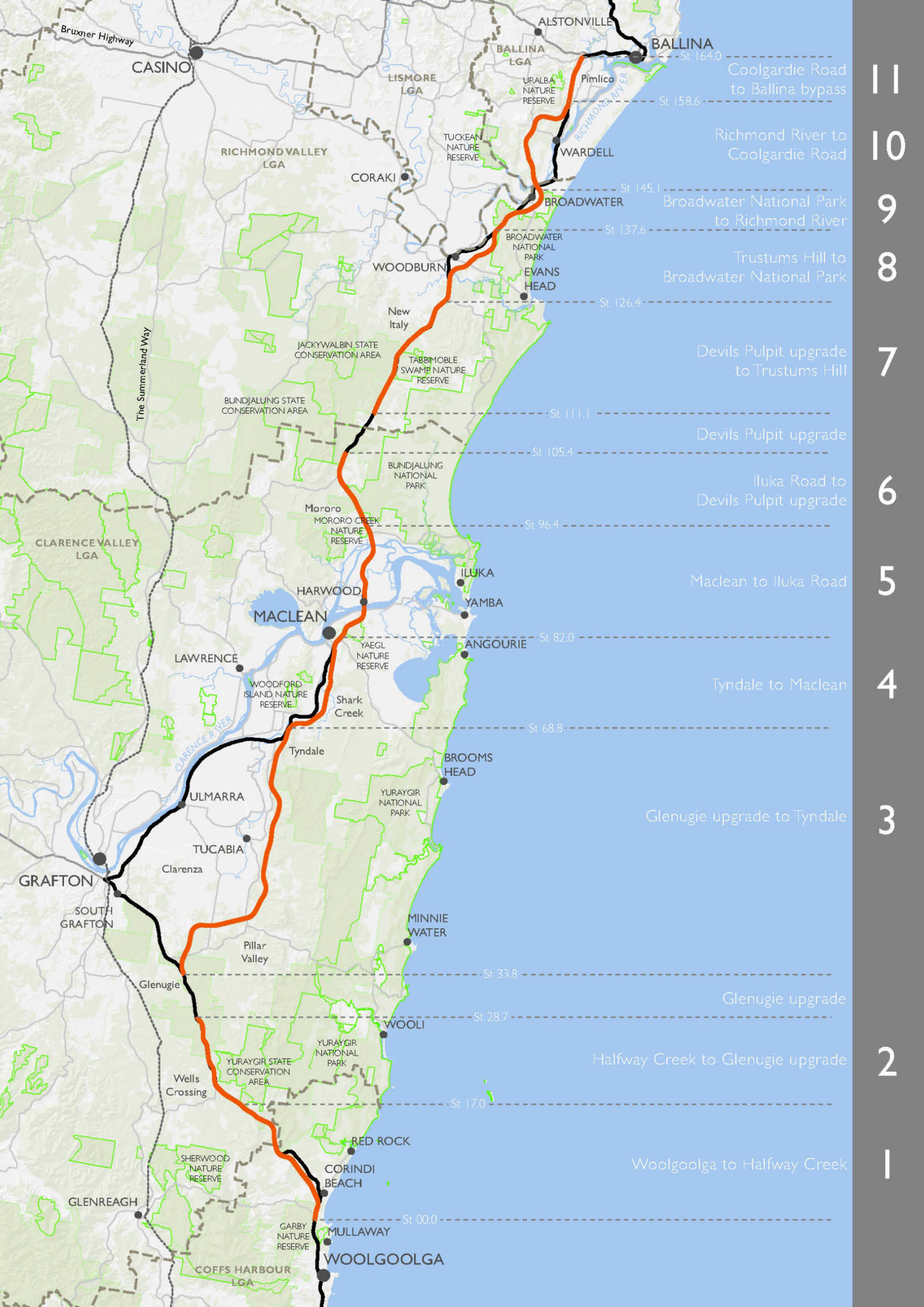


## **NSW Roads and Maritime Services**

# **WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE SUBMISSIONS / PREFERRED INFRASTRUCTURE REPORT**

Chapter 4

November 2013



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Coolgardie Road to Ballina bypass  
Richmond River to Coolgardie Road  
Broadwater National Park to Richmond River  
Trustums Hill to Broadwater National Park  
Devils Pulpit upgrade to Trustums Hill  
Devils Pulpit upgrade  
Iluka Road to Devils Pulpit upgrade  
Maclean to Iluka Road  
Tyndale to Maclean  
Glenugie upgrade to Tyndale  
Glenugie upgrade  
Halfway Creek to Glenugie upgrade  
Woolgoolga to Halfway Creek

BRUXNER HIGHWAY  
CASINO  
LISMORE LGA  
RICHMOND VALLEY LGA  
CORAKI  
WOODBURN  
NEW ITALY  
JACKY WALBIN STATE CONSERVATION AREA  
TABBIMBLE SWAMP NATURE RESERVE  
BUNDJALUNG STATE CONSERVATION AREA  
BUNDJALUNG NATIONAL PARK  
MORORO MORORO CREEK NATURE RESERVE  
CLARENCE VALLEY LGA  
HARWOOD  
MACLEAN  
LAWRENCE  
WOODFORD ISLAND NATURE RESERVE  
SHARK CREEK  
TYNDALE  
ULMARRA  
TUCABIA  
CLARENZA  
GRAFTON  
SOUTH GRAFTON  
GLENUGIE  
WELLS CROSSING  
SHERWOOD NATURE RESERVE  
GLENREAGH  
SHERWOOD NATURE RESERVE  
CORINDI BEACH  
GARBY NATURE RESERVE  
COFFS HARBOUR LGA  
WOLFGOOLGA  
ALSTONVILLE  
BALLINA LGA  
URALBA NATURE RESERVE  
PIMLICO  
RICHMOND RIVER  
WARDELL  
BROADWATER  
BROADWATER NATIONAL PARK  
EVANS HEAD  
ILUKA  
YAMBA  
ANGOURIE  
BROOMS HEAD  
YURAYGIR NATIONAL PARK  
MINNIE WATER  
WOOLI  
RED ROCK

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### Social and economic

There would be a change in residential amenity at the nearest receiver R1853 to the west of the project at station 152.8, and north of the borrow site. The distance between the property and the project boundary would be around 60 metres (120 metres closer to the project boundary than shown in the EIS).

Other than amenity impacts, the design refinement would not impact on any social infrastructure.

No mitigation or management measures are required beyond those identified in the EIS.

### Management and mitigation

The additional mitigation measure recommended for this design refinement is presented in Table 4-53 and Chapter 5. This design refinement would not require a change to the other proposed mitigation and management measures in Chapter 19 of the EIS.

**Table 4-53: West of Wardell borrow site – additional mitigation**

Issue	ID number	Mitigation measure	Timing	Relevant section
Urban design	UD11	Any backfilling of the Lang Hill and West of Wardell borrow sites will be undertaken with available surplus material from the project. Rehabilitation of the sites will be undertaken in accordance of the landscape strategy (UD3), design principles (UD5) and the intended future land use of the sites.	Construction	8, 10

#### 4.4.18 Interchange layout at Wardell

##### Location

The interchange at Wardell would be located between Coolgardie Road and Pimlico in Section 10 (station 157.5). It would provide access from the highway to Wardell and Broadwater.

##### EIS design

The interchange at Wardell would be a dual roundabout. The roundabouts would be located both sides of the upgraded highway and connected by an overbridge. A third roundabout would connect the interchange to a service road.

North-facing and south-facing ramps would provide highway access to the interchange and connections to Coolgardie Road and Wardell.

The western roundabout would connect the ramps associated with the northbound carriageway and Coolgardie Road. The eastern roundabout would connect the ramps associated with the southbound carriageway and a connector road to a third roundabout at the existing highway, which would become a service road. The service roads would provide access to Wardell to the south or Pimlico to the north and ultimately connect to adjacent interchanges.

##### Proposed design refinement

The design refinement between stations 155.4 and 159.5 would revise the layout of the interchange at Wardell. The design refinement is shown in Figure 4-38 and includes:

- Relocating the highway alignment south-east from station 155.4 to the interchange at Wardell.
- Relocating the highway alignment east between station 158.3 and 159.5.
- Changing the layout of the interchange as follows:
  - Relocating the western roundabout around 50 metres east.
  - Removing the third roundabout.

- Relocating the eastern roundabout around 200 metres north-east to provide access to and from the southbound carriageway and also to the service road and local road network.
- Realigning the overpass and access between Coolgardie Road and the existing highway.
- Realigning on-ramps for northbound and southbound traffic to access the upgraded highway.
- Realigning off-ramps for northbound and southbound traffic to access the existing highway.
- Providing a local access into Kays Road from the existing highway, south of the interchange, around station 157.1.
- Narrowing the median between station 155.7 and 158.6 to initially minimise the project footprint. Potential future widening to provide two additional lanes would be undertaken on the outside shoulder of each carriageway (subject to a future approval).
- Modifying the earthworks to minimise the construction footprint and clearing boundary.
- Relocating the dedicated fauna landbridge around 100 metres further east, at station 156.1.

Details of the revised interchange layout are shown in Figure 4-39 to Figure 4-41.

### **Reason for design refinement**

The design refinement is required to avoid direct impacts on known Pink Underwing Moth habitat (*Phyllodes imperialis southern subsp*) (listed as endangered on the EPBC Act) and to minimise impacts on potential habitat. The known and potential habitat for the Pink Underwing Moth is found within the vegetation type Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (Critically endangered, EPBC Act; Endangered, TSC Act).

The project realignment and interchange changes would avoid direct impacts and minimise indirect impacts on the Lowland Rainforest and a range of threatened rainforest plants. The design refinement would also minimise impacts on the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia (critically endangered EPBC Act and endangered TSC Act).

### **Consultation**

The design refinement has been developed based on consultation with the Commonwealth Department of Environment, arising from concerns about impacts on the Pink Underwing Moth.

Roads and Maritime also consulted with property owners directly affected by this design refinement.

### **Environmental assessment**

#### **Hydrology and flooding**

The design refinement would cross Randles Creek at station 157.8. This is a small watercourse within the lower catchment of the Richmond River. The twin bridges over Randles Creek would move east by less than 20 metres due to the relocation of the alignment. There would be no change to the design of the 20-metre-long bridges and no additional impacts on the hydrology and flooding behaviour of the waterway are anticipated.

The design refinement is not situated within the Richmond River floodplain and would not affect flooding behaviour in the area.

No additional impacts are anticipated during construction and operation and no mitigation or management measures are required beyond those identified in the EIS.

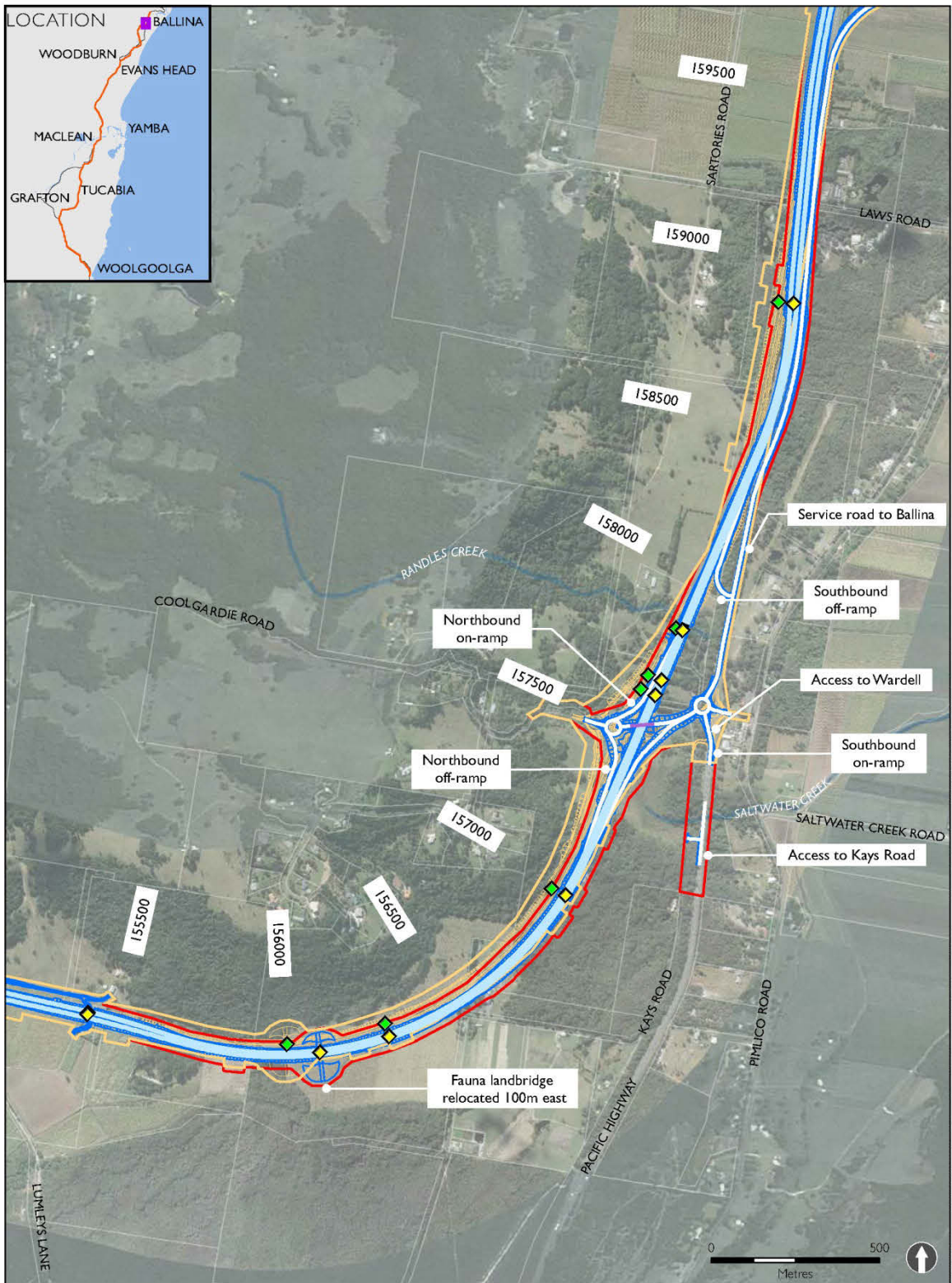
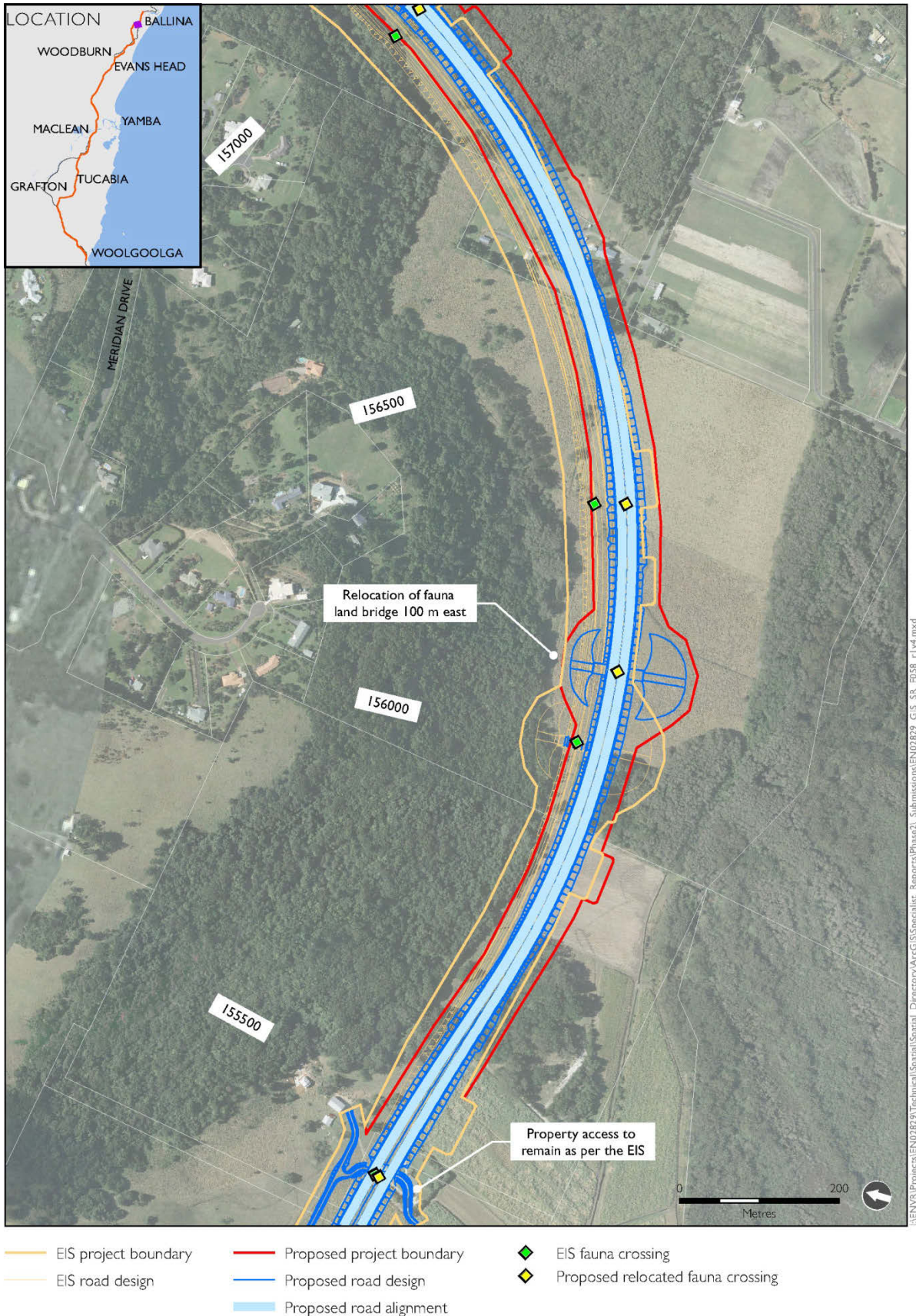


