require management measures to be implemented to minimise environmental risks to the aquatic ecosystem and to protect beneficial uses.



Act/Guideline	Summary	Comment	Conclusion
	<p><b>Clause 43 – Surface water management and works</b></p> <ul style="list-style-type: none"> <li>Minimise unnatural erosion, sediment re-suspension and other risks to aquatic habitat.</li> <li>Ensure that existing and new in situ structures do not pose a barrier to fish movement.</li> </ul> <p><b>Clause 53 – Aquatic and riparian vegetation protection and rehabilitation</b></p> <ul style="list-style-type: none"> <li>Minimise the removal of, and rehabilitate native vegetation within or adjacent to surface waters.</li> </ul> <p><b>Clause 56 - Construction activities</b></p> <ul style="list-style-type: none"> <li>Minimise soil erosion, land disturbance and discharge of sediment and other pollutants to surface waters.</li> <li>Where construction activities impinge on surface waters, construction managers need to monitor affected surface waters to assess whether beneficial uses are being protected.</li> </ul> <p><b>Clause 57 – Roads</b></p> <ul style="list-style-type: none"> <li>Manage roads and infrastructure to minimise erosion and sediment and pollutant transport.</li> <li>Maintain roads that adjoin surface waters to minimise sediment runoff.</li> </ul>		
Water Act 1989	<p>The Water Act 1989 (Water Act) is intended to ensure that water resources are conserved and properly managed for sustainable use for the benefit of present and future Victorians. It is also intended to provide formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses and to provide for the protection of catchment conditions.</p> <p>Part 10 of the Water Act outlines the Waterway Management responsibilities and requirements for regional drainage and floodplain management, as relevant to the Authorities responsible for waterway management districts. Any works undertaken in and around waterways and their floodplains will need to be undertaken in accordance with the Water Act (1989).</p>	<p>Glenelg Hopkins Catchment Management Authority (GHCMA), as caretakers for river health under the Water Act (1989) are responsible for issuing licences for works on waterways.</p>	<p>Vicroads will require a licence (Works on Waterways) from GHCMA prior to undertaking the works unless exemptions apply.</p>

## 9. Recommendations

The study area is situated within a highly modified landscape, however many ecological values persist including intact patches of remnant native vegetation and habitat for threatened flora and fauna species and communities. The removal or disturbance of areas mapped as native vegetation or habitat should be avoided where possible.

The following steps will need to be undertaken by VicRoads to aid the determination of the final alignment and construction footprint:

- Undertake a Risk Assessment (e.g. Risk Assessment workshop) to determine the preferred alignment considering ecological and other values within the study area. The results of the assessment of options should be feed into this risk assessment, weighting individual assessment criteria so they are comparable.
- Undertake targeted surveys for a number of threatened species and communities. Currently insufficient information exists to allow the level of impact to a number of threatened species and communities to be determined.

Preliminary discussions for some fauna species have been undertaken with DEWLP (Lisa Macaulay *pers. comm.* and Gary Peterson *pers. comm.*), however prior to undertaking the surveys outlined below these should be confirmed with DEWLP. DEWLP have provisionally advised that for any given project a DEWLP officer assessing a project is likely to require more detailed targeted survey to confirm the presence or absence of FFG Act listed species or communities that are determined to be likely within the study area (Mark Chisolm *pers. comm.*).

However, prior to undertaking targeted surveys DEWLP should be consulted to determine the need for targeted surveys for each species or community that has been identified as likely to occur within the study area.

If the project is required to complete an Environmental Effects Statement under the Environmental Effects Act then it is also possible that the panel may include, as part of the scope of the assessment, that targeted surveys be undertaken for particular species identified as likely within the study area (Mark Chisolm *pers. comm.*).

Targeted surveys will also help determine whether a significant impact is likely on a species or community listed under the EPBC Act.

### Flora

Undertake targeted surveys for a number of flora species to further inform the potential impacts to threatened species and communities as a result of the project. These are recommended survey times based on optimal flowering time for each species, depending on seasonal conditions some of the species may be surveyed earlier or later than proposed below.

- Conduct targeted surveys in September 2015 for *Glycine latrobeana* (Clover Glycine) and *Thelymitra matthewsii* (Spiral Sun-orchid).
- Conduct targeted surveys in November 2015 for *Dianella amoena* (Matted Flax-lily),

- Conduct targeted surveys in September 2015 and or November 2015 for *Caladenia versicolor* (Candy Spider-orchid), *Dodonaea procumbens* (Trailing Hop-bush), *Grevillea floripendula* (Ben Major Grevillea), and *Leucochrysum albicans* subsp. *albicans* var. *tricolor* (White Sunray).

Targeted surveys may also be required for EPBC or FFG Act-listed flora communities as a result of the preferred alignment identified during the next stage of the project.

### **Fauna**

Undertake targeted surveys for a number of fauna species to further inform the potential impacts to threatened species and communities as a result of the project.

- Conduct targeted surveys for the following threatened fauna species to determine presence or absence: Growling Grass Frog, Golden Sun Moth, Striped Legless Lizard, Brown Toadlet, Brush-tailed Phascogale.
- Conduct a targeted survey for hollow-bearing trees along the final alignment (habitat for Lace Monitor and Brush-tailed Phascogale).

### **Aquatic**

Undertake targeted surveys for a number of aquatic species to further inform the potential impacts to threatened species and communities as a result of the project.

- Conduct a targeted survey along the final alignment for remnant pools that may provide aquatic habitat refugia for threatened aquatic species within the ephemeral stream network. Disturbance of existing refugia should be avoided.
- Conduct targeted surveys for the following threatened aquatic species to determine presence or absence: Dwarf Galaxias.
- Follow the mitigation measures outlined in Table 18 designed to minimise impacts to terrestrial and aquatic ecology values identified within the study area.

Once the final alignment has been identified more detailed recommendations will be provided based on specific impacts to ecological values.

## 10. References

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# Appendix A – Key project personnel

The following personnel are key members of the delivery team. Curriculum Vitae have been provided for the Project Director, Field Manager and Project Manager. Curriculum Vitae for other key personnel can be provided upon request.



**Katie Watt** Project Director and Principal Environmental Scientist

**Qualified.** BSc (Hons) – 13 years of experience

**Relevant experience:** Katie is a principal environmental scientist with a focus on approvals for state significant projects. Katie has been involved with the management and delivery of approvals for the largest projects in Victoria over the last five years. She is skilled in the areas of environmental impact assessment, environmental approvals, project concept and feasibility studies, and the management of multi-disciplinary projects. Her experience covers transport, water and recycled water projects.

Katie will bring to the project her experience of managing the Environment Effects Statements for the duplication of the Western Highway between Beaufort and Ararat, and Ararat and Stawell.