Figure 4-38: Overview of revised interchange design at Wardell



**Figure 4-39: Revised interchange at Wardell station 155.5 to 157.5**

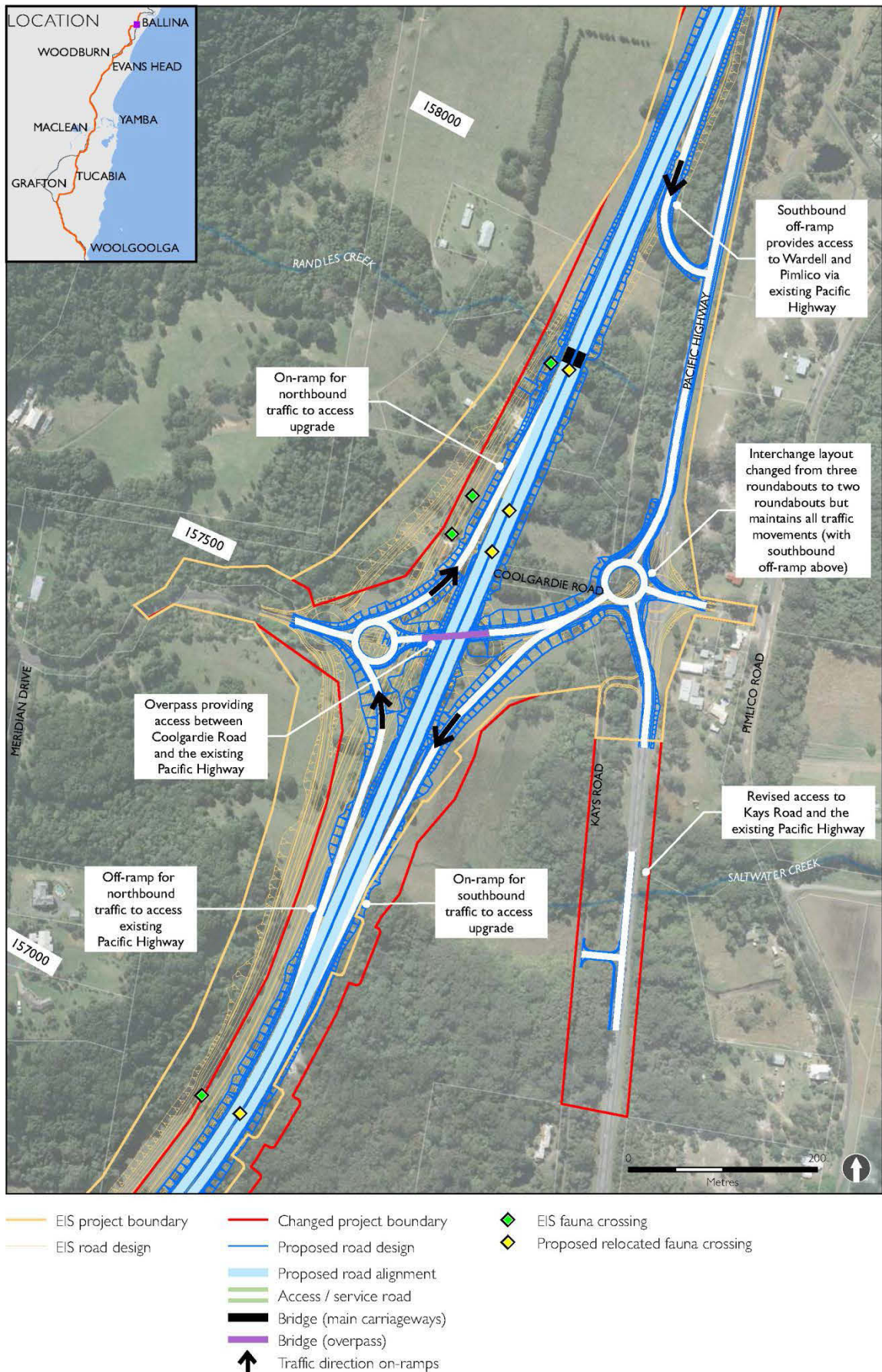
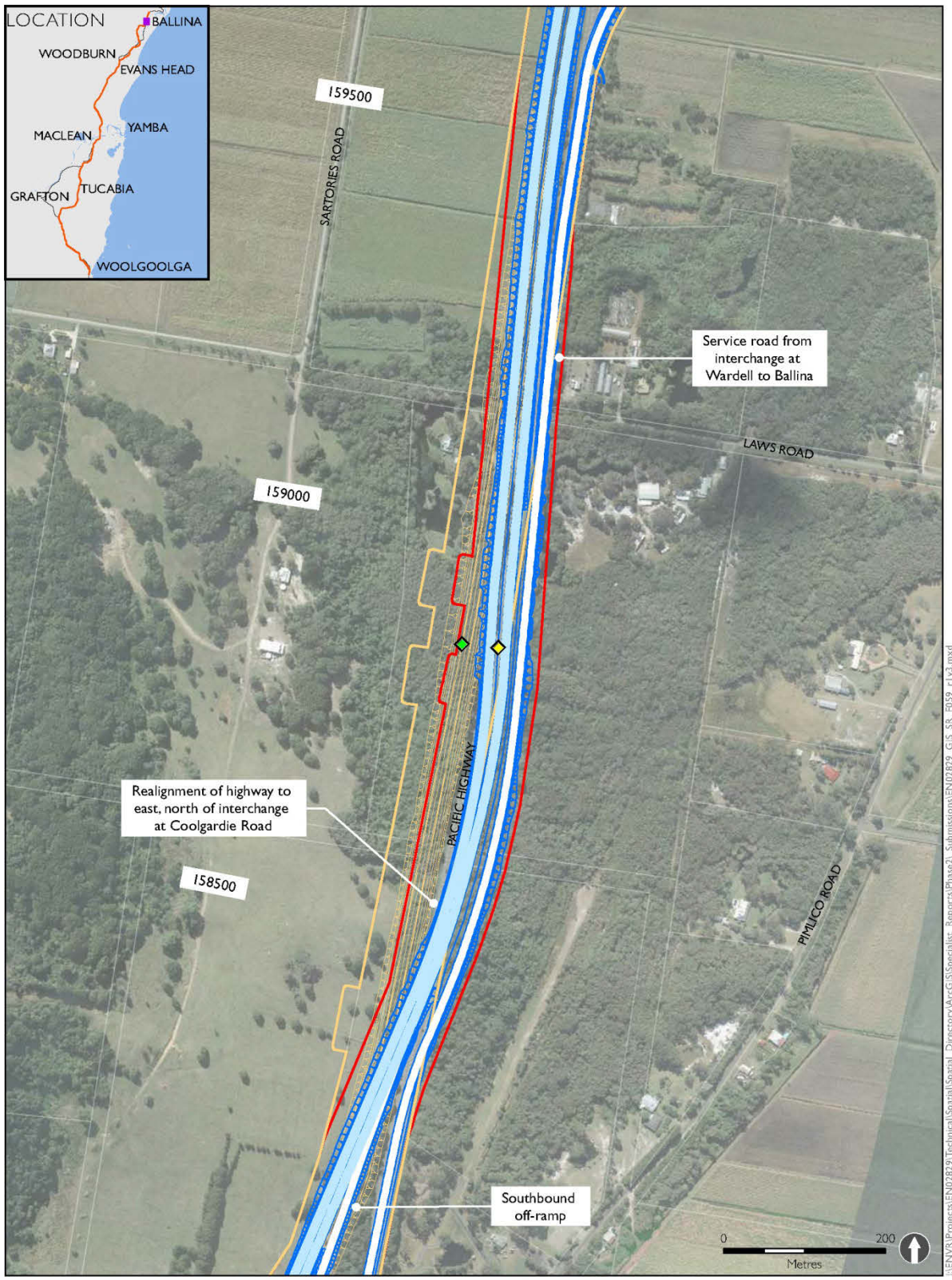


Figure 4-40: Revised interchange at Wardell station 157.5 to 158.5



**Figure 4-41: Revised interchange at Wardell station 158.5 to 159.5**

### Soils, sediments and water

The design refinement would be mostly located in an area of no known occurrence of acid sulfate soils. North of the interchange, the project alignment would be located in an area mapped as having a low occurrence of acid sulfate soils.

Near Laws Road, in the northern section of the design refinement, potential contamination has been noted from agricultural land uses. Investigations would be undertaken (as identified in section 9.4 of the EIS) to identify and manage any potential contamination.

The design refinement would cross Randles Creek. The design refinement would include sedimentation and water quality basins to manage water runoff that would otherwise affect water quality in the creek.

Groundwater drawdown or changes to quality are unlikely to be result from the design refinement as the project would be located on a series of low embankments with only shallow cuttings required.

The impacts of this design refinement would be consistent with the impacts described in section 9.3 of the EIS with no additional impacts anticipated during construction and operation. Therefore, no mitigation or management measures are required beyond those identified in the EIS.

### Biodiversity

The road alignment between station 154.0 and 158.0 would be positioned to follow the base of the foothills of a low basalt escarpment covering both vegetated and cleared land. Vegetation to the west of the road within the escarpment and foothills is dominated by rainforest while to the east of the project the vegetation is low-lying and mostly dominated by Eucalypt or Melaleuca forests. Biodiversity features of the design refinement are shown in Figure 4-42 to Figure 4-44.

The key objective of the design refinement is to avoid impacts on known habitat and potential habitat of the Pink Underwing Moth. The refinement also aims to minimise impacts on listed rainforest vegetation patches (EPBC Act and TSC Act) and a number of threatened rainforest flora. However, the design refinement would increase impact on other EPBC Act listed items including habitat critical to the survival of the koala and on *Acronychia littoralis*, a threatened plant species. There would also be increased impacts on non-listed vegetation communities over that identified in the EIS.

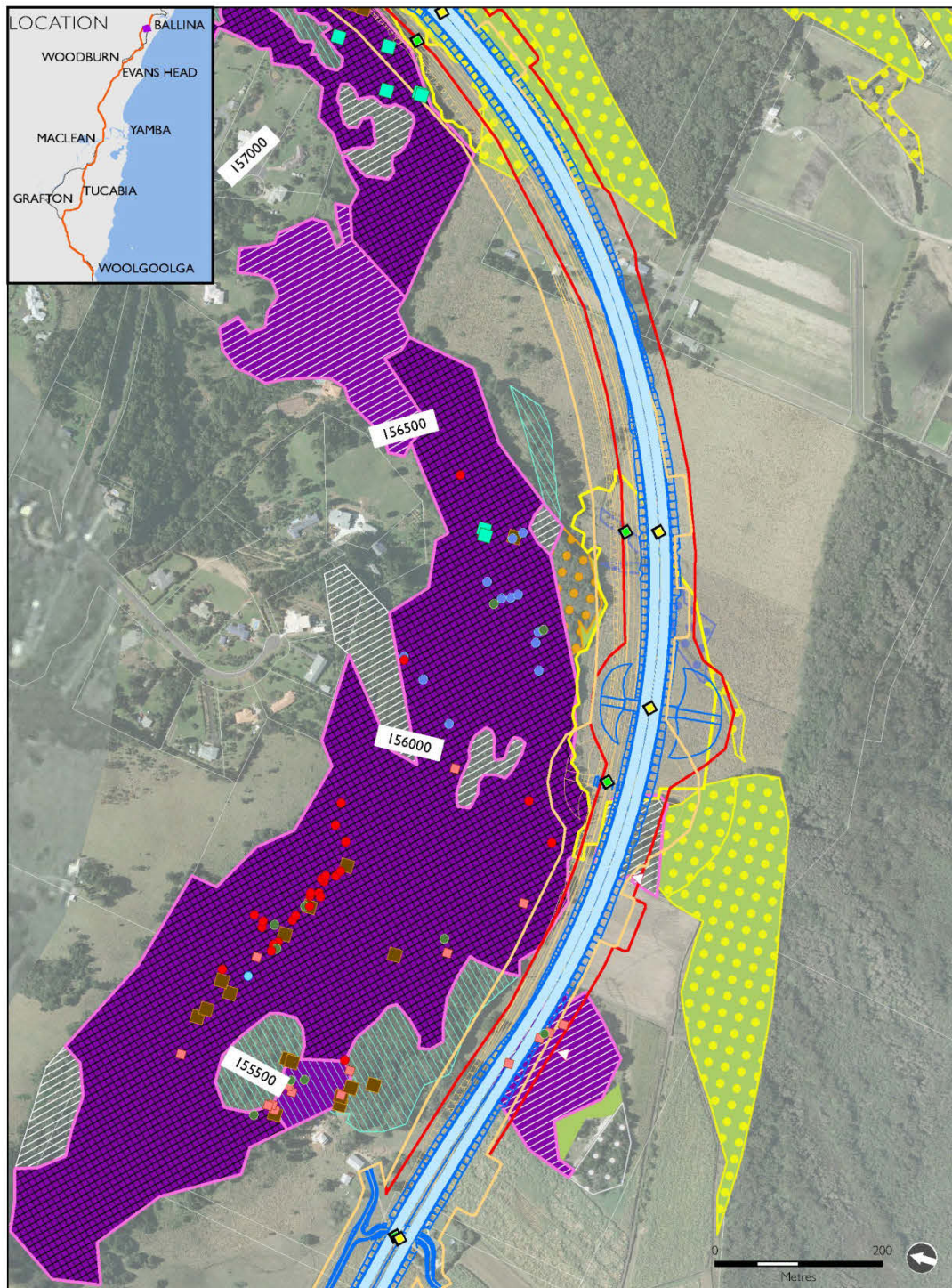
For further details refer to the Supplementary Biodiversity Assessment included in Appendix J.

#### Pink Underwing Moth (*Phyllodes imperialis southern subsp*)

The EIS design would directly impact on 6.4 hectares of known and potential habitat for the Pink Underwing Moth. Under the design refinement, this direct impact would be reduced to 2.5 hectares of potential habitat (Table 4-54). Of particular importance is the reduction in the direct impact on known habitat for the species (ie from 1.2 hectares down to zero) and the complete avoidance of direct impacts on areas where the host plant for the moth (*Carronia multisepelea*) has been recorded.

**Table 4-54: Comparison of impacts on habitat for the Pink Underwing Moth**

Habitat	EIS design	Design refinement
Known habitat (moth presence confirmed)	1.2 ha	0.0 ha
Potential habitat (non-breeding; no host plant present)	4.7 ha	2.5 ha
Potential habitat (breeding; host plant present)	0.5 ha	0.0 ha
Total	6.4 ha	2.5 ha



**Figure 4-42: Revised interchange at Wardell with biodiversity features station 155.5 to 157.5**



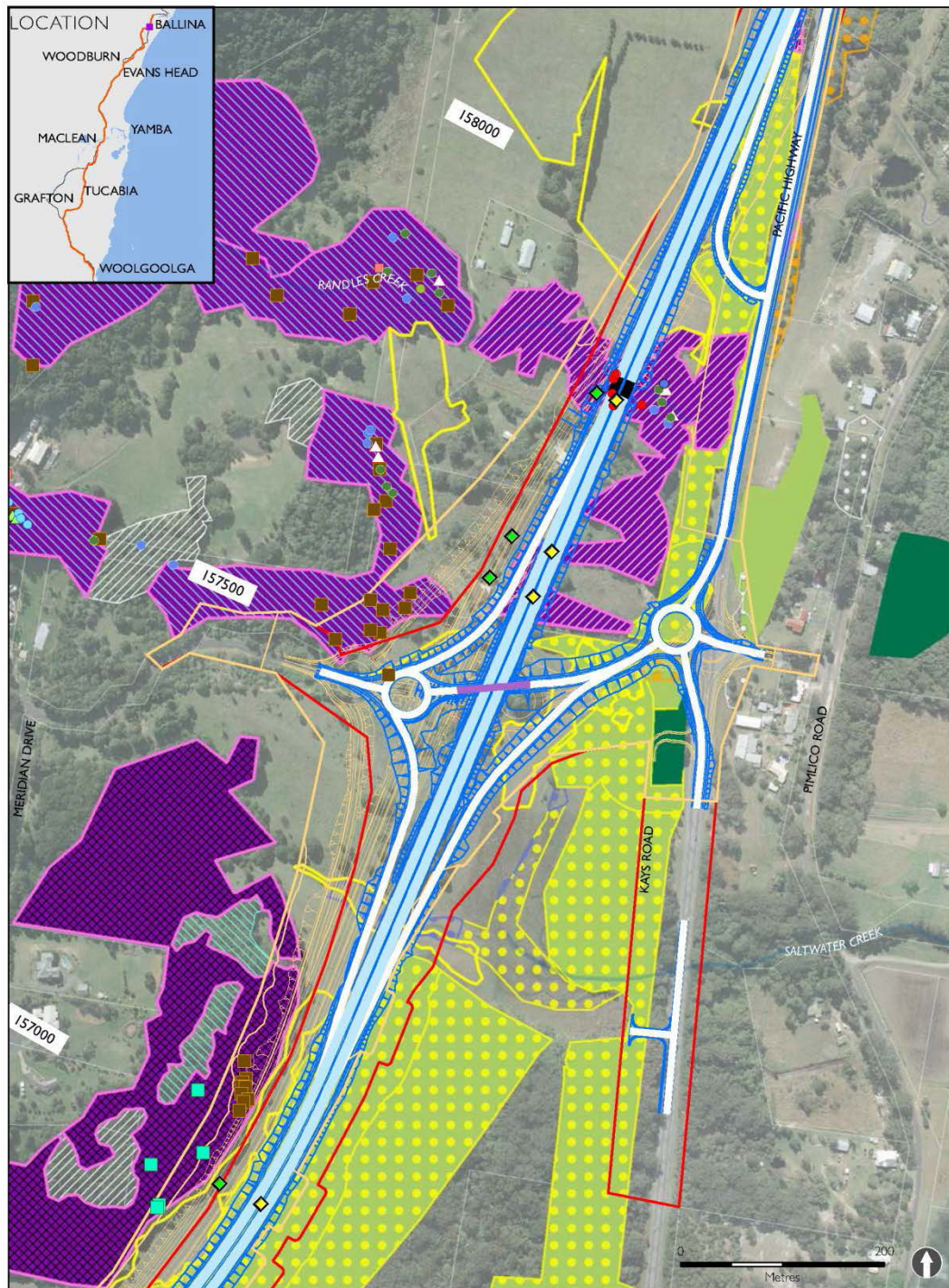
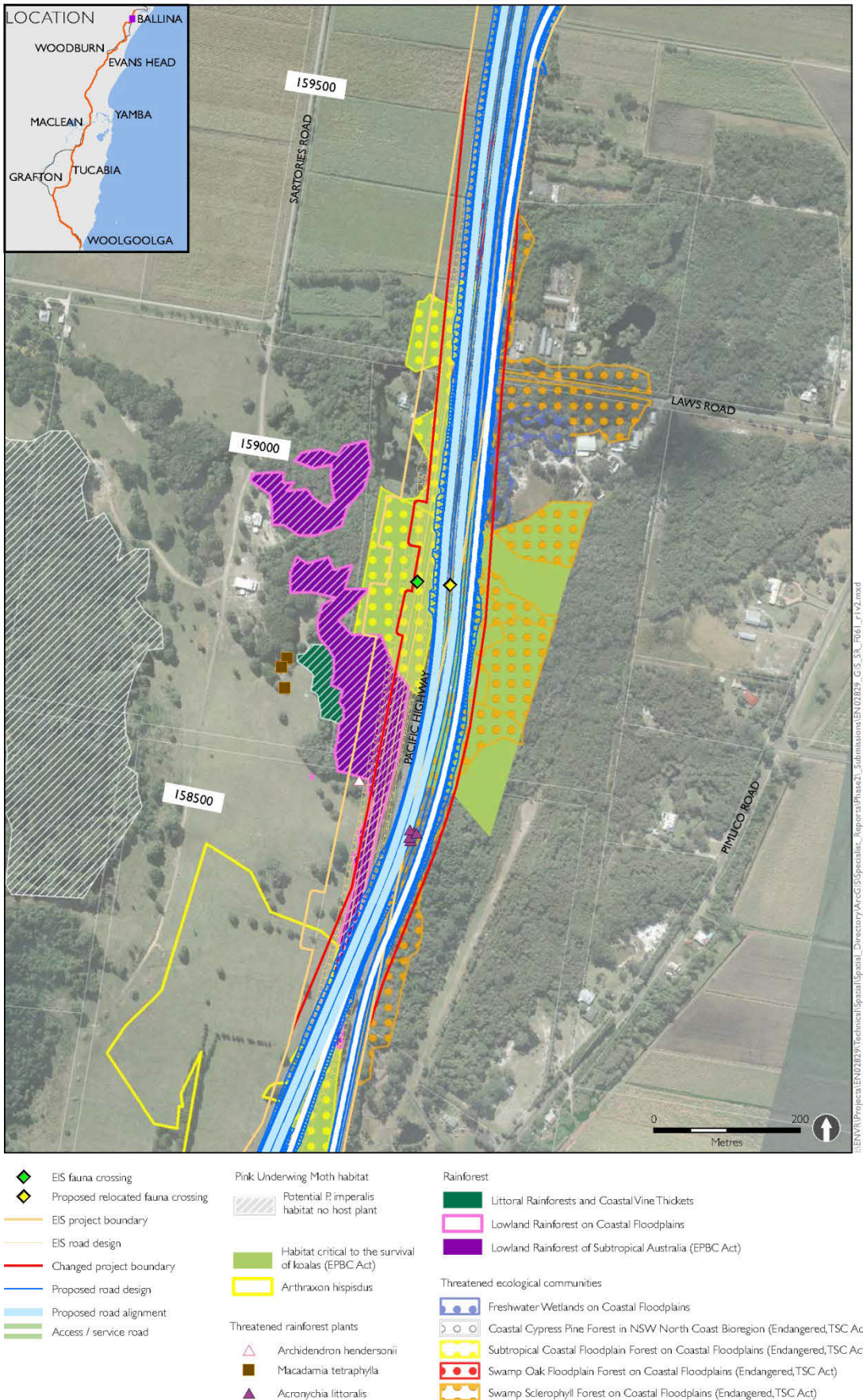


Figure 4-43: Revised interchange at Wardell with biodiversity features station 157.5 to 158.5



**Figure 4-44: Revised interchange at Wardell with biodiversity features station 158.5 to 159.5**

The design refinement would pass through an area of cleared land which adjoins the known and potential habitat of the Pink Underwing Moth, resulting in an existing edge effect on this habitat. This habitat appears in the form of a denser understorey, more open canopy in parts, and presence of weeds (mostly Camphor Laurel and Lantana, although these weeds also occur throughout the rainforest patches). There are no impacts from runoff at the site due to the slope of the site, but there is evidence of grazing in parts of the known moth habitat. Despite the existing edge effects, the host plant (*Carronia multisepealea*), and eggs and larvae of the Pink Underwing Moth were located within the edge zones.

The presence of the highway would contribute to indirect impacts at the current edge-affected zone although it may be difficult to distinguish these from the existing impacts particularly where weed invasion is concerned. Also dust created during construction and during operation from vehicle emissions may settle on habitat areas and inhibit egg and/or larvae viability. A changed structure of the habitat (canopy and shade) in edge areas could also lead to competition with the host plant and decreased potential for breeding and feeding.

Traffic and street lighting and noise would be new impacts that may negatively impact on the species, and so were considered in the design refinement. There is no published research on the effects of lights on the Pink Underwing Moth; while any lights are likely to disrupt normal adult moth activity for a range of common species, lights are not particularly attractive to species of Phyllodes moths (Dr Don Sands, pers. comm.). Night-time lights are not expected to pose a significant threat to the Pink Underwing Moth because:

- Car headlights would be transient rather than fixed.
- The design refinement would shift the alignment further east near Coolgardie Road to minimise potential impacts from lighting on the habitat of the moth.
- Lighting would not be provided for the ramps associated with the interchange at Wardell.

However, a management measure (B56) has been included to minimise potential light spill from required lighting on the western roundabout to minimise any potential impacts.

Currently there is limited potential for dispersal of the species at this location, which favours dense shaded canopy and, given its large size, is susceptible to air movements (wind) restricting its dispersal capability over cleared land. Given that the majority of the habitat of the moth occurs to the west of the project, impacts from habitat fragmentation and loss of connectivity are not expected. While the presence of the road corridor and traffic would inhibit movements of the moth, there are currently limited opportunities for dispersal to the east, due to the absence of preferred habitat, with the exception of a patch (around 6.5 hectares) of potential habitat (non-breeding) that would become fragmented to the east of the highway on the northern side of the interchange at Wardell (station 157.0). The area of habitat isolated by the project would be expected to provide only marginal non-breeding habitat for the moth and possible temporary refuge area during dispersal. Dispersal is likely to currently occur to the north and west of the project and may be associated with Randles Creek (Dr Don Sands, pers. comm.).

As noted above, the design at this location incorporates a narrower median to avoid impacts on the known Pink Underwing Moth habitat. This narrower median means any future upgrade to a six-lane highway would be constructed on the outside of the carriageways and not in the median as per the remainder of the project. The assessment of direct impacts on the known habitat has been based on (generally) a 10-metre construction boundary, which is sufficient for construction of the project. An additional assessment was undertaken for a 13-metre boundary (which would factor in a 10-metre construction boundary and a third traffic lane). This found that there would not be any further direct impacts on the known habitat as a result of the increased footprint.

### **Lowland rainforest**

The EIS design would have impacted on 10.3 hectares of lowland rainforest, listed as endangered on the TSC Act (Lowland Rainforest on Coastal Floodplains) of which 5.8 hectares is consistent with the Commonwealth listed endangered ecological community on the EPBC Act (Lowland Rainforest of Subtropical Australia).

The design refinement would have a reduced impact on Lowland Rainforest, impacting on 2.5 hectares. Overall, the project would now impact on 4.2 hectares of Lowland Rainforest (TSC Act listed), with two hectares being consistent with the EPBC Act listing criteria.

The project has been positioned to traverse cleared areas as much as possible with much of the rainforest positioned upslope and to the west. Due to the existing cleared habitat, there is an existing edge-affected zone along the edge of the rainforest. Indirect impacts on this edge-affected zone could occur from potential weed invasion, particularly Camphor Laurel. Indirect impacts from surface runoff are expected to be minimal with the upgraded highway draining away from the rainforest areas.

The design refinement would traverse a larger patch of rainforest (patch 2) between station 157.7 and 157.9 resulting in two smaller patches being retained on either side of the highway. These remaining patches would be subject to future edge effects over a distance of around 300 metres which may impact on their long-term integrity. The design refinement would not increase the impact of fragmentation identified in section 10.3 of the EIS.

### **Littoral rainforest**

The supplementary biodiversity surveys identified an additional 0.2 hectare patch of littoral rainforest south of Coolgardie Road, between the existing highway and Kays Road. This patch meets the criteria given in the listing advice for the Littoral Rainforests and Coastal Vine Thickets of Eastern Australia (EPBC Act listed). It also meets the criteria for Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (TSC Act listed). The entire patch is located adjacent to the highway and a local road. An existing power easement at the northern end of the population impacts the condition of the vegetation and there are a high number of weeds.

The design refinement was further modified to minimise to the greatest extent possible impacts on this patch. However, a small section of around 50 square metres at the northern end would be directly impacted. As such, the design refinement would impact on a littoral rainforest patch not previously impacted by 0.03 hectare, bringing the overall project impact on littoral rainforest to 0.23 hectare.

The design refinement is expected to have a minimal net increase in edge effects beyond what is already occurring. This is because all impacted areas of littoral rainforest are currently positioned along the edge of the existing highway.

### **Other vegetation communities**

The design refinement would result in a slight increase of around 2.3 hectares in the direct impacts on other State listed threatened ecological communities (TECs) and of around 0.9 hectares on other non-listed vegetation types (refer Table 4-55), some of which is habitat critical for the survival of koalas. Much of this increase would occur to the east of the existing highway between stations 158.3 and 159.5 and is associated with existing, edge-affected vegetation.

**Table 4-55: Comparison of impacts on vegetation communities at Wardell interchange**

BioMetric vegetation types*	EIS design (ha)	Design refinement (ha)	Change in vegetation loss (ha)
Blackbutt – Bloodwood Dry Heathy Open Forest on Sandstones of the Northern North Coast	0.1	0.04	-0.06
Coast Cypress Pine Shrubby Open Forest of the North Coast Bioregion (TEC, Coastal Cypress Pine Forest – TSC Act)	0.1	0.2	+0.1
Coastal Floodplain Sedgeland, Rushlands, and Forblands (TEC, Freshwater Wetlands – TSC Act)	0.6	0.7	+0.1
Coastal Heath on Sands of the North Coast	0.0	0.2	+0.2
Flooded Gum – Tallowwood – Brush Box Moist Open Forest of the Coastal Ranges of the North Coast	0.2	0.5	+0.3
Forest Red Gum – Swamp Box of the Clarence Valley Lowlands of the North Coast (TEC, Subtropical Coastal Floodplain Forest – TSC Act)	7.5	6.5	-1.0
Hoop Pine – Yellow Tulipwood dry rainforest of the North Coast	0.5	0.0	-0.5
Paperbark Swamp Forest of the Coastal Lowlands of the North Coast (TEC, Swamp Sclerophyll Forest – TSC Act)	0.0	1.4	+1.4
Red Mahogany Open Forest of the Coastal Lowlands of the North Coast	0.0	0.5	+0.5
Swamp Mahogany Swamp Forest of the Coastal Lowlands of the North Coast (TEC, Swamp Sclerophyll Forest – TSC Act)	0.1	1.8	+1.7
Swamp Oak Swamp Forest of the Coastal Lowlands of the North Coast (TEC, Swamp Oak Floodplain Forest – TSC Act)	0.3	0.3	0.0
Tuckeroo - Riberry - Yellow Tulipwood littoral rainforest of the North Coast (TEC, Littoral Rainforest- EPBC Act)	0.0	0.03	+0.03
White Booyong - Fig subtropical rainforest of the North Coast (TEC, Lowland Rainforest – TSC Act)	6.0	2.6	-3.4
Total	15.4	14.67	-0.63

\*Bold type indicates vegetation communities listed on the *Threatened Species Conservation Act 1995*

### Threatened flora

The design refinement would reduce direct impacts on rainforest vegetation communities, and this would in turn reduce direct impacts on several threatened rainforest flora species. This includes a much reduced impact on the vulnerable species *Macadamia tetraphylla* (EPBC Act and TSC Act) from a loss of 37 plants reported in the EIS to only one plant with the design refinement. Similarly, there would be no direct loss of the vulnerable *Archidendron hendersonii* (TSC Act); the EIS design would impact six plants.

A comparison of impacts on threatened flora is provided in Table 4-56.

**Table 4-56: Comparison of impacts on threatened flora at Wardell interchange**

Species	EPBC Act	TSC Act	EIS design	Design refinement
<i>Archidendron hendersonii</i>		Vulnerable	6 individuals	0 individuals
<i>Cryptocarya foetida</i>	Vulnerable	Vulnerable	13 individuals	13 individuals
<i>Endiandra hayesii</i>	Vulnerable	Vulnerable	5 individuals	5 individuals
<i>Geijera peniculata</i>		Endangered	0 individuals	0 individuals
<i>Macadamia tetraphylla</i>	Vulnerable	Vulnerable	37 individuals	1 individual

Species	EPBC Act	TSC Act	EIS design	Design refinement
<i>Streblus pendulinus</i>	Endangered		0 individuals	16 individuals
<i>Ochrosia moorei</i>	Endangered	Endangered	0 individuals	0 individuals
<i>Acronychia littoralis</i>	Endangered	Endangered	0 individuals	1 individual
<i>Arthraxon hispidus</i>	Vulnerable	Vulnerable	10.4 hectares of known habitat	5.5 hectares of known habitat

During the supplementary biodiversity investigations two new species were identified within the design refinement study area: *Streblus pendulinus* and *Acronychia littoralis*. There would be a direct impact on both species. *Acronychia littoralis* was found on the eastern edge of the existing highway north of Coolgardie Road (station 158.5) in a stand that was apparently entirely clonal (estimated 125 stems from the one parent plant). It is unclear if this clonal stand of *Acronychia sp.* is a form of *A. littoralis* or a sterile form of *A. oblongifolia s. str.* As a precautionary measure this plant is considered as the listed *A. littoralis*. Only one *Acronychia sp.* would be impacted by the design refinement.

*Streblus pendulinus* was not assessed in the EIS as the mainland species was only recently listed on the EPBC Act. The design refinement would remove 16 individuals.

The design refinement would reduce the loss of known habitat area for Hairy Joint Grass (*Arthraxon hispidus*) by around 48 per cent. This is calculated as area of habitat rather than individual plants for this grass species, as individuals are difficult to quantify in the field.

There is potential for indirect impacts to modify the habitat attributes of the remaining areas of Hairy Joint Grass habitat that adjoin the project footprint. Mitigation measures would be implemented to minimise indirect impacts as far as practicable. These would include provision of drainage through bridges and culverts, water quality controls, weed control and habitat restoration. There is potential for indirect impacts on at least five hectares of the remaining areas of occupied habitat of Hairy Joint Grass.

The degree of indirect impacts on threatened flora would not change between the design refinement and the EIS design. This is because the road alignment would only shift slightly and the potential edge effects associated with weeds and runoff would be similar between designs and relate to increased potential for weeds. For rainforest species located on the higher elevated areas upslope and to the west of the alignment, such as *Macadamia tetraphylla*, runoff from the project would not occur, although a potential for increased weed invasion would remain.

### Threatened fauna

Man-made lakes occur on the eastern side of the existing highway, immediately south of Laws Road at station 159.1. These small areas of freshwater provide potential habitat for threatened fish and frog species. Aquatic surveys undertaken in August 2013 failed to find the Oxleyan Pygmy Perch (*Nannoperca oxleyana*) (OPP) in the freshwater habitat. This habitat has been modified through dredging and excavation, reducing its suitability for this species. These freshwater habitats, which extend outside the design refinement to the east, also provide potential habitat for the threatened Green-thighed Frog (*Litoria brevipalmata*), Wallum Sedge Frog (*Litoria olongburensis*) and Wallum Froglet (*Crinia tinnula*). *Crinia tinnula* was confirmed in habitats that occur north and south of Laws Road, in shallow flooded depressions between stations 158.9 and 159.4.

The design refinement would extend around 25–30 metres east beyond the existing footprint and directly impact these small areas of freshwater habitat. The presence of potential habitat is not restricted to the construction boundary, and extends around 250–300 metres from the highway. To the extent that viable populations of these threatened fish and frog species are expected, a large area of potential habitat would remain once the road becomes operational.

There is potential for indirect impacts on these remaining habitats associated with runoff from the road and weed invasion. However, this habitat is adjacent to the existing highway and, as such; conditions at this location are presently affected by those same impacts. Management of surface runoff during construction and operation is required prior to discharging into the remaining aquatic habitats east of the highway (refer to management measures B57 in chapter 5 of this report).

### **Koala habitat**

The low-lying eucalypt forest habitats east of the highway and north and south of Laws Road between stations 158.2 and 159.4 comprise a mix of swamp forest and open forest habitats. The areas are potential habitat for koala, given the presence of the primary koala feed trees, Swamp Mahogany (*Eucalyptus robusta*) and Tallowwood (*E.microcorys*) and the secondary feed tree species Red Mahogany (*Eucalyptus resinifera*) (DECC, 2008). Evidence of koala activity was recorded immediately south of Laws Road on the eastern side of the existing highway at station 159.1. The habitat at this location fits the definition of ‘habitat critical to the survival of koalas’ as per the Commonwealth’s interim advice (DSEWPaC, 2012).

The design refinement would result in an increase in direct impact on koala habitat from 7.8 hectares (EIS design) to 9.3 hectares. This minor 1.5-hectare increase would mostly affect currently edge-affected habitats close to the existing highway. Larger areas of habitat would remain adjacent to these locations. There would be a further small direct loss south of the interchange between station 156.7 and 157.2. The remaining areas of koala habitat would be subject to new edge effects, particularly increased highway noise and, potentially, the spread of weeds.

### **Connectivity for fauna**

The fauna overpass included in the EIS design at station 156.0 (North Wardell fauna bridge) is important for regional connectivity. The inclusion of the overpass in the project targets a range of fauna including the koala, Long-nosed Potoroo and rainforest fauna. It is expected to be used by koalas for dispersal from source populations at Wardell and Bagotville to populations on the Alstonville plateau and Blackwall Range.

In order to minimise the need to clear rainforest habitat (including known habitat of the Pink Underwing Moth) the fauna overpass would be relocated east by around 100 metres under the design refinement. This movement is not expected to change the effectiveness of the structure, as it would remain in the known north–south regional biodiversity corridor link in the landscape. However, the change would place the structure further away from the edge of natural vegetation at the bridge approach. As the structure would be located on land acquired by Roads and Maritime for the project, it is proposed to revegetate the approaches to the landbridge as a key mitigation measure (refer to management measure B58 in chapter 5). The structure and revegetation measures would be monitored as part of the project biodiversity monitoring programs to monitor its effectiveness; additional revegetation or maintenance would be undertaken, if required.

### **Urban design, landscape character and visual**

The landscape character of the area is mainly rural-residential, with large areas of open woodland, agricultural land and the nearby Richmond River floodplain.

The character precincts surrounding the design refinement include Blackwall Range (52) and Pimlico (53). The design refinement would only pass through Pimlico. At the western extent of the design refinement (between stations 155.4 and 156.1), the area is dominated by the Blackwall Range, which includes dense woodland, hills and mountains. Pimlico includes cropping land and floodplains.

The design refinement, while reducing the construction footprint and having a reduced visual impact, would still result in the introduction of new infrastructure to a rural environment. As such, overall impacts on landscape character would not change from negligible (for landscape precinct 52) to moderate (landscape precinct 53), as concluded in the EIS.

A visual impact assessment was undertaken from viewpoints 56 and 57 (interchange at Wardell). From viewpoint 56 (the view east along Coolgardie Road), the impact of the design refinement is likely to continue to be moderate–high due to the visual impact of the interchange. At viewpoint 57 (the view west towards the interchange from Pimlico Road), the impact would also be moderate–high.

The visual impact assessment is consistent with the impacts identified in the EIS and no mitigation or management measures are required beyond those identified in the EIS.

### Aboriginal heritage

From the EIS Aboriginal heritage assessment, five sites were identified in the vicinity of the design refinement. These sites are:

- Site 1 (artefact scatter).
- Rudgley Scarred Tree 2 (scarred tree).
- Rudgley Site 2 (artefact scatter).
- Rudgley Scarred Tree (scarred tree).
- Rudgley Site 1a and 1b (artefact scatter).
- Saezza 1 (artefact scatter).
- Site 12 (artefact scatter).

Further Aboriginal heritage investigations were undertaken to assess this design refinement (refer to Appendix D Addendum CHAR). Surveys and sub-surface testing identified two new sites. These are detailed in Table 4-57.

**Table 4-57: Summary of Aboriginal sites at the interchange at Wardell, survey and sub-surface testing undertaken**

Site name (AHIMS ID)	Site type(s) after survey	Description	Site type(s) (after fieldwork)	Significance
Rudgley Site 2 (04-4-0169)	Updated site – Artefact scatter and PAD	Raised sandplain adjacent to swampy gully and plain feeding into Randles Creek, south of Coolgardie Road	Updated site extent – Artefact scatter	Low–moderate
Rudgley Scarred Tree 2 (pending)	New site – modified tree	Scarred tree located on raised sand plain on bank of swampy gully tributary to Randles Creek	New site – Modified tree	Moderate

The design refinement would have varying impacts on these heritage sites:

- Rudgley Scarred Tree (04-4-0170) and Site 12 (04-4-0176) would no longer be impacted by the project with no potential for direct or indirect impacts.
- Rudgley Scarred Tree 2 could be potentially indirectly impacted during construction, but exclusion fencing would be erected to avoid damage.
- The other four sites would be directly impacted by the design refinement:
  - Saezza 1 (04-4-0171) would be newly affected by the design refinement.
  - Rudgley Site 2 (04-4-0169) would have increased impacts compared with the EIS design.
  - Site 1 (04-4-0179) and Rudgley Site 1a and 1b (04-4-0167) would have reduced impacts compared with the EIS design.

Due to changed impacts, additional management measures have been identified for three of the sites (refer to management measures AH36, AH37 and AH48). One property could not be accessed for field investigations and surveys would be required on the property prior to construction.

Potential impacts are summarised in Table 4-58.



**Table 4-58: Potential impacts on archaeological sites and Aboriginal cultural places from the design refinement**

Name (AHIMS ID)	Overall significance	Site type	Impact	Description of impacts and required mitigation
Site 1 (04-4-0179)	Low–moderate	Artefact scatter	Direct	The impacts on this site would be reduced from around a total site impact to around 85%. However, this would still result in an irreversible impact on the heritage values of the site. The remaining 15% of the site would not be directly or indirectly impacted by the project.
Rudgley Scarred Tree 2 (pending)	Moderate	Scarred tree	Indirect	Although the tree and its canopy are located within the project boundary, the tree can be retained within the future road reserve without being directly impacted. The tree would be protected by exclusion fencing during construction to avoid impacts on the tree's root system.
Rudgley Site 2 (04-4-0169)	Low–moderate	Artefact scatter	Direct	The impact on this site would be increased and around 40% of the site would be directly impacted. This would still result in irreversible impact on the heritage values of the site. The remaining 60% of the site would not be directly or indirectly impacted by the project.
Rudgley Scarred Tree (04-4-0170)	Moderate–high	Scarred tree	None	This site would no longer be in the project boundary, and would not be directly or indirectly impacted by the project.
Rudgley Site 1a and 1b (04-4-0167)	Low	Artefact scatter	Direct	The impacts on this site would be reduced from around 50% to around 5%. However, these impacts would still result in irreversible impacts on the heritage values of the site. The remaining 95% of the site would not be directly or indirectly impacted by the project. The site would be protected by exclusion fencing during construction to avoid accidental impacts.
Saezza 1 (04-4-0171)	Moderate	Artefact scatter	Direct	This site was not impacted under the EIS design, but the design refinement would impact on around 30% of the site. There would be irreversible impacts on the heritage values of the site. The remaining 70% of the site would not be directly or indirectly impacted by the project.
Site 12 (04-4-0176)	Moderate	Artefact scatter	None	This site would no longer be included in the project boundary, and would not be impacted by the project.

### Historical (non-Aboriginal) heritage

There are no historical heritage items listed on the State Heritage Register or Local Environmental Plan in the vicinity of the design refinement. The historical (non-Aboriginal) heritage assessment for the EIS identified one heritage site at station 155.4, near the eastern extent of the design refinement. There would not be any additional impacts on this site from those identified in the EIS as a result of the design refinement.

Further historical heritage assessment was undertaken for this design refinement. This assessment identified three potential heritage sites: a historical dump site, dairy remains at Pimlico and drainage channels near Broadwater. The historical dump site and the dairy remains at Pimlico had insufficient significance to meet the criteria for either State or local heritage listing and are not considered to be heritage sites. Further information on these sites is provided in Appendix E.

The drainage channels near Broadwater were considered to be of local significance. These drainage channels appear to connect to drainage channels on the adjacent 'Stonehenge' property. ('Stonehenge' is also a heritage item (Item 29) assessed as part of the project.) The drainage channels, from previous investigations on the 'Stonehenge' property, appear to be related to the drainage unions in the early 20<sup>th</sup> century. The design refinement would increase the impact on this heritage item, impacting around 50 per cent of the drainage channels identified and affecting the heritage significance of the site. To mitigate impacts and maximise the opportunity for realising research potential, an archival photographic recording would be made of the drainage channels and surrounds in accordance with the Heritage Branch of the Office of Environment and Heritage prior to its destruction. This additional management measure (HH53) is described in Chapter 5 of this report.

### Traffic and transport

The interchange would provide access to Wardell, Pimlico and Coolgardie. While the design refinement would change the layout of the interchange, there would be no change to the functionality. The design refinement would result in some minor access changes. For example:

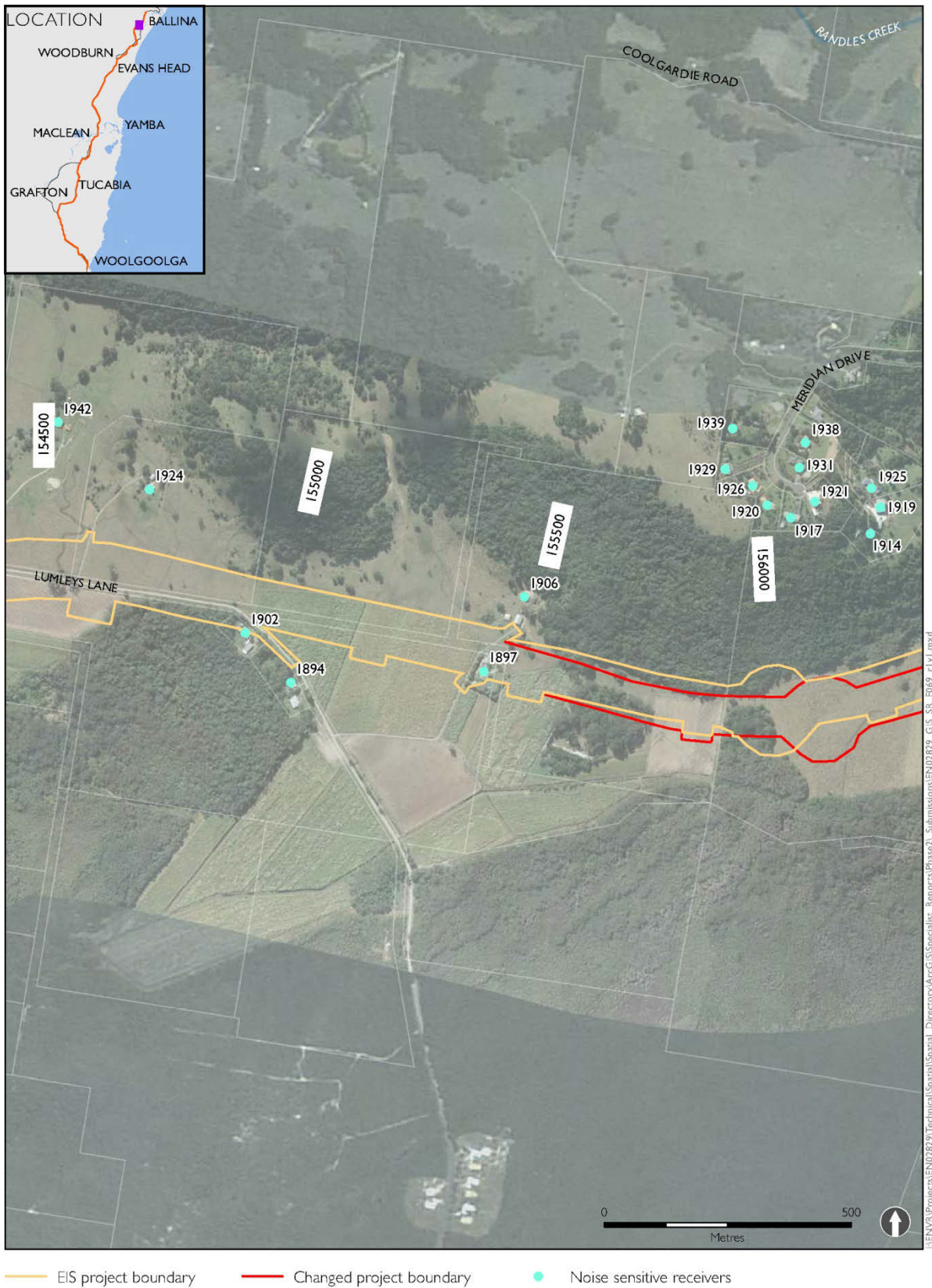
- The southbound off-ramp to access Pimlico and Wardell has been relocated in the design refinement north to station 157.9 and would connect to the service road (existing highway).
- The rearrangement of the interchange layout would result in the access to Kays Road to be relocated further south to station 157.2 on the service road. This may result in a small increase in travel times from the highway to residences and businesses located on Kays Road.