*As Project Director, Katie will provide strategic guidance and focus for the outcomes of field assessments and how they can be used to inform selection of the preferred options and project approvals.*



**Tim Wills** Principal Field Manager and Principal Botanist

**Qualified.** BSc(Hons); PhD; CEnvP – 16 years of experience

**Relevant experience:** Tim is a principal botanist and project director, with extensive experiences in vegetation ecology, fire ecology research and ecological consulting. Tim has experience leading large botanical surveys, having recently acted as job manager and principal botanist for the successful delivery on time and budget (\$1.3M) for a survey of c. 1,800 sites across Victoria for the Department of Environment and Primary Industries. Tim has excellent vegetation mapping skills, he is certified competent in the Habitat hectare vegetation condition assessment method, and is a specialist familiar with numerous threatened flora species and vegetation communities of central Victoria.

Tim regularly provides high-level ecological advice and has led the ecology studies on numerous major (EES-level) linear infrastructure projects across Victoria, including the Sugarloaf Pipeline Project, East West Link CIS, WestLink IIS and Princes Hwy duplication (Traralgon to Kilmany) EES. These studies often involve detailed ecological risk and options assessments to help determine appropriate alignments for important infrastructure. He has experience presenting expert evidence to planning tribunals and panels, and will bring to this project considerable experience working on large multi-disciplinary projects with competing social, economic and environmental interests.

*As Field Manager, Tim will be responsible for overseeing the field tasks and providing advice on the stratification process, reporting, developing assessment criteria and undertaking technical review*



### Kelly Dalton Project Manager and Zoologist

**Qualified.** BSc. (Hons) – eight years of experience

**Relevant experience:** Kelly Dalton is a zoologist with GHD's Natural Resource and Heritage group in Melbourne. She has eight years' experience as a zoologist, utilising a broad range of survey methods across several faunal groups. Kelly has experience in all states of Australia. As part of Kelly's role within GHD she is required to conduct desktop fauna assessments, fauna habitat assessments and targeted threatened fauna surveys. As such she has worked closely with a range of threatened species and understands the issues and legislation that surround them. She has experience with the environmental legislation and assessment process at both State and Commonwealth levels. A majority of the work Kelly undertakes is for large linear infrastructure projects such as road, rail and water pipelines. Kelly currently manages all of GHD's Golden Sun Moth work and has worked closely with this species for more than 5 years. Kelly has experience leading targeted surveys for large projects. Some of the projects Kelly's has most recently worked on include: East West Link, West Link, Sugarloaf Pipeline Project, Hamilton Grampians Pipeline Project and Traralgon to Sale Road Duplication.

*As Project Manager, Kelly will be the main point of contact. She will be responsible for the smooth running and timely provision of deliverables and briefing the GHD project team on expectations and budget.*



### Richard Retallick Senior Zoologist

**Qualified.** PhD ; BSc – 20 years' experience

**Relevant experience:** Richard has more than 20 years of experience as a zoologist/ecologist, stemming from consultancy work with GHD and research projects prior to that in Australia and USA. Richard's research career focussed on amphibians, but his experience and interests include all terrestrial vertebrate fauna groups (mammals, birds, reptiles and amphibians). Richard has worked closely with many of Victoria's threatened fauna species, particularly Growling Grass Frog, Brown Toadlet, Striped Legless Lizard and Golden Sun Moth. He has extensive experience with surveying, identification and management of fauna in western Victoria, having worked on a number of linear infrastructure projects and options assessments in that area over the past seven years. Accompanying his field skills, Richard has highly developed data management and communication skills for presentations and preparation of reports.



### Sjaan Bidwell Principal Botanist

**Qualified.** PhD , BSc (Hons) – 18 years' experience

**Relevant experience:** Sjaan is a principal botanist and project director, with extensive experience in vegetation ecology and ecological consulting. Sjaan has undertaken many flora surveys, vegetation condition assessments and targeted surveys for threatened flora. Her survey work has included threatened communities of relevance to this project such as the Natural Temperate Grasslands of the Victorian Volcanic Plains, Grey Box Woodland of south-eastern Australia and Grassy Woodland and derived grassland communities of south-eastern Australia. She has also undertaken surveys of threatened species likely to be of relevance to this project such as *Pimelea spinescens*, *Glycine latrobeana* and threatened orchid species. She is certified competent in undertaking habitat hectare assessments by DEPI. Sjaan coordinated an internal training program for 20 GHD ecologists in Habitat Hectare methods. She has undertaken many Net Gain assessments and assists in ongoing training of our staff and review of Net Gain reports.

Sjaan has a sound understanding of national and state environmental legislation, including approval requirements for the Melbourne Strategic Assessment Area. She has experience in preparing approval applications and referrals for large scale linear infrastructure projects, such as planning permits to remove native vegetation, referrals under the Environment Protection and Biodiversity Conservation Act, and preparation of environmental management plans, threatened species management plans and offset plans.



### Patrick Maiden Aquatic Ecologist

**Qualified.** BSc (Hons) – 16 years of experience

**Relevant experience:** Patrick is a principal aquatic ecologist with over 15 years' experience in the ecology and water chemistry of inland aquatic ecosystems. Patrick has designed and conducted multiple surveys for aquatic flora and fauna throughout the waterways in Victoria's central highlands and goldfields region for Central Highlands Water, EPA Victoria and Wimmera CMA, and is familiar with the ecological values within these bioregions. Patrick is also experienced with setting measurable consequence criteria for impact assessment, and developing risk mitigation measures for aquatic ecosystem and water quality impacts, including recent project for VicRoads at Echuca Moama Bridge. These typically include tight timeframes and require engagement with multiple stakeholders, including government agencies and other industry and community groups



### Alex Holmes Principal Ecologist

**Qualified.** BSc (Hons) – 14 years of experience

**Relevant experience:** Alex is a Project Director within GHD and the Fauna Team Leader. Alex's 14 years of professional experience extends to environmental impact assessment, ecological management planning, temperate and semi-arid/arid zone ecology, wetland/floodplain ecology, ecological monitoring and detailed fauna and flora survey within south-eastern, central and northern Australia. He possesses a working knowledge of commonwealth and various state environmental legislation and assessment processes across Australia.

Alex has undertaken targeted surveys for threatened fauna species including Striped Legless Lizard and Golden Sun Moth throughout western and central Victoria for a range of water authorities and Department of Defence. Alex is the Project Director for a large ongoing ecological monitoring program for Defence at Puckapunyal, in this role Alex manages a complex arrangement of seasonal and targeted surveys for a range of threatened flora and fauna species and communities.



### Simon Harrow Aquatic Ecologist

**Qualified.** MSc, BSc (Hons), Senior Electrofisher Operator – nine years of experience

**Relevant experience:** Simon has over nine years of ecological experience, predominantly in freshwater ecosystems. He currently manages a diverse range of aquatic ecology-based projects with government and private industry clients. Simon is a Senior Electrofisher operator and has led or participated in many aquatic ecology projects across Victoria and in the Northern Territory. He has recent experience working as the lead aquatic ecologist on the Victorian Stockman Mine Project EES and acted as expert witness for this project. The baseline data collection for this project involved detection of threatened fish and crustacean species and long-term monitoring of macroinvertebrate communities potentially impacted by development. He is currently contracted by VicRoads as Project Director for the aquatic ecology component of the Echuca-Moama Bridge Crossing EES. He is confident analysing large ecological datasets using multivariate and univariate statistical analysis has authored numerous technical reports for a range of clients.