Constructability of the eastern roundabout from the interchange would be made simpler given that it would now be outside the existing highway travel lanes. This may assist in reducing traffic delays during construction.

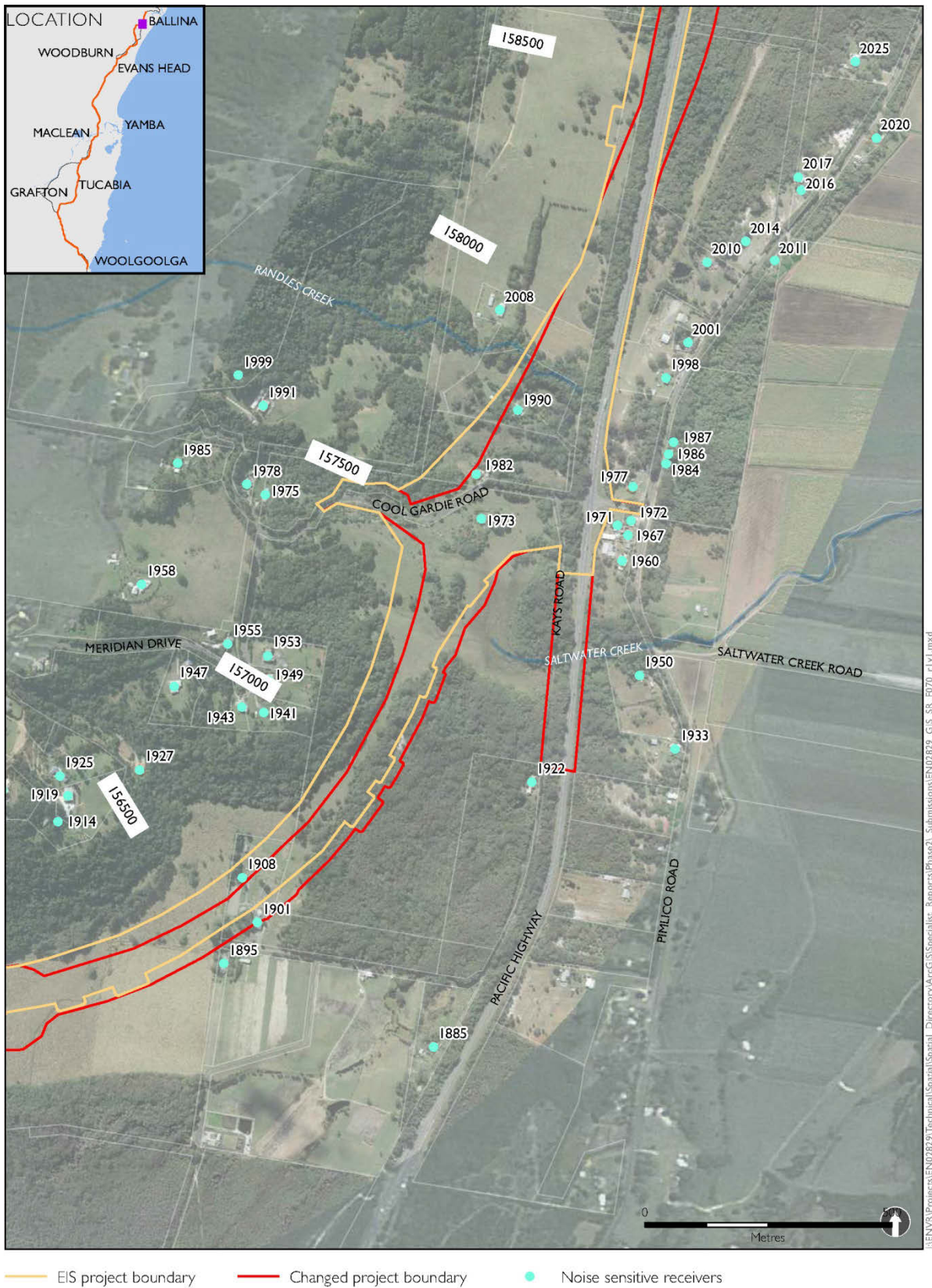
Overall, the traffic and transport impacts, including travel times and level of service, would be consistent with those documented in the EIS. No mitigation or management measures are required beyond those identified in the EIS.

### Noise and vibration

An operational and construction noise assessment was undertaken to consider changes in impacts as a result of the design refinement. The assessment was undertaken as the realignment would move the project closer to some sensitive receivers (refer to Figure 4-45 and Figure 4-46).



**Figure 4-45: Interchange at Wardell sensitive receivers between station 154.5 to 157.0**



**Figure 4-46: Interchange at Wardell sensitive receivers between station 156.5 to 158.5**

**Construction noise assessment**

The construction noise assessment shows a slight increase in predicted noise levels from the EIS design for some residential receivers near the design refinement. This is due to the project being moved closer to residences to the east. Overall, the number of receivers affected by the design refinement would be similar to those in the EIS. However, there would be an increase in the number of receivers predicted to be ‘highly noise affected’ (considered to be 75 dB (A) in accordance with the ICNG).

A summary of the noise levels predicted during standard construction hours from the main types of linear construction activity (site clearing, earthworks, paving and asphaltting) are shown in Table 4-59, Table 4-60 and Table 4-61. These tables identify the number of sensitive receivers who would be above the noise management levels (NMLs), and those who would be highly noise affected.

**Table 4-59: Proposed hours construction noise summary – formation, clearing and mulching**

NCA	Total no. receivers	NML, dB(A)	Maximum predicted noise level / dB(A)	No. receivers exceeding NML	No. receivers highly noise affected	Highly noise affected receivers
10-a	7	53	63	7	0	-
10-b	19	43	72	18	0	
10-c	11	43	83	7	5	R1819, R1845, R1895, R1901, R1902
10-d	16	43	79	7	3	R1853, R1858, R1866
10-e	24	43	72	24	0	-
10-f	21	45	64	15	0	-

**Table 4-60: Proposed hours construction noise summary – earthworks**

NCA	Total no. receivers	NML, dB(A)	Maximum predicted noise level / dB(A)	No. receivers exceeding NML	No. receivers highly noise affected	Highly noise affected receivers
10-a	7	53	68	7	0	R1852, R1855
10-b	19	43	77	18	2	-
10-c	11	43	88	7	6	R1819, R1843, R1845, R1895, R1901, R1902
10-d	16	43	84	7	5	R1871, R1924, R1853, R1858, R1866
10-e	24	43	77	24	1	R1874
10-f	21	45	69	20	0	-

**Table 4-61: Proposed hours construction noise summary – paving and asphaltting**

NCA	Total no. receivers	NML, dB(A)	Maximum predicted noise / dB(A)	No. receivers exceeding NML	No. receivers highly noise affected	Highly noise affected receivers
10-a	7	53	66	7	0	R1852, R1855
10-b	19	43	75	18	1	-
10-c	11	43	86	7	6	R1819, R1843, R1845, R1895,

NCA	Total no. receivers	NML, dB(A)	Maximum predicted noise / dB(A)	No. receivers exceeding NML	No. receivers highly noise affected	Highly noise affected receivers
						R1901, R1902
10-d	16	43	82	7	5	R1871, R1924, R1853, R1858, R1866
10-e	24	43	75	24	0	R1874
10-f	21	45	67	18	0	-

The assessment shows there would be exceedances of NMLs, with a slight increase in the number of receivers exposed to levels above the NML. There would also be an increase in the number of receivers that would be highly noise affected (when compared to the EIS design) for each of the activities. The greatest increase would result from earthworks activities, where an additional eight receivers would be highly noise affected – making a total of 14 receivers who would be highly noise affected.

For receivers that are highly noise affected, construction noise mitigation measures identified in the EIS Appendix I of the Working paper – Noise and vibration would be implemented.

No additional mitigation measures are required.

The design refinement is likely to move bridge construction activities, including piling, around 50 metres closer to residential receivers. This would increase noise levels at the closest receivers by around 1 dB(A). This increase in noise would not be perceptible and, as such, noise impacts would be consistent with the assessment in the EIS.

### Out-of-hours works

A summary of the noise levels predicted during any out-of-hours work is shown in Table 4-62, Table 4-63 and Table 4-64. These tables list those receivers likely to be affected by construction noise during out-of-hours periods.

**Table 4-62: Out-of-hours construction noise summary – formation, clearing and mulching**

NCA	Total no. receivers	Out of hours NML, dB(A)	Maximum predicted noise level / dB(A)	No. receivers exceeding RBL, dB(A)	No. receivers exceeding NML	No. receivers highly noise affected
10-a	7	44	63	7	7	0
10-b	19	41	72	18	18	0
10-c	11	41	83	7	7	5
10-d	16	41	79	7	7	3
10-e	24	41	72	24	24	0
10-f	21	41	64	20	15	0

**Table 4-63: Out-of-hours construction noise summary – earthworks**

NCA	Total no. receivers	Out of hours NML, dB(A)	Maximum predicted noise level / dB(A)	No. receivers exceeding RBL, dB(A)	No. receivers exceeding NML	No. receivers highly noise affected
10-a	7	44	7	7	7	0
10-b	19	41	18	18	18	2
10-c	11	41	7	7	7	6
10-d	16	41	7	7	7	5

NCA	Total no. receivers	Out of hours NML, dB(A)	Maximum predicted noise level / dB(A)	No. receivers exceeding RBL, dB(A)	No. receivers exceeding NML	No. receivers highly noise affected
10-e	24	41	24	24	24	1
10-f	21	41	20	21	20	0

**Table 4-64: Out-of-hours construction noise summary – paving and asphaltting**

NCA	Total no. receivers	Out of hours NML, dB(A)	Maximum predicted noise level / dB(A)	No. receivers exceeding RBL, dB(A)	No. receivers exceeding NML	No. receivers highly noise affected
10-a	7	44	66	7	7	0
10-b	19	41	75	18	18	1
10-c	11	41	86	7	7	6
10-d	16	41	82	7	7	5
10-e	24	41	75	24	24	0
10-f	21	41	67	21	18	0

Table 4-62, Table 4-63 and Table 4-64 show those receivers predicted to be exposed to noise levels above the night-time NML. Construction noise is predicted to be inaudible at around 10 per cent of receiver locations in Section 10. This is a decrease in the number of receivers where noise would be inaudible from the EIS design. These would be the only areas where out-of-hours work is considered to be appropriate without further consultation.

The design refinement would result in a slight increase in construction noise impacts and number of noise-affected receivers when compared to the EIS design. Sensitive receivers who would be highly noise affected during the proposed hours would also be highly noise affected during out-of-hours work.

Where exceedances of night-time NMLs are predicted, the mitigation measures identified in section 15.4 of the EIS would continue to apply.

### **Vibration impacts**

The main vibration sources would be from impact piling during bridge construction. The design refinement would not generate additional vibration impacts. The potential impacts of the design refinement would be consistent with the vibration impact assessment in section 15.3 of the EIS.

### **Operational noise assessment**

The design refinement would shift the alignment away from the largest groups of receivers. This would result in a small reduction in predicted noise levels during operation, as shown in Table 4-65.

The majority of identified receivers would experience changes in the predicted noise levels included in section 15.3 of the EIS. The general variance would be between  $\pm 1$  dB(A). There are two receiver locations (R1895 and R1901), which would have a 3 and 4 dB(A) increase (respectively) in noise levels when compared to the EIS design. These receivers were identified for noise mitigation in the EIS and no further noise management measures are proposed. However, it should be noted that receiver R1895 would be acquired as part of the project, as it is within the project boundary.

**Table 4-65: Operational noise impact for refined design of interchange at Wardell**

ID	Year opening 'no build' scenario dB(A)		Year opening 'build' scenario dB(A)		Design year 'no build' scenario dB(A)		Design year 'build' scenario dB(A)		RNP criteria, dB(A)		Are the RNP Criteria exceeded?		Change in noise level dB(A)				Acute level of noise		Consider mitigation?
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Opening Year		Design year		Day	Night	
													Day	Night	Day	Night			
1885	53	55	49	49	54	56	49	49	55	50	NO	NO	-4.9	-6.5	-5.0	-6.7	NO	NO	NO
1894	30	30	61	61	30	30	62	62	55	50	YES	YES	31.1	30.7	32.0	31.8	NO	YES	YES
1895	41	43	58	58	42	44	59	59	55	50	YES	YES	17.1	15.2	17.0	15.2	NO	NO	YES
1901	42	43	61	61	42	44	62	62	55	50	YES	YES	19.9	18.1	19.9	17.9	NO	NO	YES
1902	30	30	67	66	30	30	68	67	55	50	YES	YES	36.8	36.3	37.7	37.3	YES	YES	YES
1906	30	30	60	60	30	30	61	61	55	50	YES	YES	29.9	29.7	30.8	30.8	NO	YES	YES
1914	51	53	49	49	52	54	50	50	55	50	NO	NO	-1.8	-3.5	-1.8	-3.6	NO	NO	NO
1917	51	53	46	46	52	54	47	47	55	50	NO	NO	-5.6	-7.3	-5.6	-7.3	NO	NO	NO
1919	51	52	48	48	52	54	49	49	55	50	NO	NO	-3.2	-4.8	-3.2	-4.9	NO	NO	NO
1920	30	30	40	40	30	30	41	41	55	50	NO	NO	10.4	10.1	11.2	11.1	NO	NO	NO
1921	51	53	46	46	52	54	47	47	55	50	NO	NO	-5.1	-6.7	-5.1	-6.8	NO	NO	NO
1924	30	30	60	60	30	30	61	61	55	50	YES	YES	29.9	29.7	30.8	30.7	NO	YES	YES
1925	51	52	44	44	52	53	45	45	55	50	NO	NO	-6.3	-8.2	-6.5	-8.2	NO	NO	NO
1926	30	30	38	38	30	30	39	39	55	50	NO	NO	8.0	7.8	8.9	8.8	NO	NO	NO
1927	50	51	48	47	51	52	48	48	55	50	NO	NO	-2.4	-4.0	-2.4	-4.0	NO	NO	NO
1929	30	30	37	37	30	30	38	38	55	50	NO	NO	7.1	7.0	8.1	8.0	NO	NO	NO
1931	30	30	40	40	30	30	41	41	55	50	NO	NO	10.3	10.1	11.1	11.0	NO	NO	NO
1933	57	58	49	49	58	59	50	50	60	55	NO	NO	-7.8	-8.8	-8.0	-9.3	NO	NO	NO
1938	30	30	40	40	30	30	41	41	55	50	NO	NO	10.2	10.0	11.1	11.0	NO	NO	NO
1939	30	30	34	34	30	30	35	35	55	50	NO	NO	4.4	4.2	5.3	5.2	NO	NO	NO



WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE

ID	Year opening 'no build' scenario dB(A)		Year opening 'build' scenario dB(A)		Design year 'no build' scenario dB(A)		Design year 'build' scenario dB(A)		RNP criteria, dB(A)		Are the RNP Criteria exceeded?		Change in noise level dB(A)				Acute level of noise		Consider mitigation?
													Opening Year		Design year				
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	
1941	54	55	51	51	55	56	52	52	55	50	NO	YES	-2.7	-4.3	-2.8	-4.4	NO	NO	NO
1942	30	30	56	56	30	30	57	57	55	50	YES	YES	26.3	26.1	27.2	27.2	NO	NO	YES
1943	52	54	48	48	53	55	49	49	55	50	NO	NO	-4.1	-5.8	-4.1	-5.8	NO	NO	NO
1947	51	52	42	42	51	53	43	43	55	50	NO	NO	-8.1	-9.6	-8.1	-9.8	NO	NO	NO
1949	53	55	50	50	54	56	51	51	55	50	NO	YES	-2.8	-4.4	-3.0	-4.6	NO	NO	NO
1950	59	61	49	50	60	62	50	50	60	55	NO	NO	-10.2	-11.3	-10.4	-11.6	NO	NO	NO
1953	53	55	52	52	54	56	52	52	55	50	NO	YES	-1.7	-3.0	-1.8	-3.3	NO	NO	NO
1955	53	55	51	51	54	56	52	52	55	50	NO	YES	-2.0	-3.4	-2.1	-3.6	NO	NO	NO
1958	53	54	47	47	53	55	48	48	55	50	NO	NO	-5.7	-7.3	-5.8	-7.5	NO	NO	NO
1960	63	64	53	53	64	65	54	54	60	55	NO	NO	-10.0	-11.4	-10.3	-11.8	NO	NO	NO
1967	62	64	54	54	63	65	55	55	60	55	NO	NO	-8.1	-9.7	-8.5	-10.1	NO	NO	NO
1971	64	66	55	55	65	67	55	55	60	55	NO	NO	-9.4	-10.9	-9.6	-11.3	NO	NO	NO
1972	62	64	55	54	63	65	55	55	60	55	NO	NO	-7.6	-9.2	-7.8	-9.5	NO	NO	NO
1975	51	52	51	50	52	53	51	51	55	50	NO	YES	0.0	-1.8	-0.3	-2.2	NO	NO	NO
1977	62	64	55	55	63	65	56	56	60	55	NO	NO	-6.8	-8.6	-7.2	-8.8	NO	NO	NO
1978	51	53	51	50	52	54	51	51	55	50	NO	YES	-0.5	-2.2	-0.8	-2.5	NO	NO	NO
1984	59	60	54	54	60	61	55	55	60	55	NO	NO	-4.8	-6.4	-5.0	-6.8	NO	NO	NO
1985	52	53	48	48	53	55	49	49	55	50	NO	NO	-3.6	-5.2	-3.8	-5.3	NO	NO	NO
1986	59	60	54	54	60	61	55	55	60	55	NO	NO	-4.6	-6.2	-4.8	-6.5	NO	NO	NO
1987	58	60	54	54	59	61	55	55	60	55	NO	NO	-4.3	-6.0	-4.5	-6.1	NO	NO	NO
1991	53	54	53	53	54	55	53	53	55	50	NO	YES	0.0	-1.4	-0.2	-1.8	NO	NO	NO

ID	Year opening 'no build' scenario dB(A)		Year opening 'build' scenario dB(A)		Design year 'no build' scenario dB(A)		Design year 'build' scenario dB(A)		RNP criteria, dB(A)		Are the RNP Criteria exceeded?		Change in noise level dB(A)				Acute level of noise		Consider mitigation?
													Opening Year		Design year				
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	
1998	60	62	57	56	61	63	57	57	60	55	NO	YES	-3.6	-5.4	-3.8	-5.5	NO	NO	NO
1999	53	54	52	52	54	55	53	53	55	50	NO	YES	-0.4	-2.1	-0.6	-2.3	NO	NO	NO
2001	59	60	57	57	60	61	58	57	60	55	NO	YES	-2.1	-3.7	-2.2	-3.8	NO	NO	NO
2008	56	58	58	58	57	59	59	58	55	50	YES	YES	1.8	0.2	1.6	-0.2	NO	NO	YES
2011	55	56	55	55	56	57	56	56	60	55	NO	YES	0.6	-1.1	0.6	-1.2	NO	NO	NO
2014	56	58	57	57	57	59	58	58	60	55	NO	YES	0.8	-1.1	0.7	-1.1	NO	NO	NO
2016	54	56	56	55	55	57	57	56	60	55	NO	YES	1.7	-0.1	1.6	-0.3	NO	NO	NO
2017	54	56	56	56	55	57	57	57	60	55	NO	YES	1.7	0.0	1.7	0.0	NO	NO	NO
2020	52	54	54	54	53	55	55	55	60	55	NO	NO	2.0	0.4	2.0	0.2	NO	NO	NO
2025	52	54	55	55	53	55	56	56	60	55	NO	NO	2.9	1.1	2.8	1.0	NO	NO	NO

**Land use and property**

The design refinement would be surrounded by rural residential land uses, open woodland and cleared areas. The alignment immediately north and south of Coolgardie Road would run parallel with the existing highway.

The design refinement would result in direct property impacts, but there would only be minimal impact on the land use of adjoining properties. To the north of Coolgardie Road is a paintball range operated by Paintball Skirmish Ballina Byron. The range includes a requirement that it must be 300 metres from any public areas (including public roads). The design refinement would impact the western extent of the property and require that the paintball range be reconfigured to still meet the 300-metre buffer required.

The design refinement would result in a decrease in property acquisition (both public and privately owned land) of around 9.75 hectares compared to the EIS design (refer to Table 4-66). There would be changes to the acquisition of a number of properties:

- Five properties would be newly affected, including land zoned as transport corridor, urban, grazing, tree and shrub cover.
- 11 properties would have reduced impacts.