### Zoe Jellie Botanist

**Qualified.** BSc – seven years of experience

**Relevant experience:** Zoe is a field botanist and project manager within GHD's ecology team and has extensive experience in environmental consulting, having worked in a range of industries including roads and general construction, mining, water supply, treatment and management, and conservation, with work including ecological impact assessment, targeted flora and fauna survey, weed and vegetation mapping and management, revegetation/rehabilitation planning and monitoring, experimental design and research, preparation of management plans and the provision of recommendations to both minimise and mitigate against environmental impacts.

Zoe assisted with the mapping of over 10,000 ha of grassland in the Victorian Volcanic Plain for the Growth Area Authority and has experience on a range of projects conducting targeted surveys for threatened flora species and communities known and predicted to occur within the project area

Over the last six years Zoe has been involved in targeted surveys for GSM and flora assessments monitoring GSM habitat within grassland of varying conditions. Zoe was the lead author on a paper published earlier this year describing salvage and reinstatement options for grassland known to contain populations of GSM: *Experimental slab salvage and reinstatement after pipeline construction in a threatened grassland community* (EMR 2014).



### Giles Flower Ecologist

**Qualified.** PhD BSc (Hons) – 20 years of experience

**Relevant Experience:** Giles is an environmental consultant with experience in a number of fields of ecological endeavour. Giles has been with GHD for nine years and in that time has worked throughout Victoria. His recent experience has been as Team Leader of Approvals and Environment for the Barwon Water Alliance, working from Queenscliff through to Apollo Bay and Colac on over one hundred infrastructure construction projects. These have included significant pipeline projects through many environments, from forest to grassland plains.

This adds to his previous pipeline experience, and has included environmental management of projects, surveys of flora and fauna and management of environmental requirements for listed species under State and Federal legislation.



### Andy Lovell Spatial Sciences Manager Victoria

**Qualified.** MSc, BAppSc – 10+ years of experience

**Relevance Experience.** As the Manager of GHD's Spatial Sciences team, Andy has a proven ability to bring together a team and build positive and productive working relationships with all stakeholders. A specialist Geographical Information Systems (GIS) and Database Analyst, with over ten years' experience in data management and analysis, he is experienced in spatial analysis and the preparation and high quality presentation of data for a range of project types. He is therefore skilled in the implementation of GIS across multiple disciplines, providing specific assessment and presentation solutions to a wide range of clients.



### Estrella Melero Spatial Consultant

**Qualified.** B Ag Eng – seven years of experience

**Relevant Experience.** Estrella is a spatial professional with seven years of employment in the industry. She has experience in applying GIS and remote sensing technologies to environmental projects, including vegetation assessments, bushfire risk and recovery, multi-criteria analysis, 3D modelling and visualisation, capacity assessments and hydrological modelling.

In this project, Estrella will be responsible for spatial data management, preparation of mobile devices for fieldwork, spatial analysis and report mapping.



# Curriculum Vitae

## Katie Watt Principal Environmental Scientist



Qualified. Bachelor of Science (Environmental Science) (Hons), 1996 – 1999  
Relevance to project. Katie is a principal environment scientist of 13 years-experience with a focus on approvals for state significant projects. Katie has been involved with the management and delivery of approvals for the largest projects in Victoria over the last five years. She is skilled in the areas of environmental impact assessment, environmental approvals, project concept and feasibility studies, and the management of multi-disciplinary projects. Her experience covers transport, water and recycled water projects.

Project Manager  
East West Link – Eastern Section  
Linking Melbourne Authority |  
Melbourne, Australia

Katie was the Project Manager for the East West Link Comprehensive Impact Statement (CIS) which is a new proposed major road link between the Eastern Freeway and CityLink. Katie managed the preparation of specialist studies, the CIS and applicable approvals documentation, as well as facilitated the Agency Liaison Group meetings. Katie continued to manage the project in the lead up to the Panel Hearing in March 2014. East West Link has been the first project to completely utilise the provisions of the Major Transport Projects Facilitation Act 2009 and exhibit a CIS with applicable approvals.

Project Director  
Kilmore-Wallan Bypass  
VicRoads | Melbourne, Australia  
Katie was the Project Director for GHD's engagement to write the Environment Effects Statements (EESs) for the Kilmore-Wallan Bypass. Katie provided strategic advice for the preparation of the EES and review of the document, focusing on key components such as the options assessment and conclusion chapters.

Project Manager  
Western Highway Stage 2 and 3  
VicRoads | Melbourne, Australia  
Katie was the Project Manager for two separate Environment Effects Statements (EESs) and Planning Scheme Amendments (PSAs) that were prepared in parallel for the Western Highway

Project. It is the key road link between Melbourne and Adelaide and is being progressively upgraded to be a safer and more efficient four-lane divided freeway. Katie managed the agency engagement, specialist studies and preparation of the EESs and PSAs for duplication of the Western Highway between Beaufort and Ararat (Section 2), and Ararat and Stawell (Section 3).

Project Coordinator  
Victorian Desalination Project Approvals  
Department of Sustainability and  
Environment | Melbourne, Australia  
Katie was the Project Coordinator for the Reference Design and Environment Effects Statement. This role required the management of information from the design team to environmental specialists to inform the project approvals. Due to the multiple large components of the project and the extremely tight timeframe, this was a full time role to make sure the approvals documentation was complete on time and accounted for all design changes.

Project Manager  
Victorian Desalination Project Referrals  
Department of Sustainability and  
Environment | Melbourne, Australia  
Katie was the Project Manager for the EES Referral, Environment Protection and Biodiversity Conservation Act Referral and associated specialist studies for the Victorian Desalination Project. This included environmental studies to understand marine and terrestrial aspects of the project and developing a concept design to inform the environmental studies.



# Curriculum Vitae

Tim Wills

Field Manager - Principal Botanist / Flora Team Leader



Qualified. BSc(Hons) – Botany, Monash University 1997; PhD – Botany, Monash University 2002; CEnvP – 2006-2014

Connected. Member, Ecological Society of Australia – 1996-2014.

Relevance to project. I am a principal botanist with 16 years' experience, having led the ecology studies on numerous major (EES-level) linear infrastructure projects across Victoria. My detailed understanding of the vegetation communities and threatened species of central and western Victoria and wide-ranging experience in ecological impact assessment will enable high quality advice to be provided for the Project. I will bring to this project my considerable experience working on large multi-disciplinary projects with competing social, economic and environmental interests.