**Table 4-66: Property impacts for interchange at Wardell – EIS design and design refinement**

Property	Land use	EIS		Design refinement		Change to impact area
		Impact area (ha)	%of property affected	Impact area (ha)	% of property affected	
Lot 9 DP 1126162	Grazing	0.0	0.0	0.15	0.2	0.15
Lot 2 DP 1074389	Grazing Urban Tree and shrub cover	1.5	56.5	1.4	51.7	-0.1
Lot 3 DP 814504	River and drainage Tree and shrub cover	1.9	44.1	0.1	2.4	-1.8
Lot 2 DP 543525	Grazing Tree and shrub cover Cropping	8.6	10.5	3.8	4.7	-4.8
Lot 50 DP 1120710	Grazing	0.0	0.0	0.1	0.04	0.1
Lot 3 DP 1096778	Transport corridor Urban	0.0	0.0	0.9	8.7	0.9
Lot 5 DP 223267	Cropping Tree and shrub cover	2.4	15.5	1.0	6.3	-1.4
Lot 9 DP 594556	Transport corridor Tree and shrub cover	0.0	0.0	0.2	3.3	0.2
Lot 4 DP 223267	Transport corridor Urban Tree and shrub cover	0.0	0.0	1.8	13.4	1.8
Lot 61 DP 1088684	Grazing Urban Tree and shrub cover	12.4	29.5	10.9	26.0	-1.5
Lot 62 DP 1088684	Grazing	1.3	29.1	1.2	27.1	-0.1

Property	Land use	EIS		Design refinement		Change to impact area
		Impact area (ha)	% of property affected	Impact area (ha)	% of property affected	
Lot 1 DP 1074389	Urban Tree and shrub cover	2.0	63.3	1.6	49.8	-0.4
Lot 4 DP 877097	Urban	2.8	80.9	1.9	54.6	-0.9
Lot 51 DP 1120710	Grazing Tree and shrub cover	7.2	21.2	6.4	27.6	-0.8
Lot 52 DP 1120710	Grazing	0.2	100	0.1	4.2	-0.1
Lot 10 DP 1126162	Grazing	3.0	100	2.0	69.2	-1
<b>Total</b>		<b>43.3</b>		<b>33.55</b>		<b>-9.75</b>

No additional impacts are anticipated during construction and operation and no mitigation or management measures are required beyond those identified in the EIS.

### Social and economic

The existing socio-economic environment features the highway and rural-residential land uses. In the surrounding areas, amenity is likely to be influenced by the highway transport corridor; those with more rural lifestyles are likely influenced by surrounding horticultural and open woodland land use. Some cropping and grazing activities are also carried out in the area surrounding Coolgardie Road.

There may be some additional amenity impacts during construction for residents located to the east of the existing highway off Pimlico Road.

The design refinement, involving an altered interchange design, is unlikely to change the overall socio-economic impacts of the project beyond those described in the EIS. Therefore, the design refinement is broadly consistent with the impacts described in section 17.3 of the EIS. No mitigation or management measures are required beyond those identified in the EIS.

### Management and mitigation

The additional mitigation measures recommended for this design refinement are presented in Table 4-67 and Chapter 5.

**Table 4-67: Interchange at Wardell – additional mitigation**

Issue	ID number	Mitigation measure	Timing	Relevant section
Minimise biodiversity impacts at the Interchange at Wardell	B56	Street lighting on the western roundabout at the interchange at Wardell will be designed to reduce light spill during detailed design. This could include using deflection shields around the lights or using a UV light, with reduced UV light emissions.	Pre-construction	10
	B57	Further investigation will be undertaken of the road runoff capture and storage to the east side of the existing Pacific Highway between station 158.2 and 159.4 to protect remaining in situ aquatic habitats south of Laws Road.	Pre-construction	11
	B58	Roads and Maritime owned land surrounding the dedicated landbridge at station 156.0 be revegetated in accordance with the connectivity strategy and the	Construction	10

Issue	ID number	Mitigation measure	Timing	Relevant section
		landscape management plan.		
Coolgardie Road, Rudgley Scarred Tree 2	AH36	An exclusion zone to be established 5 metres from the boundary of Rudgley Scarred Tree 2 as per management measure AH2.	Pre-construction	10
Coolgardie Road, Rudgley Site 2	AH37	The area of site to be impacted be subject to salvage excavation as detailed in the Addendum CHAR (Appendix D of the Submissions/ Preferred Infrastructure Report) and in consultation with RAPs. All cultural material recovered to be subject to detailed analysis, interpretation and reporting.	Pre-construction	10
Salvage at Saezza 1 (AHIMS ID 04-4-0171)	AH48	The area of this site to be impacted will be subject to salvage excavation as detailed in the Addendum CHAR (Appendix D of the Submissions/ Preferred Infrastructure Report) and in consultation with RAPs. All cultural material recovered will be subject to detailed analysis, interpretation and reporting. The portion of the site that not be impacted (at least 70%), will be protected by fencing as per management measure AH2.	Pre-construction	10
Impacts on Item 43: Drainage channels, Broadwater	HH53	An archival photographic recording be made of the drainage channels and its surrounds in accordance with the Heritage Branch guidelines prior to its destruction.	Pre-construction	10

This design refinement would not require a change to the other proposed mitigation and management measures in Chapter 19 of the EIS.

#### 4.4.19 Ancillary facilities for construction

##### EIS design

Ancillary facility sites would be used temporarily by Roads and Maritime, and where appropriate in agreement with the landowner, for one or more construction uses, such as site compounds, satellite compounds, batch plants, plant workshops, material storage, and stockpile sites. The EIS identified 81 potential ancillary facility sites. Of these, 129 hectares are within the project and were assessed in the EIS. However, another 233 hectares were not fully assessed in the EIS.

##### Proposed design refinement

In addition to the 81 sites identified in the EIS, four additional potential ancillary sites were identified after the display of the EIS, bringing the total to 85. The ancillary facilities were subject to additional assessment to confirm suitability of the sites in terms of heritage and biodiversity impacts, as described in Chapter 3. The final list of 73 proposed ancillary facilities is shown in Table 4-68 and in Figure 4-47 to Figure 4-100.

This list excludes 12 sites that were found to be unsuitable for use due to Aboriginal heritage or biodiversity constraints.

##### Consultation

Consultation with the property owners of potential ancillary facility sites was undertaken during the EIS process. A number of property owners informed Roads and Maritime that they were not interested in

leasing the property for ancillary facility activities. These sites were also removed from the list of potential sites.

Consultation with affected landowners during the property acquisition and community consultation process identified four additional sites suitable for ancillary site uses. These additional sites are located in Section 1 and Section 5 of the project (refer to section 3.11 of this report).

Further consultation would be undertaken with property owners of the identified ancillary facilities prior to construction.

### **Environmental assessment**

Desktop assessments were undertaken as part of the EIS to assess the potential impacts of the ancillary facility locations. The assessments included hydrology, heritage (both Aboriginal and historical (non-Aboriginal)), biodiversity and noise. These assessments also identified whether additional field investigations should be undertaken for the Submissions / Preferred Infrastructure Report; further investigations were identified for heritage and biodiversity. Full details on the assessment of the ancillary facilities can be found in section 3.11 of this report and Appendix J (Biodiversity) and Appendix D (Aboriginal heritage).

The aim of these further assessments was to identify those sites that would be suitable for use as ancillary facilities. As part of this, the results of the hydrology and noise assessments undertaken in the EIS were also considered. A number of sites were identified as unsuitable for use as an ancillary facility (refer to Table 3-40 of this report) due to:

- High biodiversity impacts.
- High Aboriginal heritage impacts.
- High hydrological impacts.
- Property owner not interested (based on preliminary feedback).

Those sites considered to be suitable for ancillary facilities are listed Table 4-68: identifies whether specific mitigation measures are required. Specific mitigation measures (where relevant) include:

- Aboriginal heritage measures (refer to AH14a to AH14v).
- Historical heritage measures (refer to HH5 and HH6).
- Hydrology measures (refer to HF22).
- Biodiversity measures (refer to B52a to B52y).

These mitigation measures are detailed in Chapter 5 of this report.

The ancillary facility site locations that have been assessed as suitable are shown in Figure 4-47 to Figure 4-100.

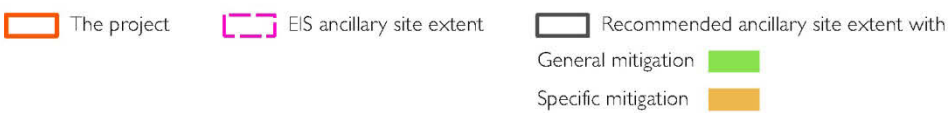
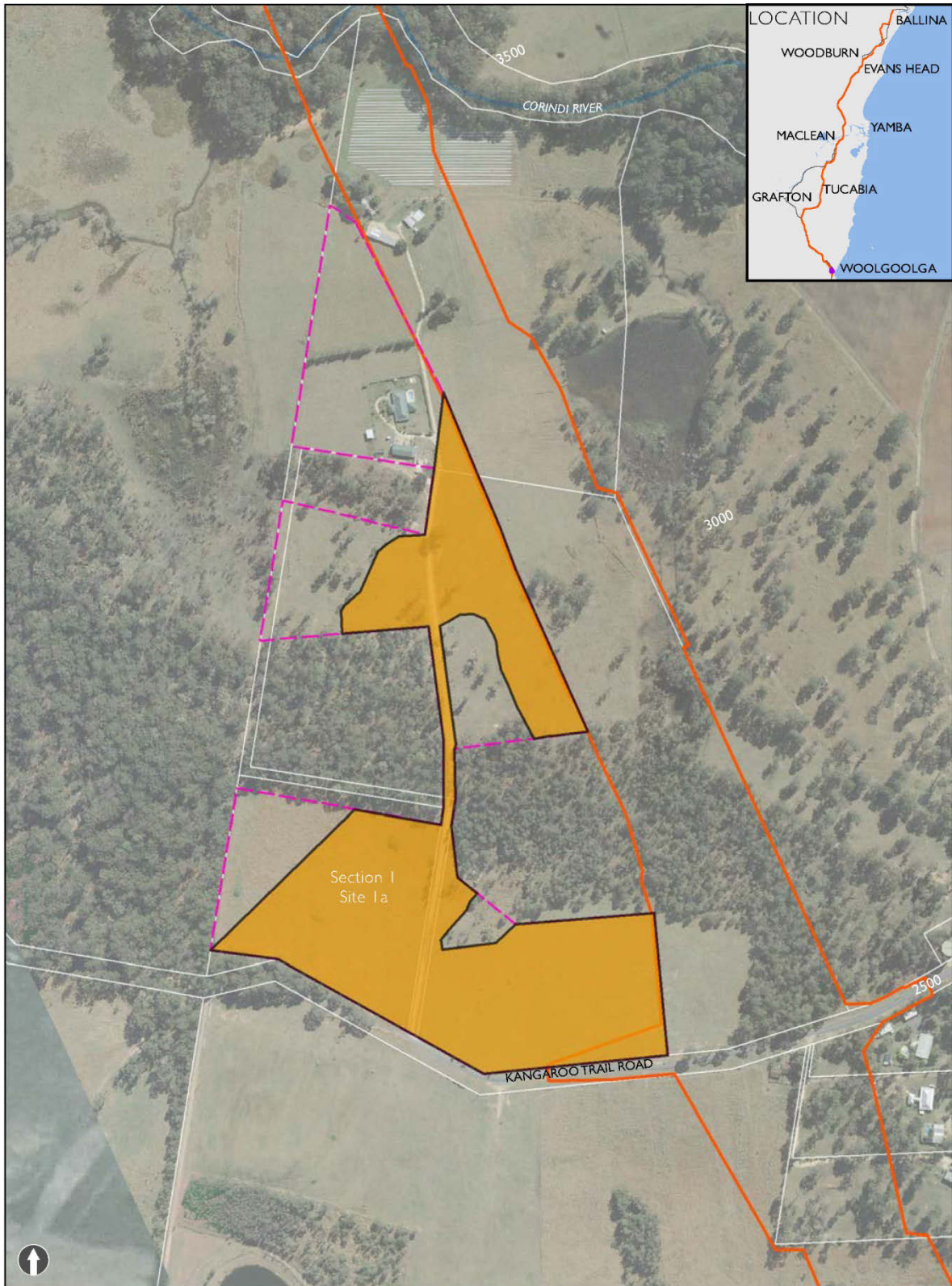
**Table 4-68: Ancillary facility sites**

Station	Site No. (EIS Table 6-9)	Use of location
<b>Section 1 – Woolgoolga to Halfway Creek</b>		
2.5 to 3.4	1a (1)	Apply specific mitigation measures
5.2 to 5.4	2 (3)	Apply specific mitigation measures
7.4 to 7.6	3 (4)	Apply general mitigation measures
9.4 to 9.6	4b (6)	Apply specific mitigation measures
<b>Section 2 – Halfway Creek to Glenugie upgrade</b>		
16.7 to 17.0	1a (7)	Apply specific mitigation measures
17.1 to 17.4	1b (8)	Apply specific mitigation measures
17.5 to 18.1	1c (9)	Apply general mitigation measures
21.7 to 22.2	4 (12)	Apply specific mitigation measures
23.5 to 23.8	5a (13)	Apply specific mitigation measures
23.6 to 24.0	5b (14)	Apply specific mitigation measures
25.7 to 25.9	6 (15)	Apply general mitigation measures
<b>Section 3 – Glenugie upgrade to Tyndale</b>		
34.2 to 34.4	1 (16)	Apply general mitigation measures
39.5 to 40.2	2 (17)	Apply specific mitigation measures
41.1 to 41.4	3a (18)	Apply general mitigation measures
41.1 to 41.4	3b (19)	Apply specific mitigation measures
45.5 to 45.9	4 (20)	Apply specific mitigation measures
49.4 to 49.6	5 (21)	Apply specific mitigation measures
51.4 to 51.5	6a (22)	Apply general mitigation measures
52.0	6b (23)	Apply specific mitigation measures
55.5 to 55.9	7a (24)	Apply general mitigation measures
56.1 to 56.3	7b (25)	Apply specific mitigation measures
62.0 to 62.3	9 (27)	Apply specific mitigation measures
67.2 to 67.4	10 (28)	Apply general mitigation measures
<b>Section 4 – Tyndale to Maclean</b>		
69.3 to 69.6	1 (29)	Apply specific mitigation measures
73.4 to 74.0	2 (30)	Apply specific mitigation measures
75.5 to 75.7	3 (31)	Apply specific mitigation measures
76.8 to 77.1	4a (32)	Apply specific mitigation measures
78.1 to 78.3	5 (35)	Apply specific mitigation measures
79.4 to 79.9	6 (36)	Apply specific mitigation measures
80.5 to 81.1	7a (37)	Apply specific mitigation measures

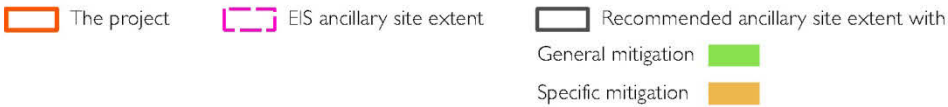
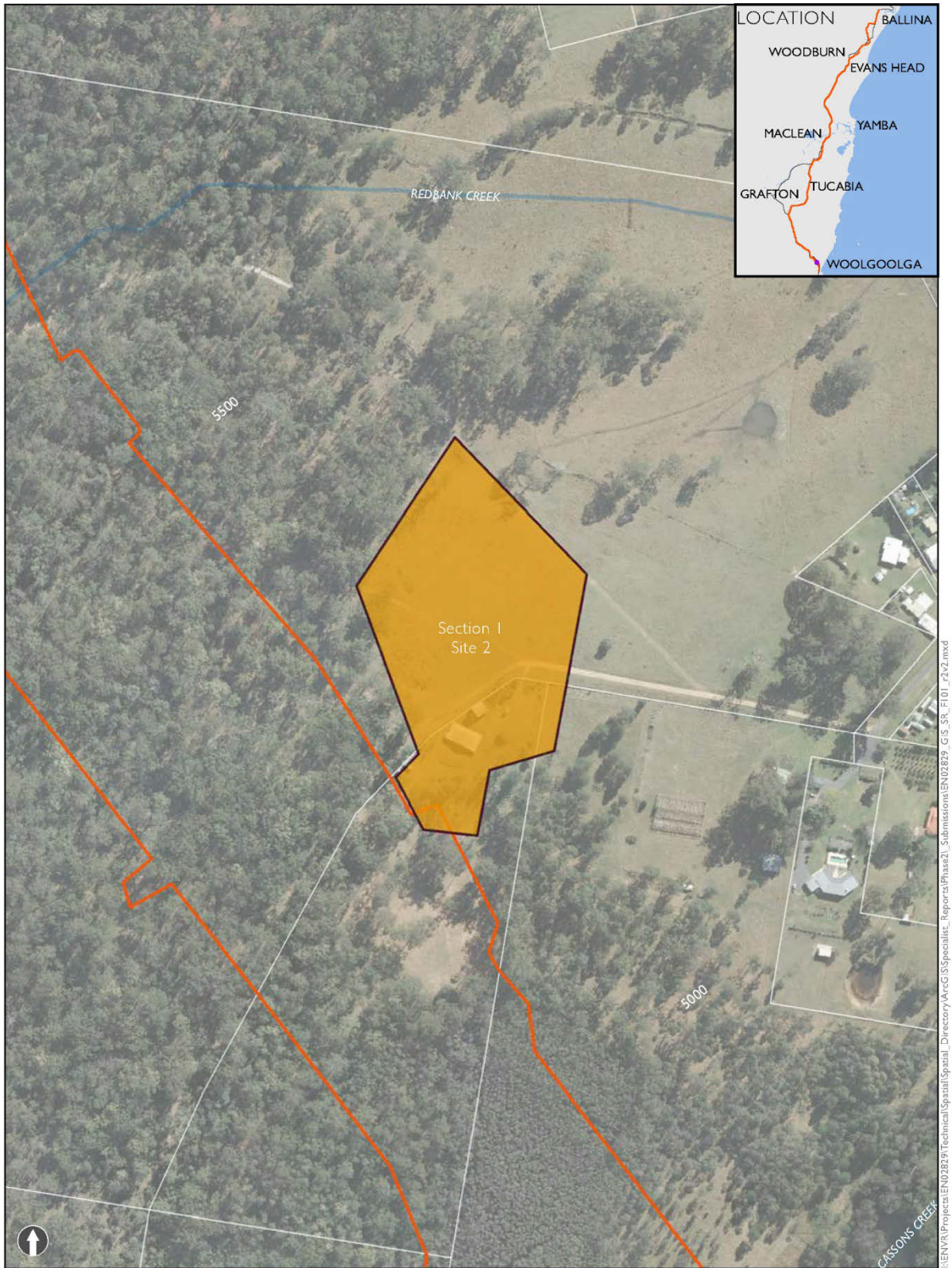
Station	Site No. (EIS Table 6-9)	Use of location
80.4 to 80.7	7b (38)	Apply specific mitigation measures
<b>Section 5 – Maclean to Iluka Road, Mororo</b>		
83.3 to 83.5	1 (39)	Apply general mitigation measures
85.8 to 86.0	2a (40)	Apply specific mitigation measures
85.8 to 86.1	2b (41)	Apply specific mitigation measures
85.8 to 85.9	2c (42)	Apply general mitigation measures
85.9 to 86.2	2d (43)	Apply specific mitigation measures
86.9 to 87.2	3a (44)	Apply specific mitigation measures
87.2 to 87.7	3b (45)	Apply specific mitigation measures
90.8 to 90.9	4a (46)	Apply specific mitigation measures
90.5 to 90.8 (multiple sites)	4b (47)	Apply specific mitigation measures
93.3 to 93.4	5a (48)	Apply specific mitigation measures
93.6 to 93.7	5b (49)	Apply general mitigation measures
93.55 to 93.8	5c (50)	Apply general mitigation measures
95.5 to 96.0	6 (51)	Apply specific mitigation measures
94.9 to 95.5	Additional site 9 (N/a)	Apply specific mitigation measures
<b>Section 6 – Iluka Road to Devils Pulpit upgrade</b>		
98.1 to 98.3	1 (52)	Apply general mitigation measures
100.1 to 100.5	2 (53)	Apply general mitigation measures
103.0 to 103.7	3a (54)	Apply specific mitigation measures
102.9 to 103.7	3b (55)	Apply specific mitigation measures
105.6 to 106.0	4 (56)	Apply general mitigation measures
108.5 to 108.8	5 (57)	Apply general mitigation measures
<b>Section 7 – Devils Pulpit upgrade to Trustums Hill</b>		
109.9 to 110.2	1 (58)	Apply specific mitigation measures
114.0 to 114.3	2a (59)	Apply general mitigation measures
114.2 to 114.4	2b (60)	Apply general mitigation measures
121.2 to 121.7	3 (61)	Apply specific mitigation measures
125.1 to 125.5	4 (62)	Apply specific mitigation measures
<b>Section 8 – Trustums Hill to Broadwater National Park</b>		
129.7 to 130.1	1 (63)	Apply specific mitigation measures
131.2 to 132.5	2a (64)	Apply specific mitigation measures
131.8 to 132.1	2b (65)	Apply specific mitigation measures
132.1 to 132.2	2c (66)	Apply specific mitigation measures
134.8 to 135.1	3 (67)	Apply specific mitigation measures