Westlink IIS

Botanist / Ecology team leader

LMA AGA, Melbourne, Victoria

Preliminary ecological assessment, targeted Spiny Rice-flower surveys, Net Gain assessment, options assessment, ecological risk assessment, presentations to TRG and technical review of all ecology reports. Tim provided high level advice in assisting LMA AGA to fine-tune the road alignment to minimise ecological impacts, particularly at the sensitive Derrimut Grasslands.

Princes Hwy Duplication: Traralgon East to Kilmany EES

Botanist / Ecology team leader

VicRoads | Traralgon, Victoria

Biodiversity and habitat assessment, options assessment and review, ecological risk assessment, targeted EPBC Act-listed grassland and threatened species surveys, presentations to TRG (including DSEWPaC, DEPI and DPCD), technical review and appearance as expert witness. Tim's practical advice helped VicRoads select an alignment that minimised impacts to critically endangered EPBC-listed grassland and navigate the approvals process.

Sugarloaf Pipeline Project

Botanist / Flora team leader

Sugarloaf Alliance | Melbourne, Victoria

Vegetation assessment of preliminary corridor options, targeted threatened species surveys, alignment risk assessments, input to EPBC Act referral, appearance as expert witness, coordination and development of over 30 EMPs and threatened species Management Plans, stakeholder liaison, and establishment of monitoring programs to assess rehabilitation success for the 70 km pipeline. Specialist advice provided by Tim helped the project minimise environmental impacts in a highly

constrained project corridor. Tim also developed a new template for threatened species mitigation plans, which DEPI endorsed as a benchmark for linear infrastructure projects in Victoria.

East West Link CIS

Botanist / Ecology team leader

LMA | Melbourne, Victoria

Technical lead for the East West Link ecology assessment, including ecological risk assessment, technical review, liaison with DEPI and representing LMA as a specialist at public information sessions. Tim worked closely with DEPI to produce an impact assessment report that adequately and fully covered all scoping requirements of the CIS.

Vegetation Quadrat Data Collection Project

Job Manager / Botanist

DEPI | Melbourne, Victoria

Tim was the job manager and lead botanist for the Vegetation quadrat data collection and Vegetation condition assessment projects 2010/11 and 2011/12. The project was the largest botanical assessment in Victoria in over 20 years, and involved sampling 987 30x30 m vegetation quadrats and 886 vegetation condition and fuel hazard site assessments, often in remote locations and involving considerable liaison with private landholders and public land managers. The project was initiated after recommendations from the Victorian Bushfires Royal Commission. The GHD team received an excellent written reference from DEPI, complimenting us on our outstanding commitment to quality, timeliness and communication throughout the \$1.3M project.

Other related areas of interest:

- **Published:** Tim and the GHD team recently published two papers in *Austral Ecology* and *Ecological Management & Restoration* on grassland ecology, Golden Sun Moth ecology and restoration techniques following work on the Sugarloaf Pipeline Project.



# Curriculum Vitae

## Kelly Dalton Project Manager - Zoologist



Qualified. BSc(Hons) – Zoology, La Trobe University 2006

Relevance to project. Kelly Dalton is a zoologist with GHD's Natural Resource and Heritage group in Melbourne. She has eight years' experience as a zoologist, utilising a broad range of survey methods across several faunal groups. Kelly has experience in all states of Australia. As part of Kelly's role within GHD she is required to conduct desktop fauna assessments, fauna habitat assessments and targeted threatened fauna surveys. As such she has worked closely with a range of threatened species and understands the issues and legislation that surround them. She has experience with the environmental legislation and assessment process at both State and Commonwealth levels. A majority of the work Kelly undertakes is for large linear infrastructure projects such as road, rail and water pipelines. Kelly currently manages all of GHD's Golden Sun Moth work and has worked closely with this species for more than five years. Kelly has experience leading targeted surveys for large projects.

Ecologist / Project Manager  
Sugarloaf Pipeline Project | Melbourne  
Water, Victoria

This is a major State Government project in central Victoria to augment Melbourne's water supply shortfall. GHD has been involved from pre-assessments to post construction monitoring projects including the development of adaptive management experiments. Kelly has been involved in preliminary ecological assessments, targeted flora and fauna assessments, and Net Gain assessment including annual Habitat Hectare updates. She has also contributed too many of the Environmental Management Programs including Threatened Species Management Plans. Kelly currently manages the several ongoing fauna projects including annual Golden Sun Moth and Striped Legless Lizard Monitoring and The Effectiveness of Habitat Linkages.

Zoologist  
Hamilton Grampians Pipeline Project |  
Wannon Water  
GHD conducted a detailed flora and fauna assessment for the Hamilton Grampians Pipeline Project. Kelly completed ecological assessments and monitoring for this large infrastructure project, which had to consider ecologically sensitive areas. GHD helped the client to identify an appropriate alignment that minimised impacts on ecological values. Kelly was involved in surveys for several key threatened fauna species in central and western Victoria over a number of years; the Growling Grass Frog, Brown Toadlet and the Striped Legless Lizard.

Princes Hwy Duplication: Traralgon East to  
Kilmany EES

Botanist / Ecology team leader  
VicRoads | Traralgon, Victoria  
GHD was engaged by VicRoads to undertake a biodiversity and habitat assessment of the Princes Highway Duplication, Traralgon East to Kilmany comprising approximately 31 km of existing highway. Kelly was involved in undertaking a range of ecological assessments including identifying potential ecological issues that could trigger state and Commonwealth permits and legislation, undertaking targeted surveys (including Growling Grass Frog) and collecting information to inform an Environmental Effects Statement. The avoidance of threatened native vegetation and ecological communities including the EPBC Act-listed ecological communities was a key driver in selecting the proposed alignment from several options. Despite considerable effort during the design phase to avoid and/or minimise impacts to areas of ecological value, native vegetation, the EPBC Act-listed ecological community, and threatened species habitat would be impacted. GHD developed mitigation measures to minimise the level of impact to these ecological values to an acceptable level. When impacts to native vegetation and ecological communities were unavoidable Victorian and Commonwealth native vegetation and habitat offset requirements were documented.

Other related areas of interest:

- **Published:** Kelly and the GHD team recently published a paper in *Austral Ecology* regarding Golden Sun Moth ecology and monitoring following work on the Sugarloaf Pipeline Project.

# Appendix B – Likelihood of occurrence of rare or threatened flora

## Key to table

### Conservation Listing

**Conservation Status under the EPBC Act:** C – Critically Endangered; E – Endangered; V – Vulnerable

**Listed as threatened under the Victorian *Flora and Fauna Guarantee Act 1988*:** L - Listed

**Conservation Status in Victoria:** x – Presumed Extinct; e – Endangered; v – Vulnerable; r – Rare (Flora species Poorly Known in Victoria have not been included in this table)

### Information Source

**VBA:** Victorian Biodiversity Atlas (maintained by DEWLP)

**FIS:** Flora Information System (maintained by Viridans)

**EPBC PMST:** EPBC Protected Matters Search Tool (maintained by DotE)



Scientific Name	Common Name	Conservation Significance			SOURCE	Habitat Description	Likelihood of occurrence
		VICADV	FFG	EPBC			
<i>Acacia aspera</i> subsp. <i>parviceps</i>	Rough Wattle	r			VBA / FIS	Species has been newly split. No detailed habitat description available.	Possible. Lack of information about suitable habitat.
<i>Amphibromus fluitans</i>	River Swamp Wallaby-grass			V	EPBC PMST	Apparently confined to permanent swamps principally along the Murray River Between Wodonga and Echuca, uncommon to rare in the south probably due to alteration of habitat (Walsh and Entwisle 1994).	Unlikely. Lack of suitable habitat found.
<i>Caladenia tensa</i>	Greencomb Spider-orchid	e		E	EPBC PMST	Only known in Victoria from the Nhill area, where it grows on red-brown sandy loams in open woodland (Walsh & Entwisle 1994).	Unlikely. Lack of suitable habitat found.
<i>Caladenia versicolor</i>	Candy Spider-orchid	e	L	V	EPBC PMST	Confined to a limited area near Stawell in western Victoria, where it grows in herb-rich Yellow Box ( <i>Eucalyptus melliodora</i> ) woodland on seasonally wet soils (Backhouse and Jeanes)	Possible. Some suitable habitat present.
<i>Carex tasmanica</i>	Curly Sedge	v	L	V	EPBC PMST	Uncommon, confined to seasonally wet, heavy clayey soils immediately north of Melbourne (Craigieburn) and further west (to Heywood, near Portland) (Walsh & Entwisle 1996).	Unlikely. Lack of suitable habitat found.
<i>Dianella amoena</i>	Matted Flax-lily	e	f	E	EPBC PMST	Usually near rocky outcrops in open-forests (Walsh and Entwisle, 1994).	Possible. Some suitable habitat present.
<i>Diuris behrii</i>	Golden Cowslips	v			VBA	Locally common in grassland and open woodland around Derrinalum, Stawell and the Grampians (Walsh & Entwisle 1996).	Possible. Some suitable habitat present.
<i>Dodonaea procumbens</i>	Trailing Hop-bush	v		V	EPBC PMST	Largely confined in Victoria to the south-west, with disjunct occurrences near Castlemaine, Sipton. Grows in low-lying often winter wet areas in woodland, low open-forest and grasslands on sands and clays (Walsh & Entwisle 1996).	Possible. Some suitable habitat present.
<i>Eucalyptus crenulata</i>	Buxton Gum	e	L	E	VBA / FIS	Confined to Swampy sites in foothills just north and south of the Great dividing range, near Buxton, Narbethong and Yarra Glen, where it forms hybrids with <i>E. ovata</i> (Walsh & Entwisle 1996).	Unlikely. Lack of suitable habitat found.
<i>Eucalyptus diversifolia</i> subsp. <i>megacarpa</i>	Coast Gum	v			VBA	In Victoria, confined to dunes and limestone soils near Cape Nelson where it is abundant (Walsh and Entwisle 1996).	Unlikely. Lack of suitable habitat found.
<i>Eucalyptus yarraensis</i>	Yarra Gum	r			VBA / FIS	Endemic in Victoria extending west from Glengarry to Melbourne and north-west to Daylesford and Ararat (Walsh & Entwisle 1996).	Possible. Some suitable habitat present, numerous local records.
<i>Glycine latrobeana</i>	Clover Glycine	v	L	V	EPBC PMST	Widespread but of sporadic occurrence and rarely encountered. Grows mainly in grasslands and grassy woodlands. (Walsh and Entwisle 1996)	Unlikely. Lack of suitable habitat found.
<i>Grevillea floripendula</i>	Ben Major Grevillea	v	f	V	VBA / FIS / EPBC PMST	Restricted to a small area north of Beaufort, from Waterloo to Ben Major Forest. Grows in dry-open forest, on shallow quartzitic soils.	Likely. Suitable habitat found, numerous local records.

Scientific Name	Common Name	Conservation Significance			SOURCE	Habitat Description	Likelihood of occurrence
		VICADV	FFG	EPBC			
<i>Leptospermum turbinatum</i>	Shiny Tea-tree	r			VBA / FIS	Endemic confined to Grampians and nearby mountains: Langi Ghiran, Buangor and Ben Nevis. Locally common on sandstone and granitic outcrops (Walsh & Entwisle 1996).	Unlikely. Lack of suitable habitat found.
<i>Leucochrysum albicans</i> subsp. <i>albicans</i> var. <i>tricolor</i>	White Sunray	e		E	VBA	Very rare in Victoria, the only recent collections from roadside verges near Wickliffe, Willaura, Streatham, Inverleigh and Creswick. All other collections at MEL were gathered last century, from Mt Cole, the Grampians and the Port Fairy district (Walsh and Entwisle, 1999).	Possible. Some suitable habitat present.
<i>Pimelea spinescens</i> subsp. <i>spinescens</i>	Spiny Rice-flower	e	L	C	EPBC PMST	Grows in grassland or open shrubland on basalt-derived soils west of Melbourne. (Walsh and Entwisle 1999).	Unlikely. Lack of suitable habitat found.
<i>Poa sallacustris</i>	Salt-lake Tussock-grass	v	L	V	EPBC PMST	Apparently endemic in Victoria where known only from margins of a few brackish to salt lakes in the western district (Lakes Corangamite and Terangpoom near Cressy, Black Lake near Skipton, Lake Linlithgow near Hamilton) and apparently threatened by grazing pressure and encroachment of exotic pasture species (Walsh & Entwisle 1994)	Unlikely. Lack of suitable habitat found.
<i>Thelymitra matthewsii</i>	Spiral Sun-orchid	v	L	V	EPBC PMST	Scattered sporadically across southern Vic and extending as far inland as the northern Grampians. Favours open forests and woodlands, where it is found in well-drained sand and clay loams. Grows best in areas where there has been soil disturbance, for example around old quarries and gravel pits, and on road verges, disused tracks or animal trails (Backhouse & Jeanes 1995)	Possible. Some suitable habitat present.
<i>Xerochrysum palustre</i>	Swamp Everlasting	v	L	V	VBA / FIS / EPBC PMST	Occurs in lowland swamps, usually on black cracking clay soils, scattered from near the South Australian border north-west of Portland to Bairnsdale district, but rare due to habitat depletion (Walsh & Entwisle 1999).	Unlikely. Lack of suitable habitat found.