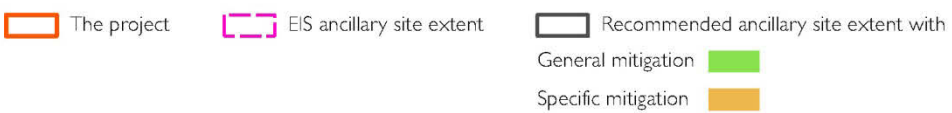
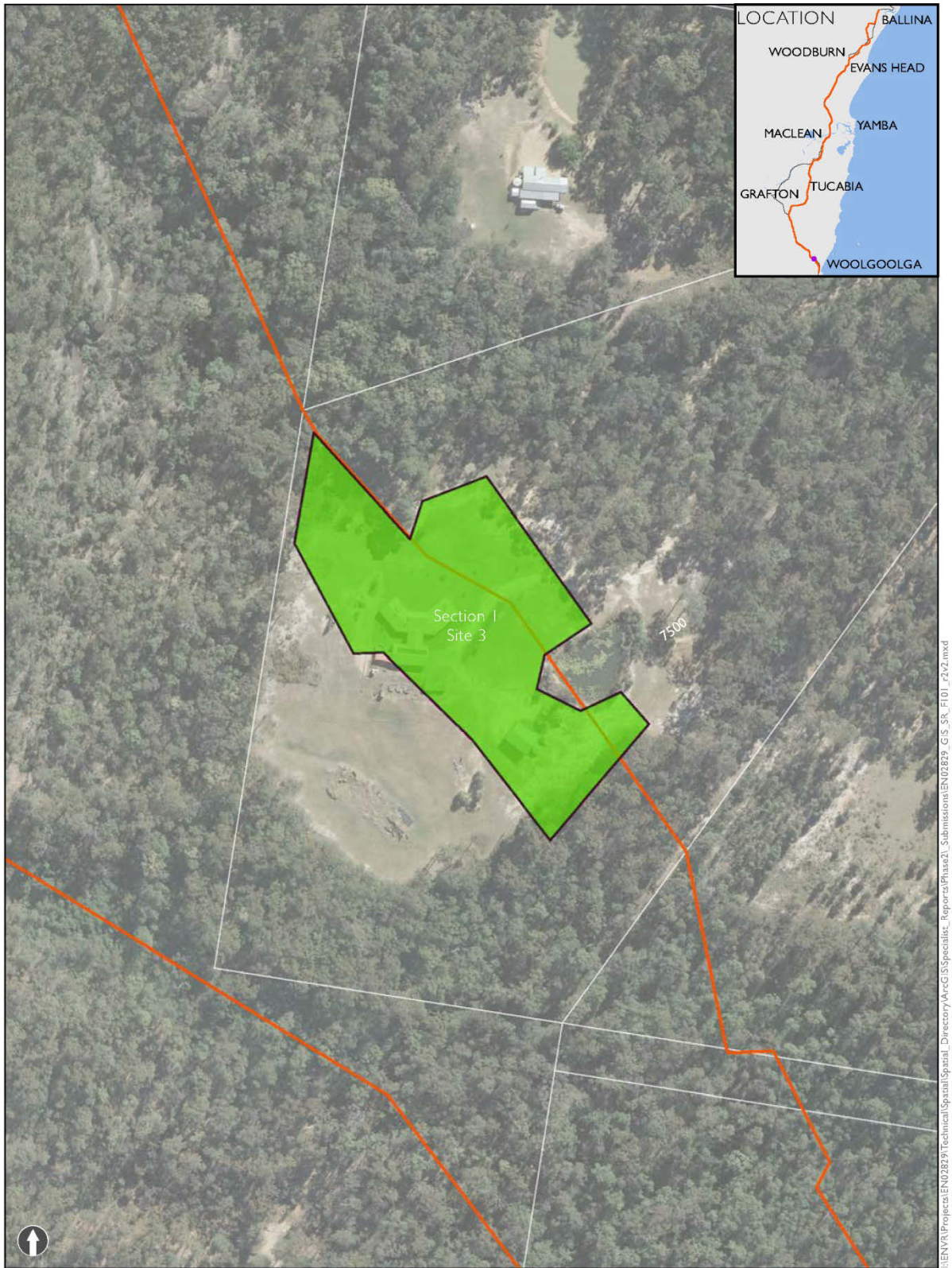
Station	Site No. (EIS Table 6-9)	Use of location
<b>Section 9 – Broadwater National Park to Richmond River</b>		
136.7 to 137.1	1 (68)	Apply specific mitigation measures
137.3 to 137.8	2 (69)	Apply specific mitigation measures
142.2 to 142.7	3 (70)	Apply general mitigation measures
<b>Section 10 – Richmond River to Coolgardie Road</b>		
146.2 to 146.4	1b (72)	Apply general mitigation measures
147.8 to 148.1	2 (73)	Apply general mitigation measures
152.1 to 152.5	3a (74)	Apply specific mitigation measures
152.5 to 152.7	3b (75)	Apply specific mitigation measures
156.0 to 156.5	4 (76)	Apply specific mitigation measures
157.3 to 157.4	5 (77)	Apply specific mitigation measures
<b>Section 11 – Coolgardie Road to Ballina bypass</b>		
159.3 to 159.8	1a (79)	Apply specific mitigation measures
159.6 to 159.9	1b (80)	Apply general mitigation measures
163.6 to 164.4	2 (81)	Apply specific mitigation measures



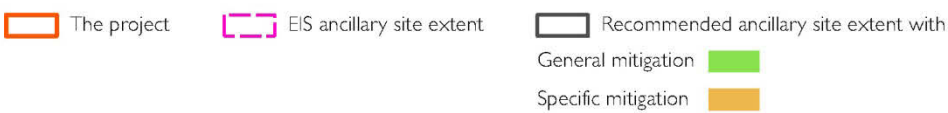
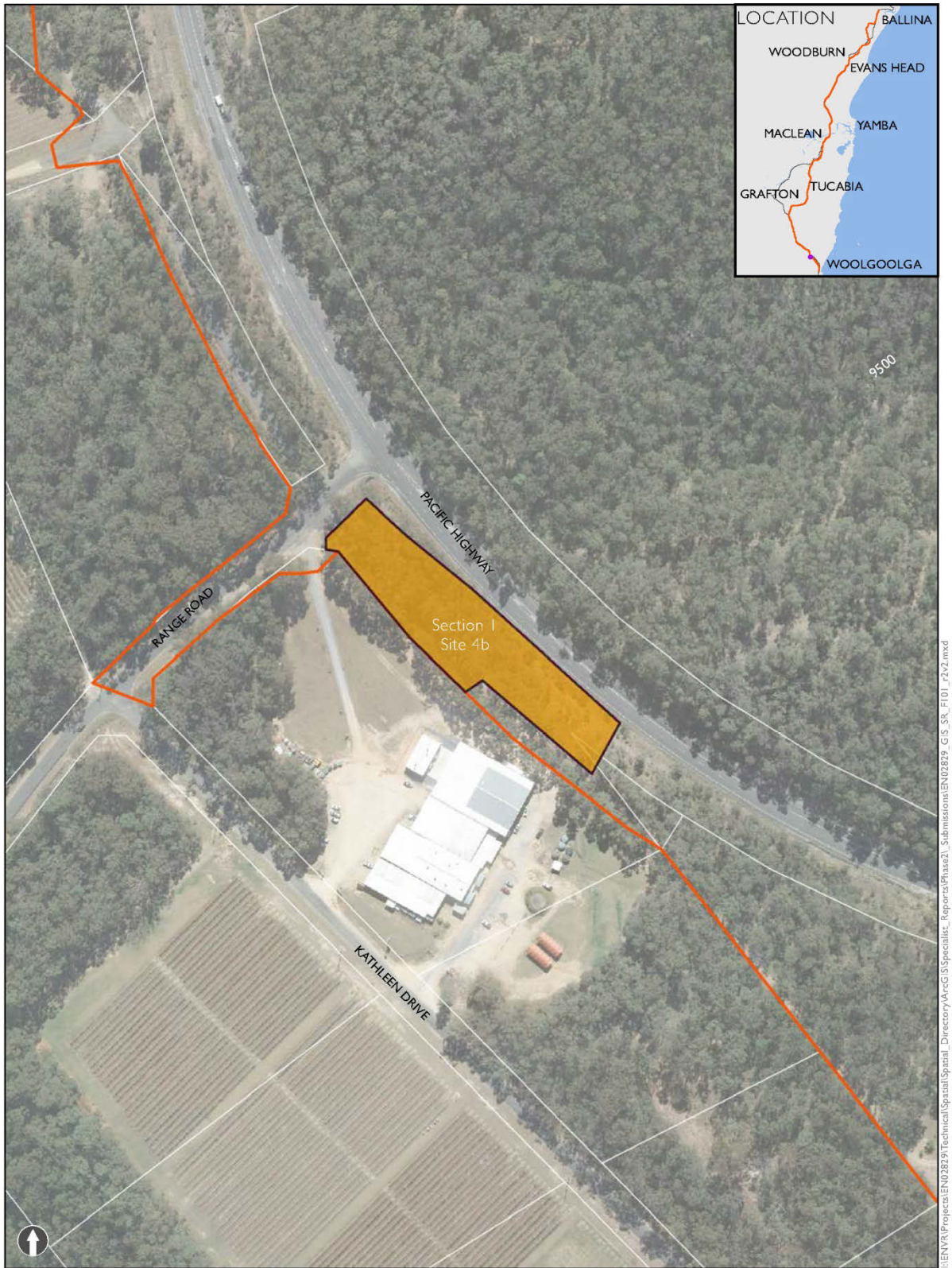
**Figure 4-47: Ancillary facility locations – Section 1 site 1a**



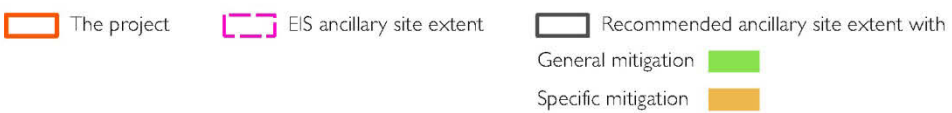
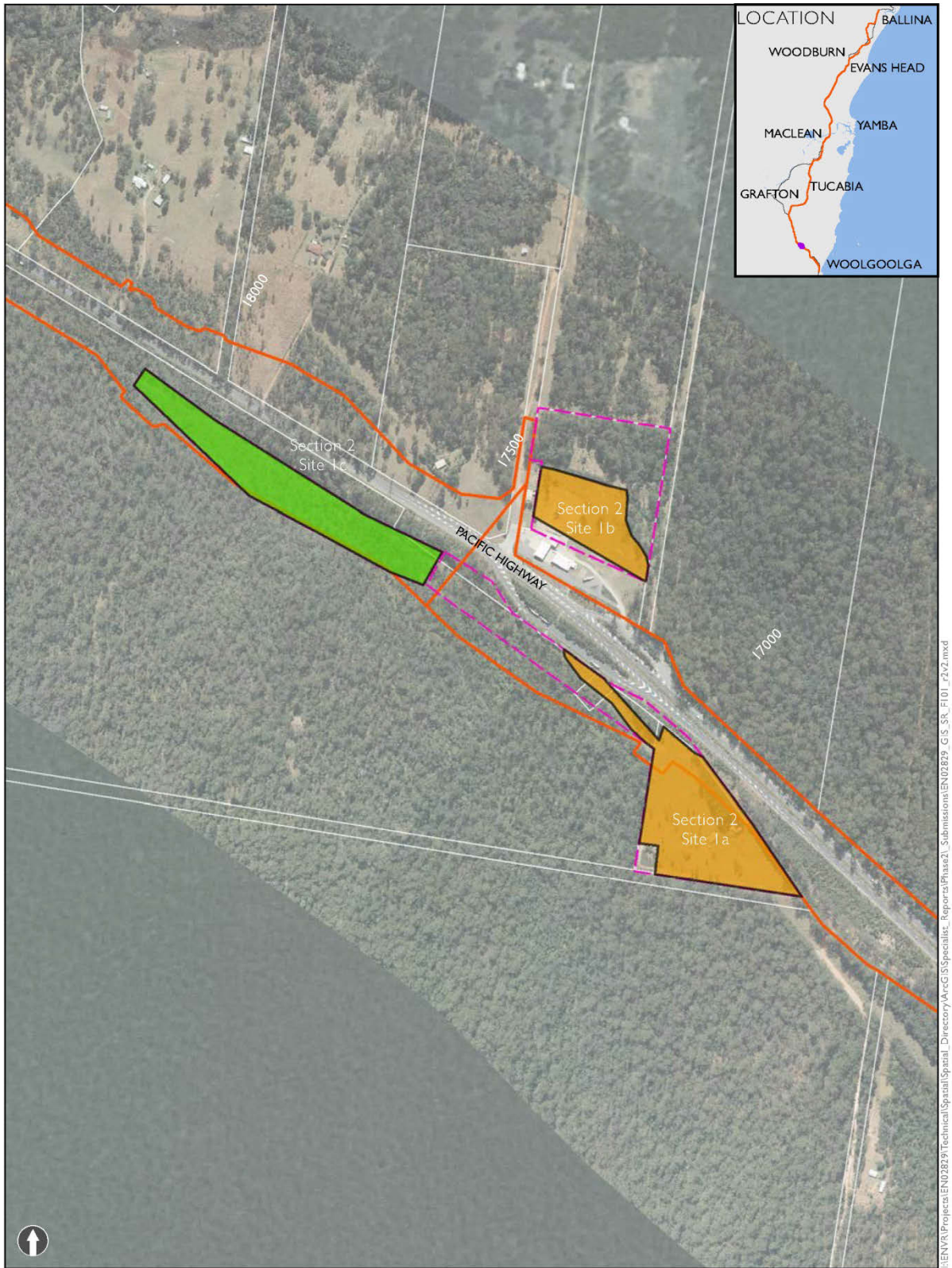
**Figure 4-48: Ancillary facility locations – Section 1 site 2**



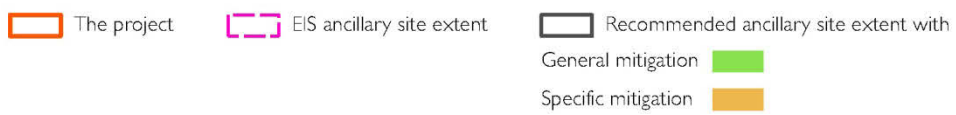
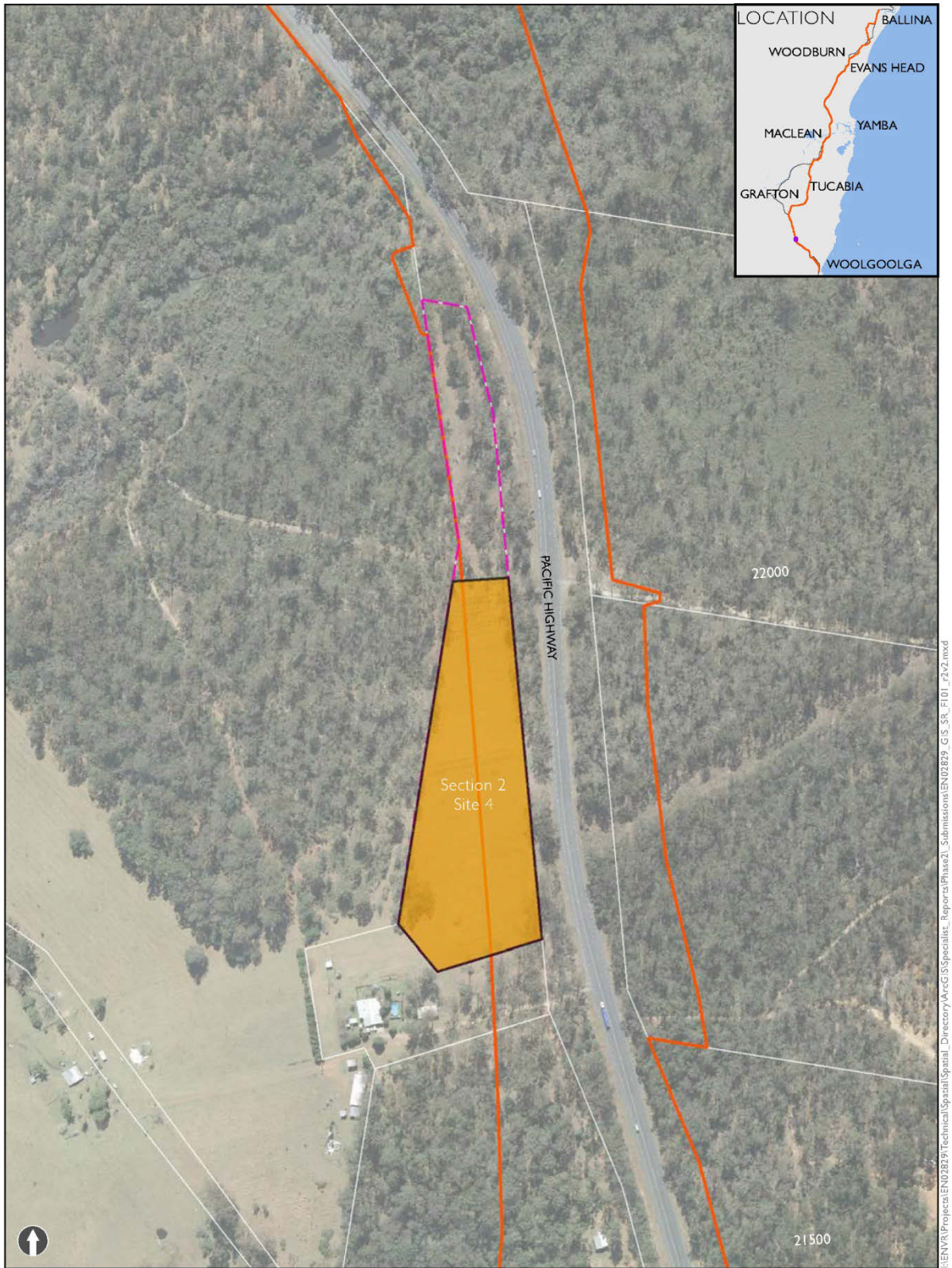
**Figure 4-49: Ancillary facility locations – Section 1 site 3**



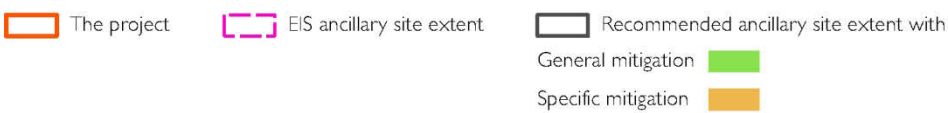
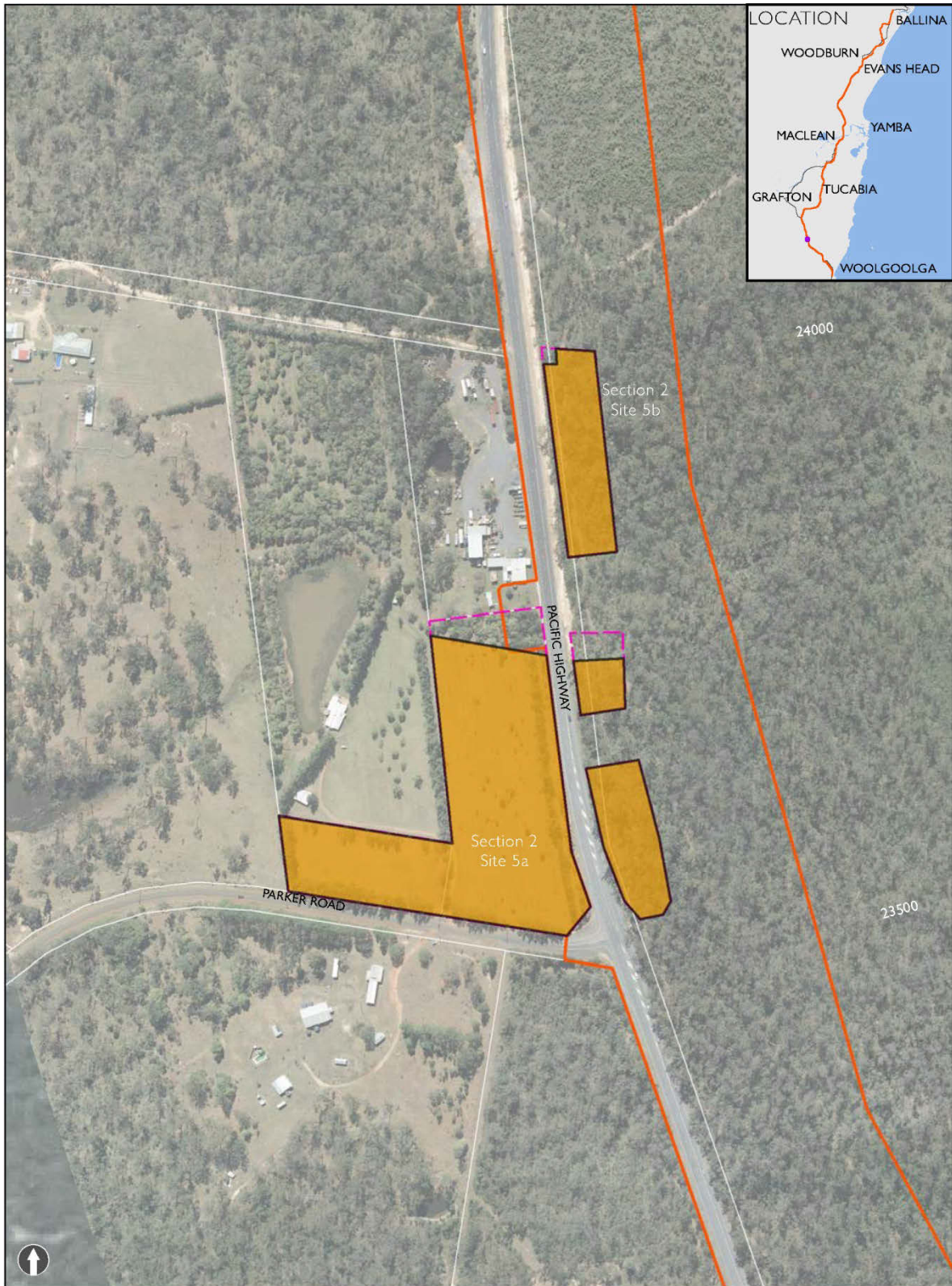
**Figure 4-50: Ancillary facility locations – Section 1 site 4b**