## Appendix C – Incidental flora species list

Species Name	Common Name	Status
<b>Native species</b>		
<i>Acacia acinacea</i> s.l.	Gold-dust Wattle	P
<i>Acacia aculeatissima</i>	Thin-leaf Wattle	P
<i>Acacia dealbata</i>	Silver Wattle	P
<i>Acacia genistifolia</i>	Spreading Wattle	P
<i>Acacia mearnsii</i>	Black Wattle	P
<i>Acacia melanoxylon</i>	Blackwood	
<i>Acacia paradoxa</i>	Hedge Wattle	
<i>Acacia</i> spp.	Wattle	P
<i>Acacia suaveolens</i>	Sweet Wattle	P
<i>Acaena echinata</i>	Sheep's Burr	
<i>Acaena novae-zelandiae</i>	Bidgee-widgee	
<i>Acaena ovina</i>	Australian Sheep's Burr	
<i>Acrotriche serrulata</i>	Honey-pots	
<i>Amyema pendula</i>	Drooping Mistletoe	
<i>Anthosachne scabra</i> s.l.	Common Wheat-grass	
<i>Arthropodium minus</i>	Small Vanilla-lily	
<i>Arthropodium strictum</i> s.l.	Chocolate Lily	
<i>Asteraceae</i> spp.	Composite	
<i>Austrostipa mollis</i>	Supple Spear-grass	
<i>Austrostipa</i> spp.	Spear Grass	
<i>Banksia marginata</i>	Silver Banksia	
<i>Bossiaea prostrata</i>	Creeping Bossiaea	
<i>Brunonia australis</i>	Blue Pincushion	
<i>Bulbine bulbosa</i>	Bulbine Lily	
<i>Burchardia umbellata</i>	Milkmaids	
<i>Caladenia</i> spp.	Caladenia	P
<i>Carex appressa</i>	Tall Sedge	
<i>Carpobrotus modestus</i>	Inland Pigface	
<i>Cassinia arcuata</i>	Drooping Cassinia	P
<i>Chrysocephalum semipapposum</i>	Clustered Everlasting	P
<i>Comesperma ericinum</i>	Heath Milkwort	
<i>Daucus glochidiatus</i>	Australian Carrot	
<i>Daviesia leptophylla</i>	Narrow-leaf Bitter-pea	
<i>Daviesia ulicifolia</i>	Gorse Bitter-pea	
<i>Dianella revoluta</i> s.l.	Black-anther Flax-lily	
<i>Dillwynia cinerascens</i> s.l.	Grey Parrot-pea	
<i>Dillwynia</i> sp.	Parrot Pea	
<i>Diuris sulphurea</i>	Tiger Orchid	
<i>Drosera peltata</i> s.l.	Pale Sundew	
<i>Eleocharis acuta</i>	Common Spike-sedge	
<i>Eleocharis sphacelata</i>	Tall Spike-sedge	
<i>Epacris impressa</i>	Common Heath	
<i>Epilobium hirtigerum</i>	Hairy Willow-herb	

Species Name	Common Name	Status
<i>Epilobium</i> sp.	Willow Herb	
<i>Eucalyptus aromaphloia</i>	Scentbark	
<i>Eucalyptus camaldulensis</i>	River Red-gum	
<i>Eucalyptus dives</i>	Broad-leaf Peppermint	
<i>Eucalyptus goniocalyx</i> s.l.	Bundy	
<i>Eucalyptus macrorhyncha</i>	Red Stringybark	
<i>Eucalyptus melliodora</i>	Yellow Box	
<i>Eucalyptus obliqua</i>	Messmate Stringybark	
<i>Eucalyptus ovata</i>	Swamp Gum	
<i>Eucalyptus polyanthemos</i>	Red Box	
<i>Eucalyptus radiata</i> s.l.	Narrow-leaf Peppermint	
<i>Eucalyptus rubida</i>	Candlebark	
<i>Exocarpos cupressiformis</i>	Cherry Ballart	
<i>Fabaceae</i> sp.	Pea	
<i>Galium gaudichaudii</i>	Rough Bedstraw	
<i>Geranium</i> sp.	Crane's Bill	
<i>Gonocarpus tetragynus</i>	Common Raspwort	
<i>Goodenia lanata</i>	Trailing Goodenia	
<i>Goodenia</i> sp.	Goodenia	
<i>Grevillea</i> sp.	Grevillea	P
<i>Hardenbergia violacea</i>	Purple Coral-pea	
<i>Hydrocotyle hirta</i>	Hairy Pennywort	
<i>Hypericum gramineum</i> spp. agg.	Small St John's Wort	
<i>Indigofera australis</i>	Austral Indigo	
<i>Juncus</i> spp.	Rush	
<i>Lachnagrostis filiformis</i> s.l.	Common Blown-grass	
<i>Lagenophora</i> sp.	Bottle Daisy	
<i>Lepidium</i> sp.	Peppercress	
<i>Lepidosperma filiforme</i>	Common Rapier-sedge	
<i>Leptospermum</i> sp.	Tea Tree	
<i>Leucopogon</i> sp.	Beard Heath	
<i>Leucopogon virgatus</i>	Common Beard-heath	
<i>Lomandra filiformis</i>	Wattle Mat-rush	
<i>Luzula meridionalis</i>	Common Woodrush	
<i>Lythrum hyssopifolia</i>	Small Loosestrife	
<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass	
<i>Monotoca scoparia</i>	Prickly Broom-heath	
<i>Opercularia varia</i>	Variable Stinkweed	
<i>Oxalis perennans</i>	Grassland Wood-sorrel	
<i>Oxalis</i> sp.	Wood Sorrel	



Species Name	Common Name	Status
<i>Ozothamnus obcordatus</i>	Grey Everlasting	P
<i>Pimelea curviflora</i> s.l.	Curved Rice-flower	
<i>Pimelea humilis</i>	Common Rice-flower	
<i>Pimelea linifolia</i>	Slender Rice-flower	
<i>Pimelea</i> sp.	Rice Flower	
<i>Plantago varia</i>	Variable Plantain	
<i>Poa labillardierei</i>	Common Tussock-grass	
<i>Poa sieberiana</i>	Grey Tussock-grass	
<i>Poa</i> spp.	Tussock Grass	
<i>Pteridium esculentum</i>	Austral Bracken	
<i>Rytidosperma caespitosum</i>	Common Wallaby-grass	
<i>Rytidosperma duttonianum</i>	Brown-back Wallaby-grass	
<i>Rytidosperma pallidum</i>	Silvertop Wallaby-grass	
<i>Rytidosperma</i> sp.	Wallaby Grass	
<i>Senecio glomeratus</i>	Annual Fireweed	P
<i>Senecio hispidulus</i> s.l.	Rough Fireweed	P
<i>Senecio quadridentatus</i>	Cotton Fireweed	P
<i>Senecio</i> sp.	Fireweed	P
<i>Senecio tenuiflorus</i> spp. agg.	Slender Fireweed	P
<i>Stackhousia viminea</i>	Slender Stackhousia	
<i>Stylidium</i> sp.	Trigger Plant	P
<i>Tetralthea</i> sp.	Pink Bells	
<i>Thelymitra</i> spp.	Sun Orchid	P
<i>Themeda triandra</i>	Kangaroo Grass	
<i>Tricoryne elatior</i>	Yellow Rush-lily	
<i>Wahlenbergia</i> spp.	Bluebell	
<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>	Tall Bluebell	
<i>Xerochrysum viscosum</i>	Shiny Everlasting	P
<b>Introduced Species</b>		
<i>Acacia baileyana</i>	Cootamundra Wattle	
<i>Acetosella vulgaris</i>	Sheep Sorrel	
<i>Agapanthus praecox</i> subsp. <i>orientalis</i>	Agapanthus	
<i>Agrostis capillaris</i>	Brown-top Bent	
<i>Aira</i> sp.	Hair Grass	
<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass	
<i>Arctotheca calendula</i>	Cape Weed	
<i>Avena barbata</i>	Bearded Oat	
<i>Briza maxima</i>	Large Quaking-grass	
<i>Briza minor</i>	Lesser Quaking-grass	
<i>Bromus diandrus</i>	Great Brome	
<i>Bromus rubens</i>	Red Brome	
<i>Cirsium vulgare</i>	Spear Thistle	R
<i>Cotoneaster</i> sp.	Cotoneaster	