**Figure 4-51: Ancillary facility locations – Section 2 sites 1a and 1b**

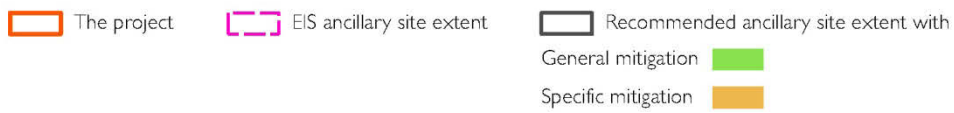
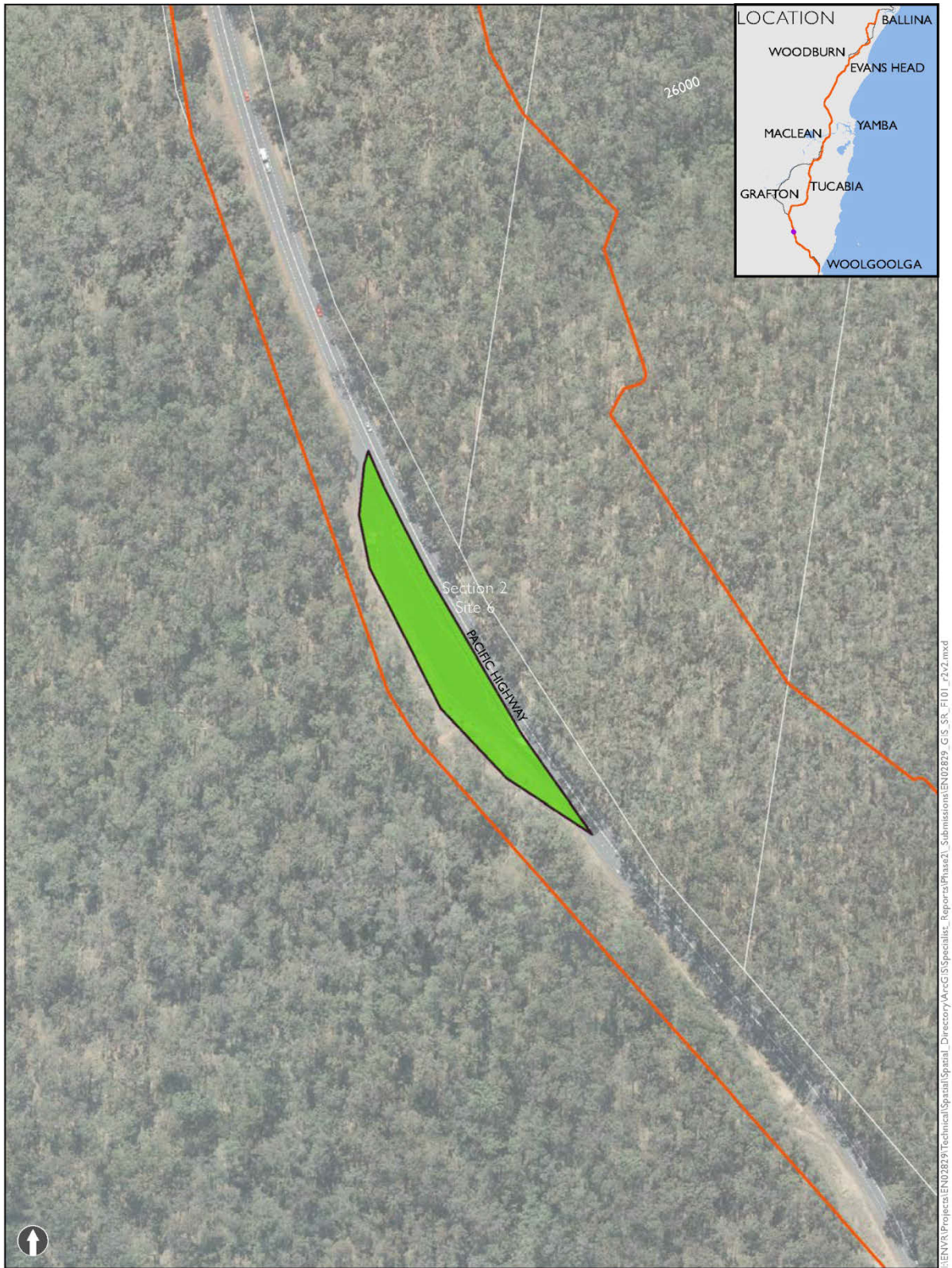


**Figure 4-52: Ancillary facility locations – Section 2 site 4**

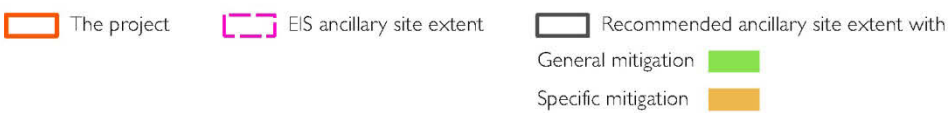
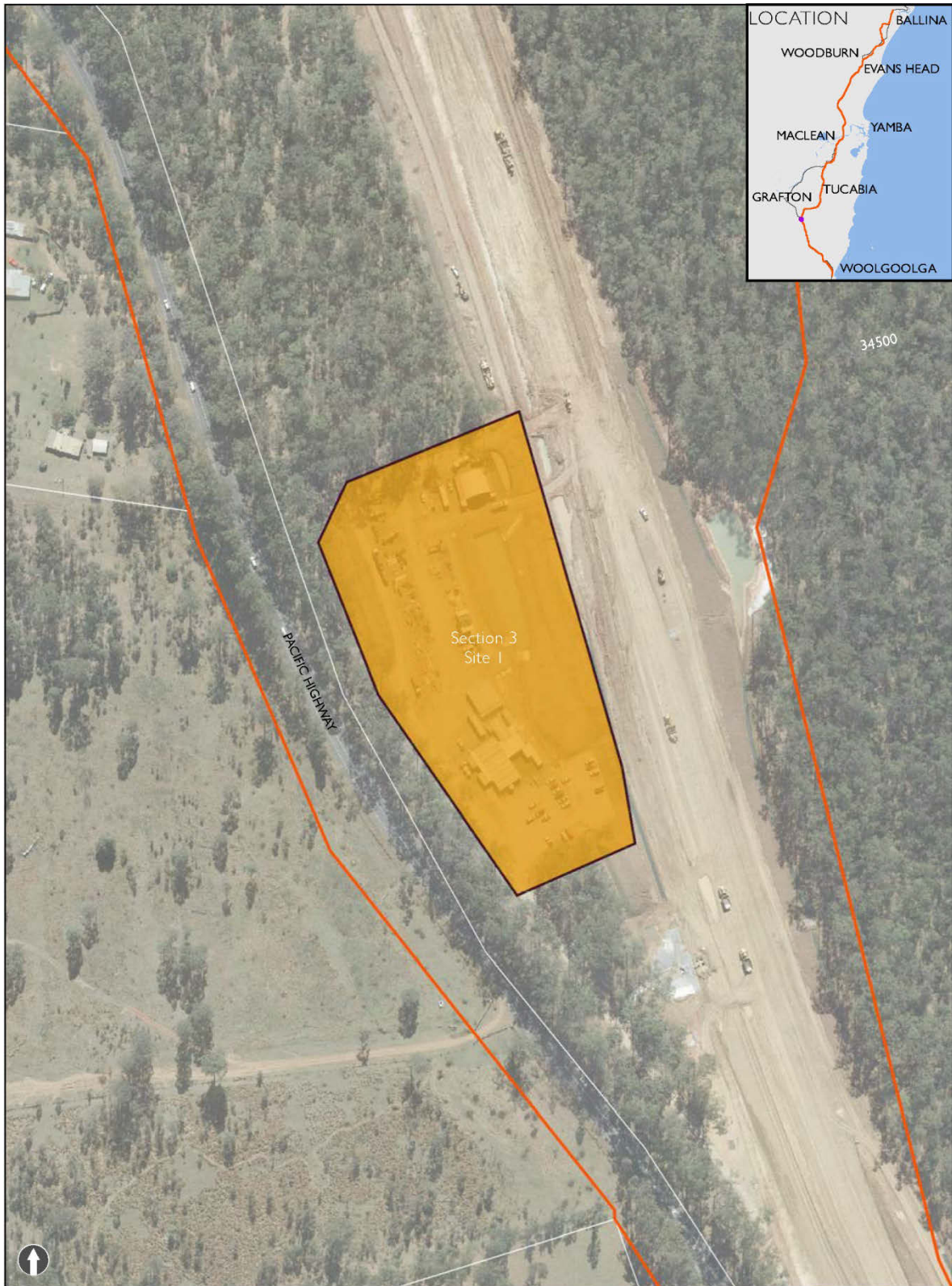


**Figure 4-53: Ancillary facility locations – Section 2 sites 5a and 5b**

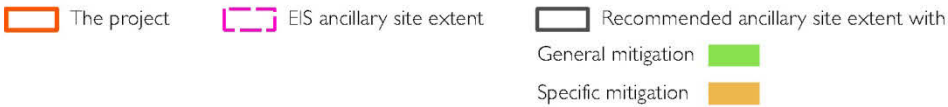
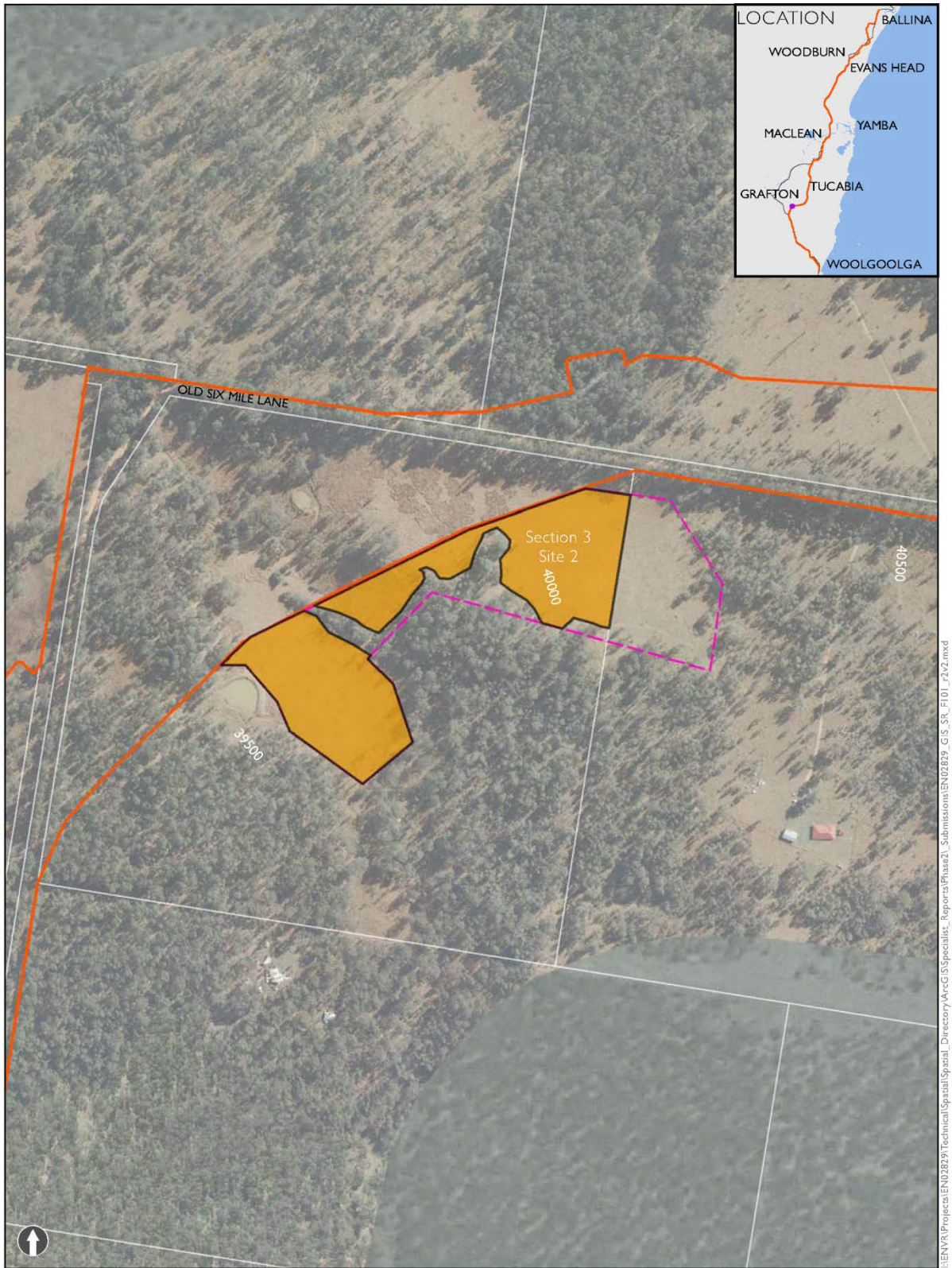




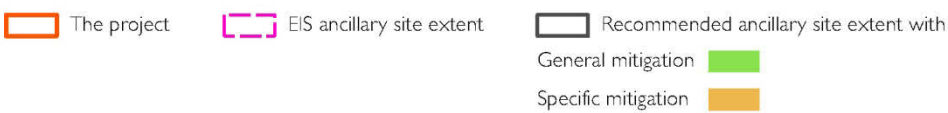
**Figure 4-54: Ancillary facility locations – Section 2 site 6**



**Figure 4-55: Ancillary facility locations – Section 3 site 1**



**Figure 4-56: Ancillary facility locations – Section 3 site 2**



**Figure 4-57: Ancillary facility locations – Section 3 sites 3a and 3b**

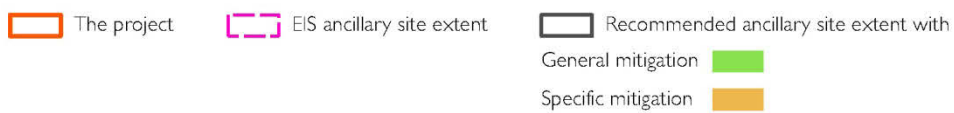
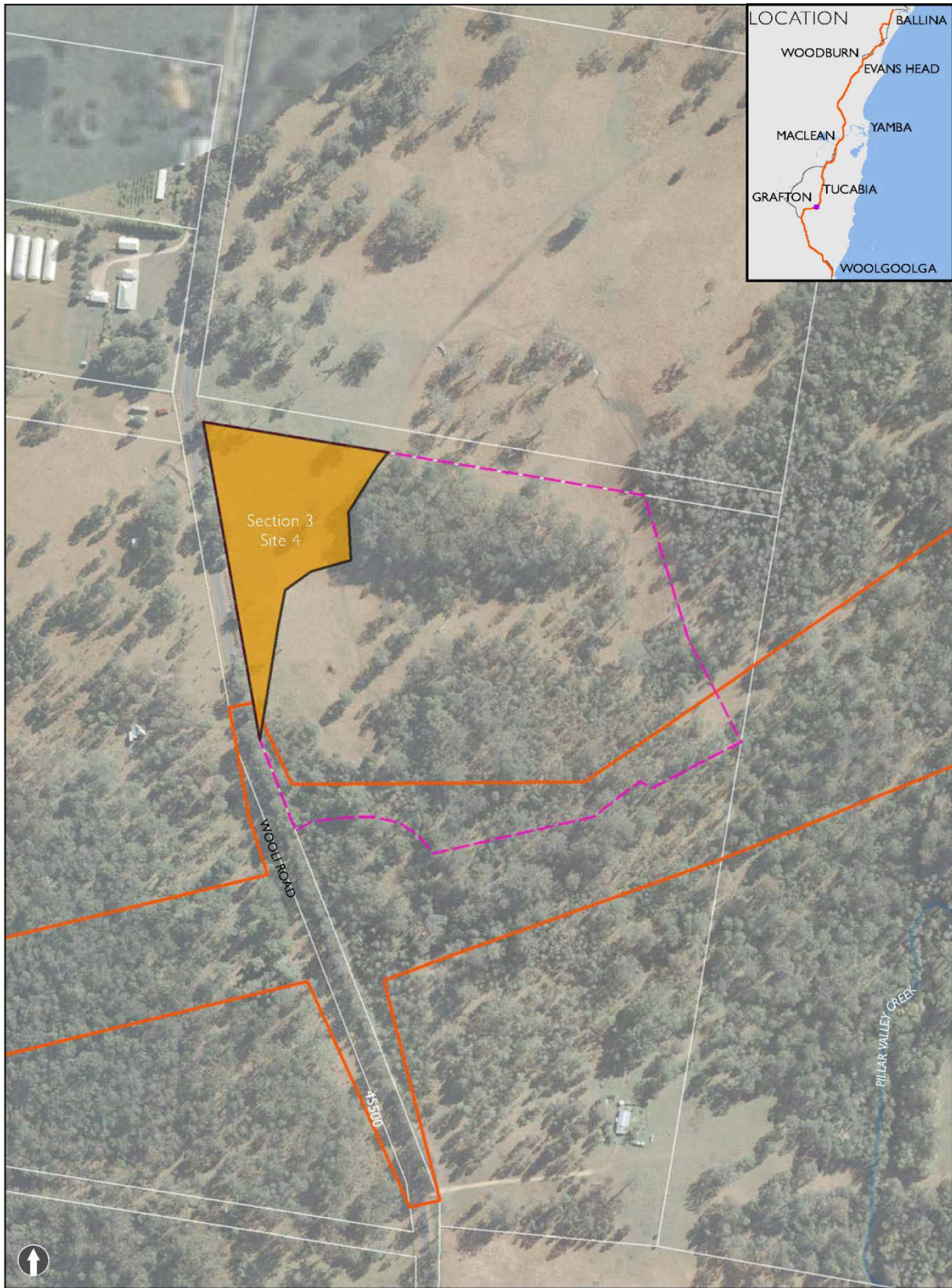
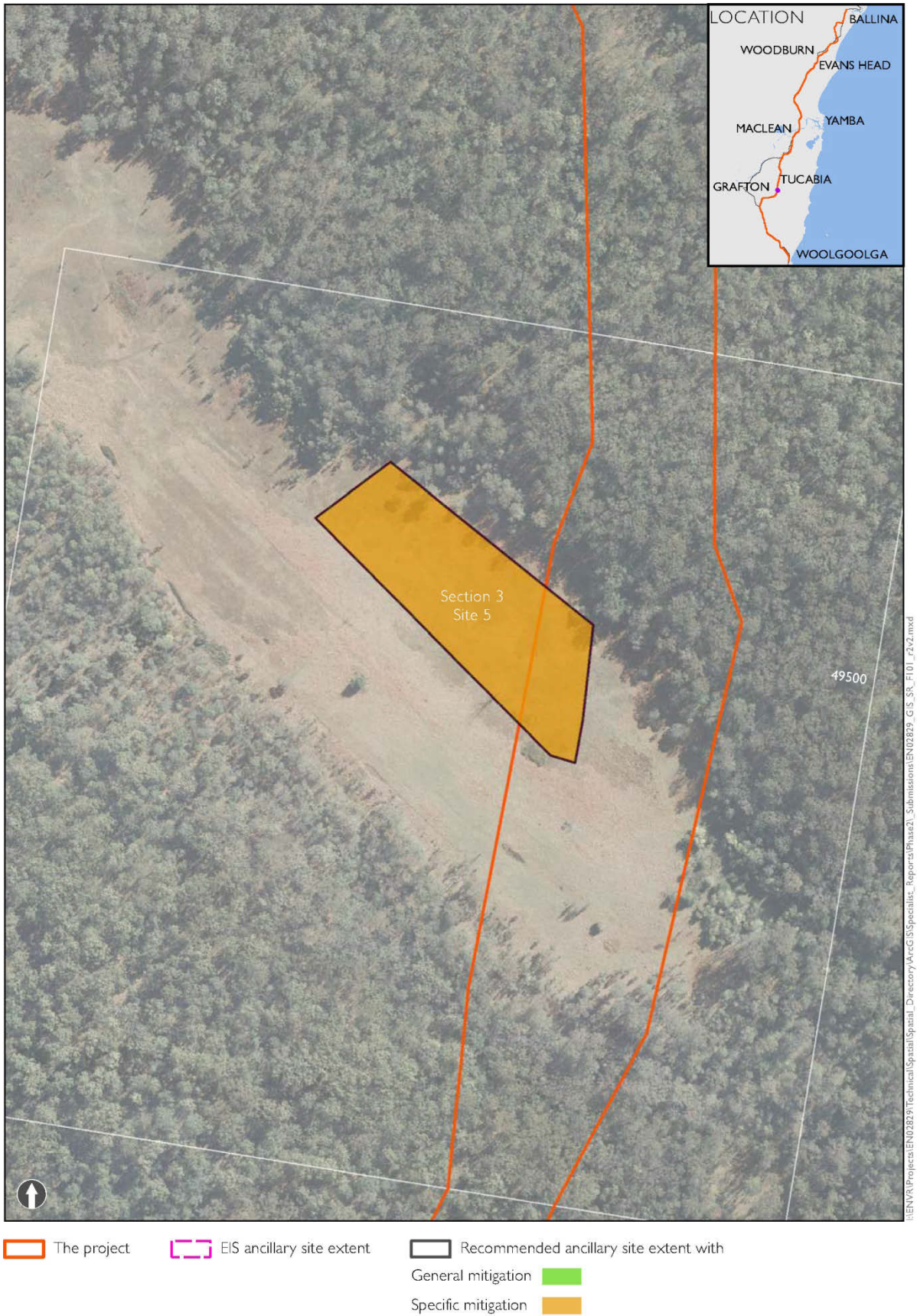
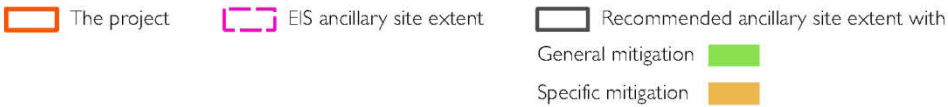
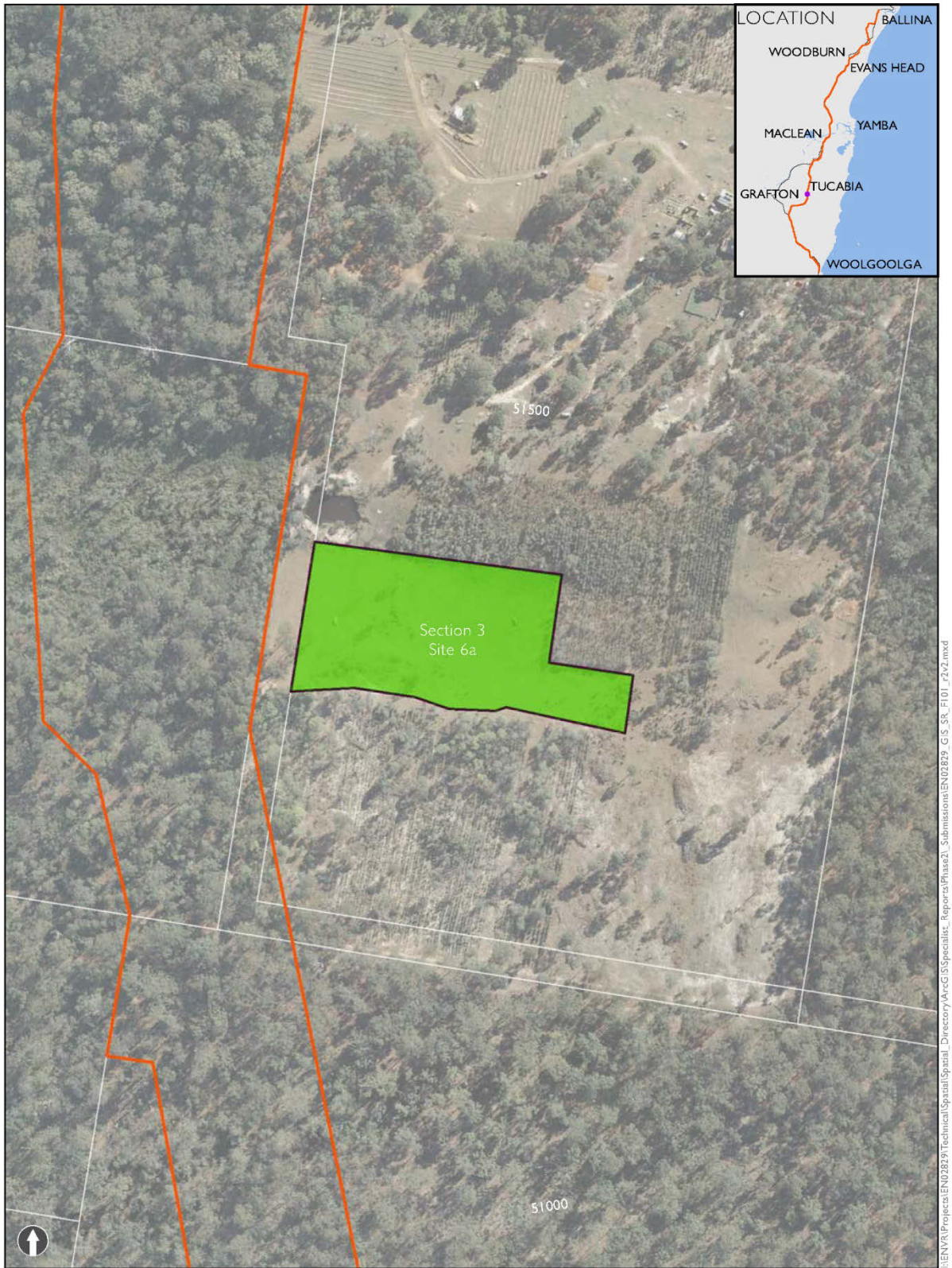