Species Name	Common Name	Status
<i>Crataegus monogyna</i>	Hawthorn	R
<i>Dactylis glomerata</i>	Cocksfoot	
<i>Erica lusitanica</i>	Spanish Heath	
<i>Festuca arundinacea</i>	Tall Fescue	
<i>Galium aparine</i>	Cleavers	
<i>Genista monspessulana</i>	Montpellier Broom	R, WONS
<i>Holcus lanatus</i>	Yorkshire Fog	
<i>Hordeum murinum</i> s.l.	Barley-grass	
<i>Hypochaeris glabra</i>	Smooth Cat's-ear	
<i>Hypochaeris radicata</i>	Flatweed	
<i>Limonium sinuatum</i>	Notch-leaf Sea-lavender	
<i>Lolium perenne</i>	Perennial Rye-grass	
<i>Phalaris aquatica</i>	Toowoomba Canary-grass	
<i>Pinus radiata</i>	Radiata Pine	
<i>Plantago coronopus</i>	Buck's-horn Plantain	
<i>Plantago lanceolata</i>	Ribwort	
<i>Romulea rosea</i>	Onion Grass	
<i>Rosa rubiginosa</i>	Sweet Briar	C
<i>Rubus fruticosus</i> spp. agg.	Blackberry	C, WONS
<i>Rumex crispus</i>	Curled Dock	
<i>Schinus molle</i>	Pepper Tree	
<i>Sonchus asper</i> s.l.	Rough Sow-thistle	
<i>Sonchus oleraceus</i>	Common Sow-thistle	
<i>Trifolium arvense</i> var. <i>arvense</i>	Hare's-foot Clover	
<i>Trifolium campestre</i> var. <i>campestre</i>	Hop Clover	
<i>Trifolium repens</i> var. <i>repens</i>	White Clover	
<i>Trifolium</i> spp.	Clover	
<i>Triticum aestivum</i>	Wheat	
<i>Ulex europaeus</i>	Gorse	C, WONS
<i>Vulpia</i> sp.	Fescue	

## Appendix D – Likelihood of threatened fauna

One category of likelihood is assigned to each threatened species according to the following criteria:

**KNOWN** – Recorded within the study area boundary within the last 5 years (includes records from this survey)

**HIGH** – Suitable habitat present within the study area **and/or** species recorded within the study area within 20 years generally

**MEDIUM** - Suitable habitat present within the study area but is modified/degraded, species may or may not have been recorded from within the study area

**LOW** – Suitable habitat unlikely to occur within the study area **or** suitable habitat substantially modified/degraded **or** suitable habitat present but species not recorded for over 50 years, **or** suitable habitat present within the study area but species is unlikely to make substantial use of this habitat e.g. vagrant species.

**Key to Table:**

EPBC *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*

FFG *Victorian Flora and Fauna Guarantee Act 1988*

DEWLP (=DEPI/DSE) Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2013) or Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2009)

VBA Victorian Biodiversity Atlas

PMST Protected Matters Search Tool

Recs Number of species recorded within 5 km of the study area from the VBA

Source Indicates data directory from which information was sourced. All dates are representative of the most recent record of that species within 5 km of the study site from the VBA database, unless a more recent record was identified during desktop assessment for a species of concern.

**Status of species:**

EW Extinct in the Wild

CR Critically Endangered

EN Endangered

VU Vulnerable

DD Data Deficient

CD Conservation Dependent

NT Near Threatened

L Listed as threatened under the FFG Act

Common name	Scientific Name	EPBC	FFG	DEWLP	Source	VBA recs	VBA last	Likelihood of Occurrence	Comments
<b>Mammals</b>									
Eastern Barred Bandicoot	<i>Perameles gunnii</i>	EN	L	EW	VBA	16	10/12/1918	Low	Species not known from area since 1918. Thought to be extinct in the wild in Victoria.
Southern Brown Bandicoot	<i>Isodon obesulus obesulus</i>	EN	L	NT	PMST		na	Low	Study area outside of species distribution
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	VU	L	VU	PMST		na	Low	Suitable habitat present but species never recorded within study area. Nearest record approximately 30 km to the east. Species unlikely to be dependent on habitat within the study area.
Brush-tailed Phascogale	<i>Phascogale tapoatafa tapoatafa</i>		L	VU	VBA	6	9/05/1997	High	Suitable habitat present. Species recorded to east of study area along Western Highway in 2011 (DEWLP Biodiversity Interactive Maps Accessed Nov 2014)
<b>Birds</b>									
Regent Honeyeater	<i>Anthochaera phrygia</i>	EN	L	CR	VBA	1	1/09/1971	Medium	Suitable habitat within the study area but species not recorded since 1971
Australasian Bittern	<i>Botaurus poiciloptilus</i>	EN	L	EN	PMST		na	Low	No suitable habitat present within study area
Swift Parrot	<i>Lathamus discolor</i>	EN	L	EN	PMST		na	Low	Suitable habitat present but species never recorded within study area. Nearest record greater than 25 km away. Whilst species may occasional make use of the study area it is outside of the main distribution.
Australian Painted Snipe	<i>Rostratula australis (=benghalensis)</i>	VU	L	CR	PMST		na	Low	No suitable habitat present within study area
Gull-billed Tern	<i>Gelochelidon nilotica macrotarsa</i>		L	EN	VBA	1	30/12/1992	Low	No suitable habitat present within study area
Blue-billed Duck	<i>Oxyura australis</i>		L	EN	VBA	1	16/01/1980	Medium	Suitable habitat present within study area but not recorded since 1980
Diamond Firetail	<i>Stagonopleura guttata</i>		L	NT	VBA	1	21/01/1977	Medium	Suitable habitat within the study area but species not recorded since 1977
Brolga	<i>Grus rubicunda</i>		L	VU	VBA	18	1/07/2005	Known	Species record in 2011 within study area (DEWLP Biodiversity Interactive Maps Accessed Nov 2014)
Eastern Great Egret	<i>Ardea modesta</i>		L	VU	PMST VBA	1	18/09/1979	Low	Small amounts of suitable habitat present within the study (though modified), species is unlikely to make substantial use of this habitat
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>		L	VU	PMST		na	Low	Species never recorded in study area. No suitable habitat.
Powerful Owl	<i>Ninox strenua</i>		L	VU	VBA	7	10/08/1998	High	Suitable habitat present. Species recorded from within the study area in 1998.
Painted Honeyeater	<i>Grantiella picta</i>		L	VU	VBA	1	11/11/1972	Medium	Suitable habitat within the study area but species not recorded since 1972
Emu	<i>Dromaius novaehollandiae</i>			NT	VBA	2	3/08/1991	High	Species recorded within 100 m of study area during assessment

Common name	Scientific Name	EPBC	FFG	DEWLP	Source	VBA recs	VBA last	Likelihood of Occurrence	Comments
Latham's Snipe	<i>Gallinago hardwickii</i>			NT	PMST VBA	1	20/01/2000	Low	No suitable habitat present within study area
Spotted Harrier	<i>Circus assimilis</i>			NT	VBA	1	1/09/1982	Medium	Suitable habitat present within the study area but modified and degraded.
Black-eared Cuckoo	<i>Chrysococcyx osculans</i>			NT	VBA	1	12/11/1970	Medium	Suitable habitat within the study area but species not recorded since 1970
Brown Treecreeper (south-eastern ssp.)	<i>Climacteris picumnus victoriae</i>			NT	VBA	8	2/05/1999	High	Suitable habitat present. Species recorded from within study area in 1990 and within 5 km in 1999.
Black-chinned Honeyeater	<i>Melithripteris gularis gularis</i>			NT	VBA	1	24/05/2001	High	Most recently recorded from within 5 km of study area in 2001. Suitable habitat present
Australasian Shoveler	<i>Anas rhynchos</i>			VU	VBA	2	7/10/1986	Known	Species recorded within the study area during this assessment
Hardhead	<i>Aythya australis</i>			VU	VBA	2	29/08/2001	Known	Species recorded within the study area during this assessment
White-throated Needletail	<i>Hirundapus caudacutus</i>			VU	PMST		na	Low	Species may occasionally visit study area but rarely lands within Australia. Species is unlikely to make substantial use of the habitat within the study area.
<b>Reptiles</b>									
Striped Legless Lizard	<i>Delma impar</i>	VU	L	EN	PMST		na	Medium	Suitable habitat within the study area but modified. Species recorded from within 20 km. Within DEWLP known/likely to occur modelled distribution.
Common Long-necked Turtle	<i>Chelodina longicollis</i>			DD	VBA	1	1/01/1991	Medium	Suitable habitat present within the study area but is modified/degraded
<b>Frogs</b>									
Growing Grass Frog	<i>Litoria raniformis</i>	VU	L	EN	PMST VBA	11	1/11/2001	High	Most recently recorded from within study area in 2001. Suitable habitat present.
Brown Toadlet	<i>Pseudophryne bibronii</i>		L	EN	EHP 2014		na	High	Suitable habitat present. Species recorded from within the study area in 2011 (DEWLP Biodiversity Interactive Maps Accessed Nov 2014)
Southern Toadlet	<i>Pseudophryne semimarmorata</i>			VU	VBA	3	01/03/1885	Low	Suitable habitat present but species not recorded for more than 50 years.
<b>Invertebrates</b>									
Golden Sun Moth	<i>Synemon plana</i>	CR	L	CR	PMST		na	High	Suitable habitat present within the study area. Species record during 2011/12 summer between Beaufort and Ararat (VicRoads 2012)



## Appendix E – Fauna species list

Common name	Scientific Name	EPBC	FFG	DEWLP	VTWBC	Migratory
<b>Mammals</b>						
Black Wallaby	<i>Wallabia bicolor</i>					
Eastern Grey Kangaroo	<i>Macropus giganteus</i>					
European Rabbit*	<i>Oryctolagus cuniculus</i>					
Brown Hare*	<i>Lepus capensis</i>					
<b>Birds</b>						
Emu	<i>Dromaius novaehollandiae</i>			NT	A	
Eurasian Coot	<i>Fulica atra</i>					
Hoary-headed Grebe	<i>Poliocephalus poliocephalus</i>					
Masked Lapwing	<i>Vanellus miles</i>					
Straw-necked Ibis	<i>Threskiornis spinicollis</i>					
White-faced Heron	<i>Egretta novaehollandiae</i>					
White-necked Heron	<i>Ardea pacifica</i>					
Australian Wood Duck	<i>Chenonetta jubata</i>					
Pacific Black Duck	<i>Anas superciliosa</i>					
Grey Teal	<i>Anas gracilis</i>					
Australasian Shoveler	<i>Anas rhynchotis</i>			VU		
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>					
Hardhead	<i>Aythya australis</i>			VU		
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>					
Black Kite	<i>Milvus migrans</i>					
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>					
Long-billed Corella	<i>Cacatua tenuirostris</i>					
Galah	<i>Cacatua (Eolophus) roseicapilla</i>					
Crimson Rosella	<i>Platycercus elegans</i>					
Laughing Kookaburra	<i>Dacelo novaeguineae</i>					
Rainbow Bee-eater	<i>Merops ornatus</i>					Mi
Welcome Swallow	<i>Hirundo neoxena</i>					
Tree Martin	<i>Hirundo nigricans</i>					
Grey Fantail	<i>Rhipidura fuliginosa</i>					
Jacky Winter	<i>Microeca fascians</i>				Key	
Eastern Yellow Robin	<i>Eopsaltria australis</i>				A	
Rufous Whistler	<i>Pachycephala rufiventris</i>				A	
Grey Shrike-thrush	<i>Colluricincla harmonica</i>					
Brown Thornbill	<i>Acanthiza pusilla</i>					
Golden-headed Cisticola	<i>Cisticola exilis</i>					
Superb Fairy-wren	<i>Malurus cyaneus</i>					
Dusky Woodswallow	<i>Artamus cyanopterus</i>				A	
White-throated Treecreeper	<i>Cormobates leucophaeus</i>					
Striated Pardalote	<i>Pardalotus striatus</i>					
White-naped honeyeater	<i>Melithreptus lunatus</i>					
White-eared honeyeater	<i>Lichenostomus leucotis</i>					
Red Wattlebird	<i>Anthochaera carunculata</i>					
Australian Raven	<i>Corvus coronoides</i>					
White-winged Chough	<i>Corcorax melanorhamphos</i>					
Pied Currawong	<i>Strepera graculina</i>					

Common name	Scientific Name	EPBC	FFG	DEWLP	VTWBC	Migratory
Grey Currawong	<i>Strepera versicolor</i>					
Australian Magpie	<i>Gymnorhina tibicen</i>					
Common Starling*	<i>Sturnus vulgaris</i>					
<b>Reptiles</b>						
Stumpy-tailed Lizard	<i>Tiliqua rugosa</i>					

## Appendix F – Previous alignment options







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