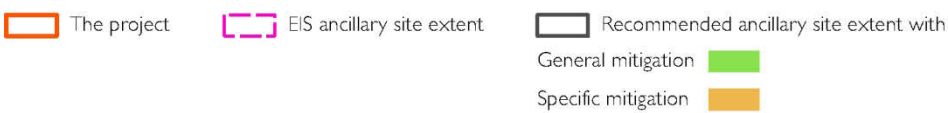
Figure 4-58: Ancillary facility locations – Section 3 site 4



**Figure 4-59: Ancillary facility locations – Section 3 site 5**

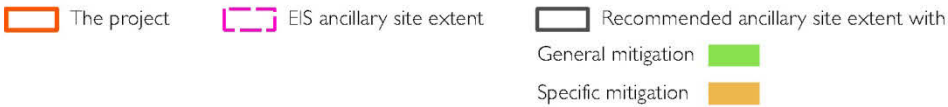
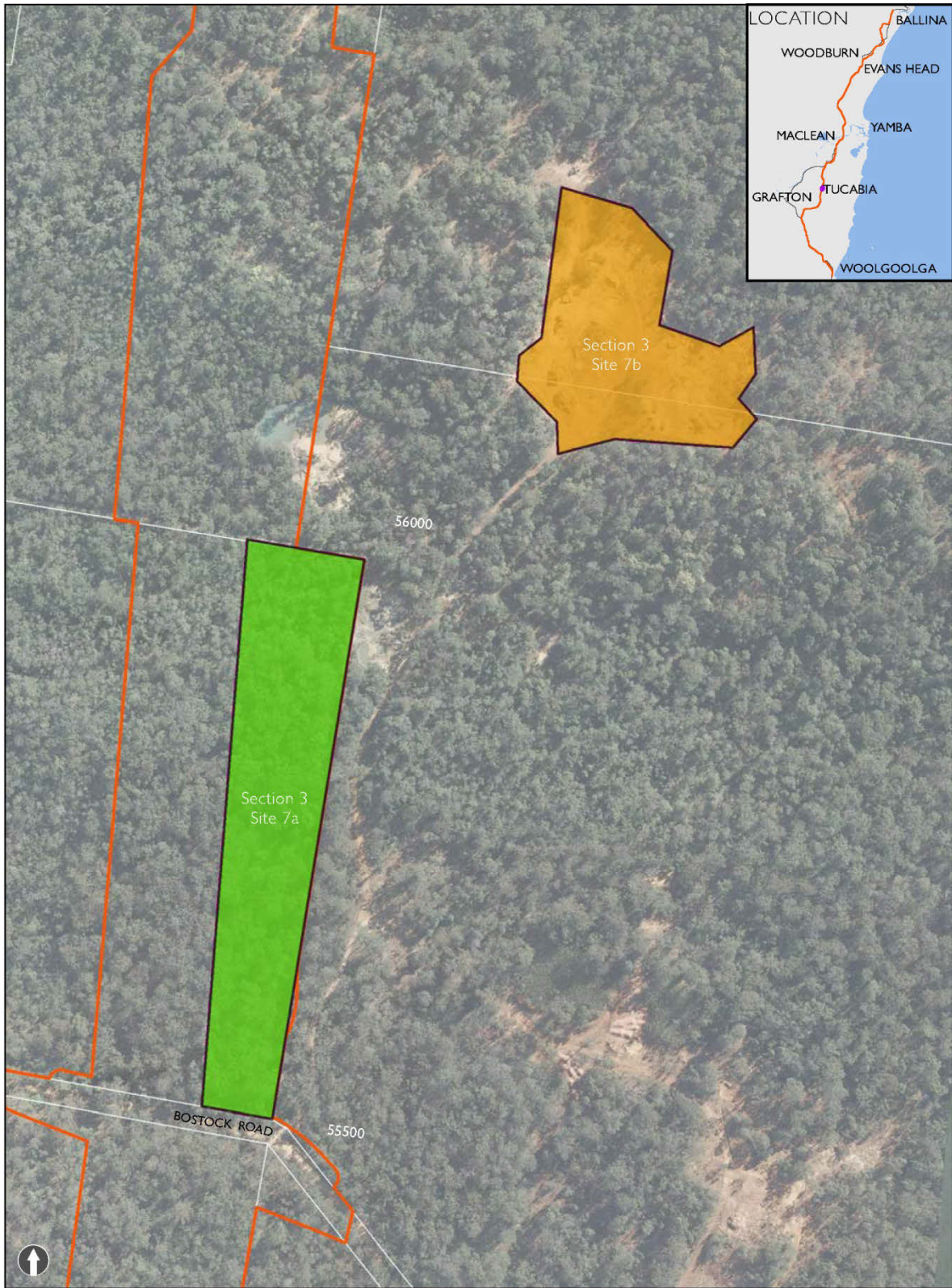


**Figure 4-60: Ancillary facility locations – Section 3 site 6a**

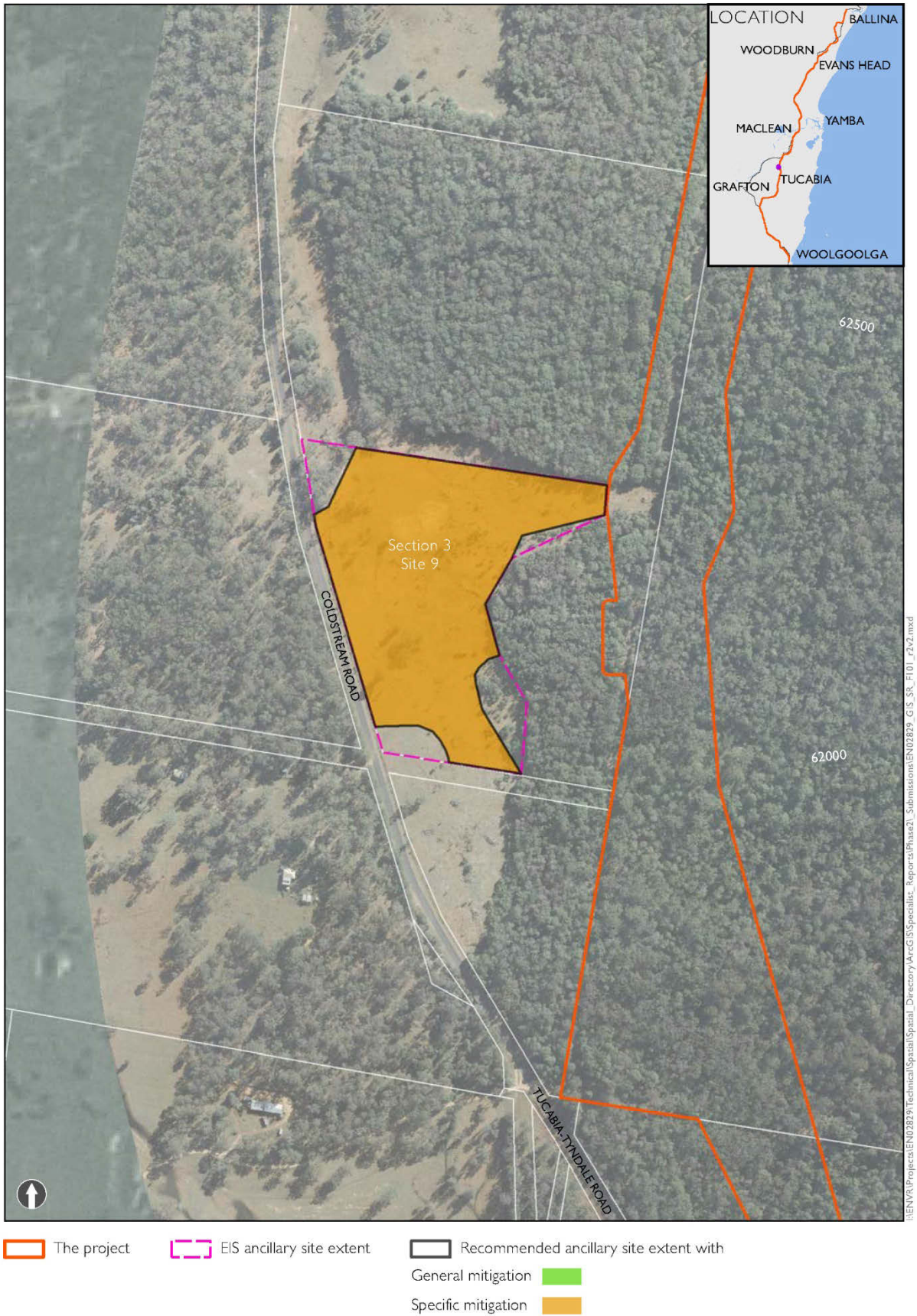


**Figure 4-61: Ancillary facility locations – Section 3 site 6b**

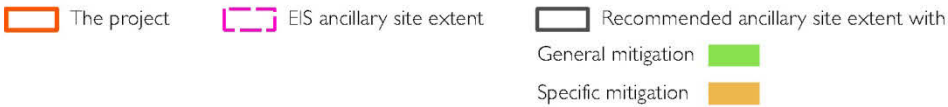
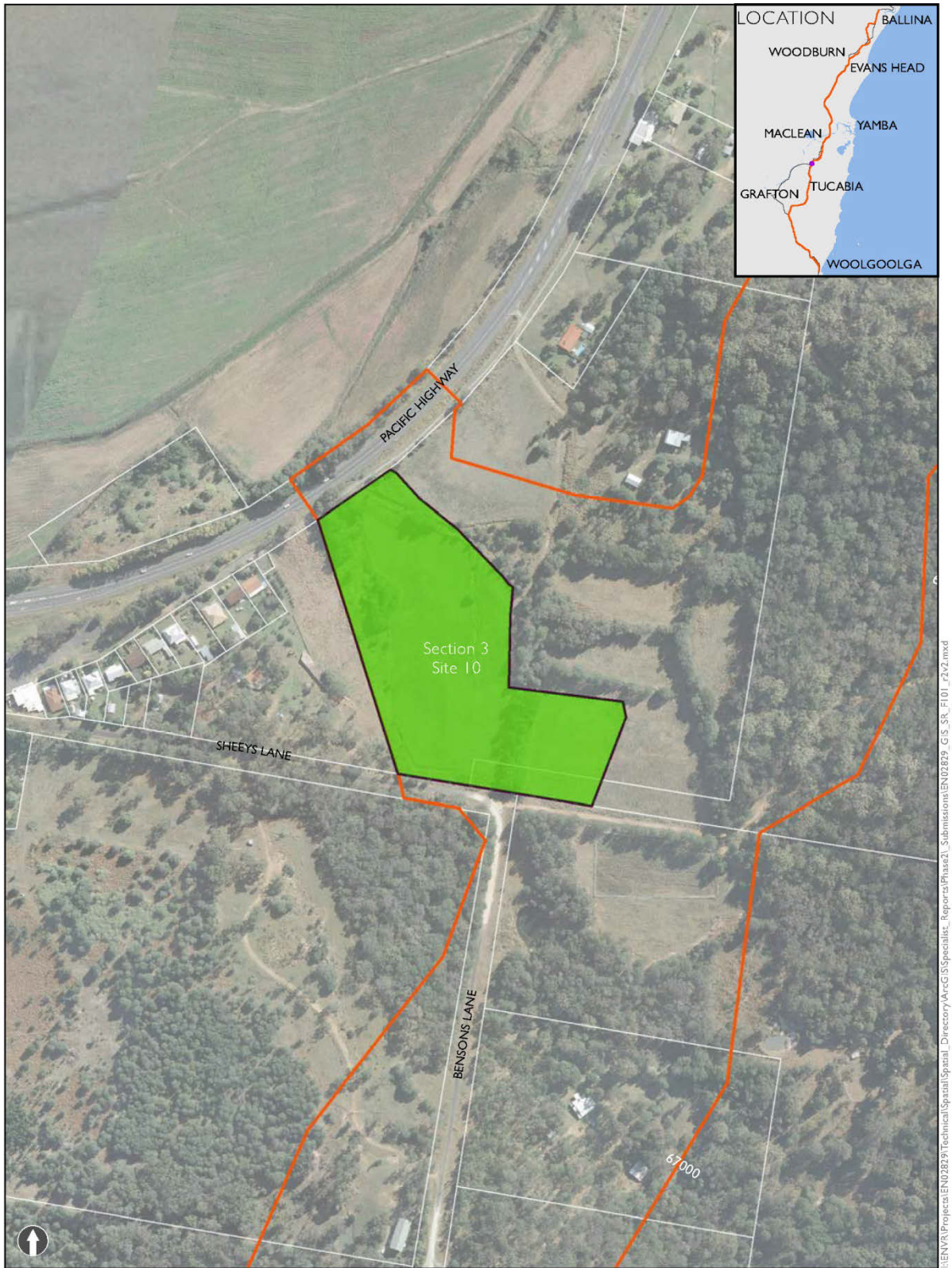




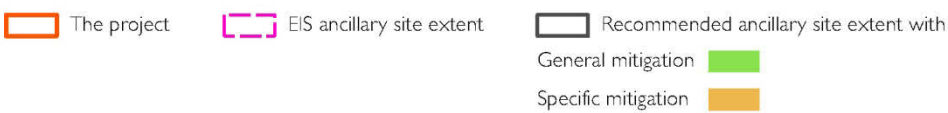
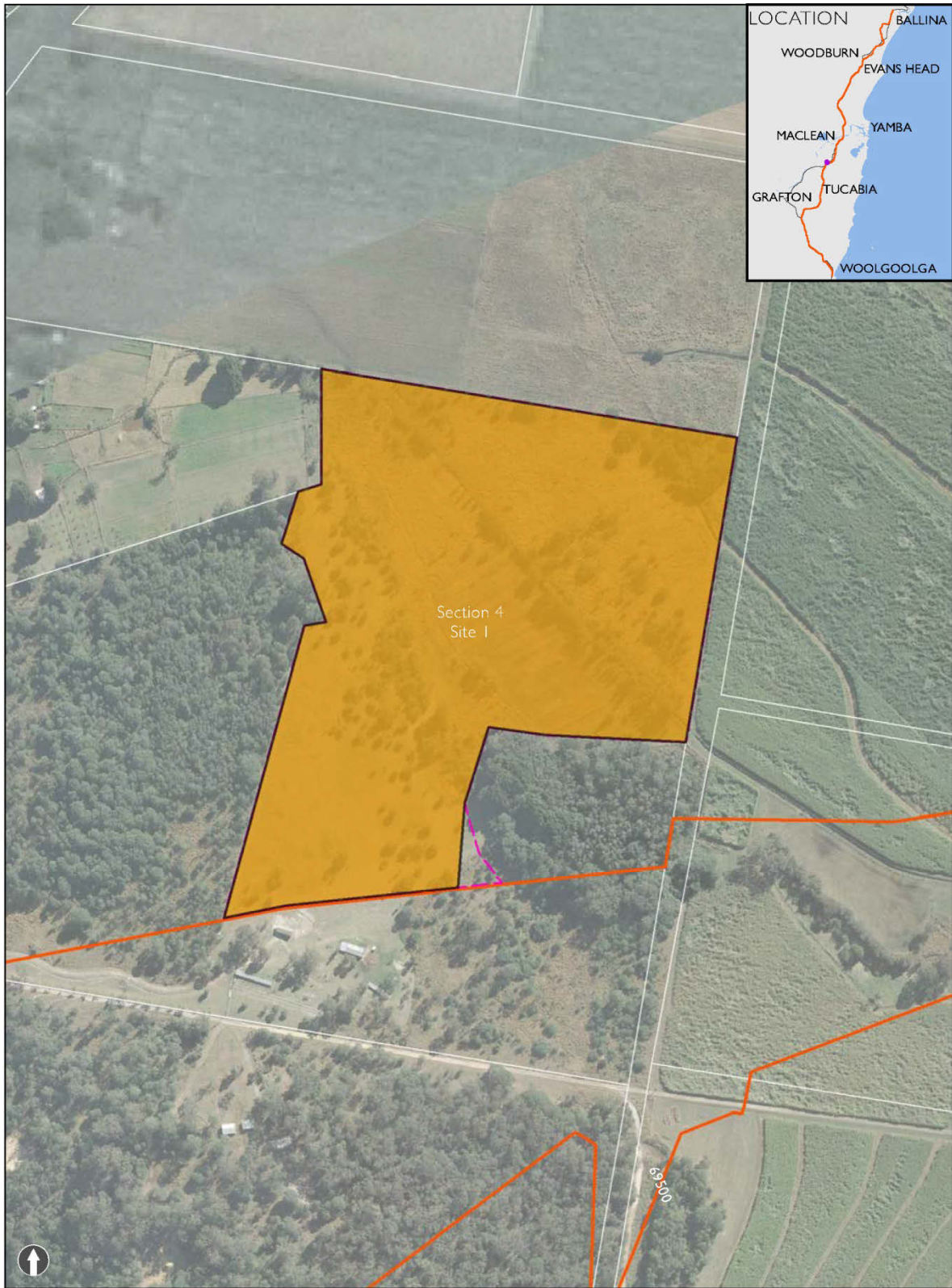
**Figure 4-62: Ancillary facility locations – Section 3 sites 7a and 7b**



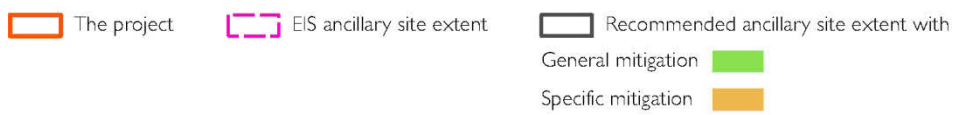
**Figure 4-63: Ancillary facility locations – Section 3 site 9**



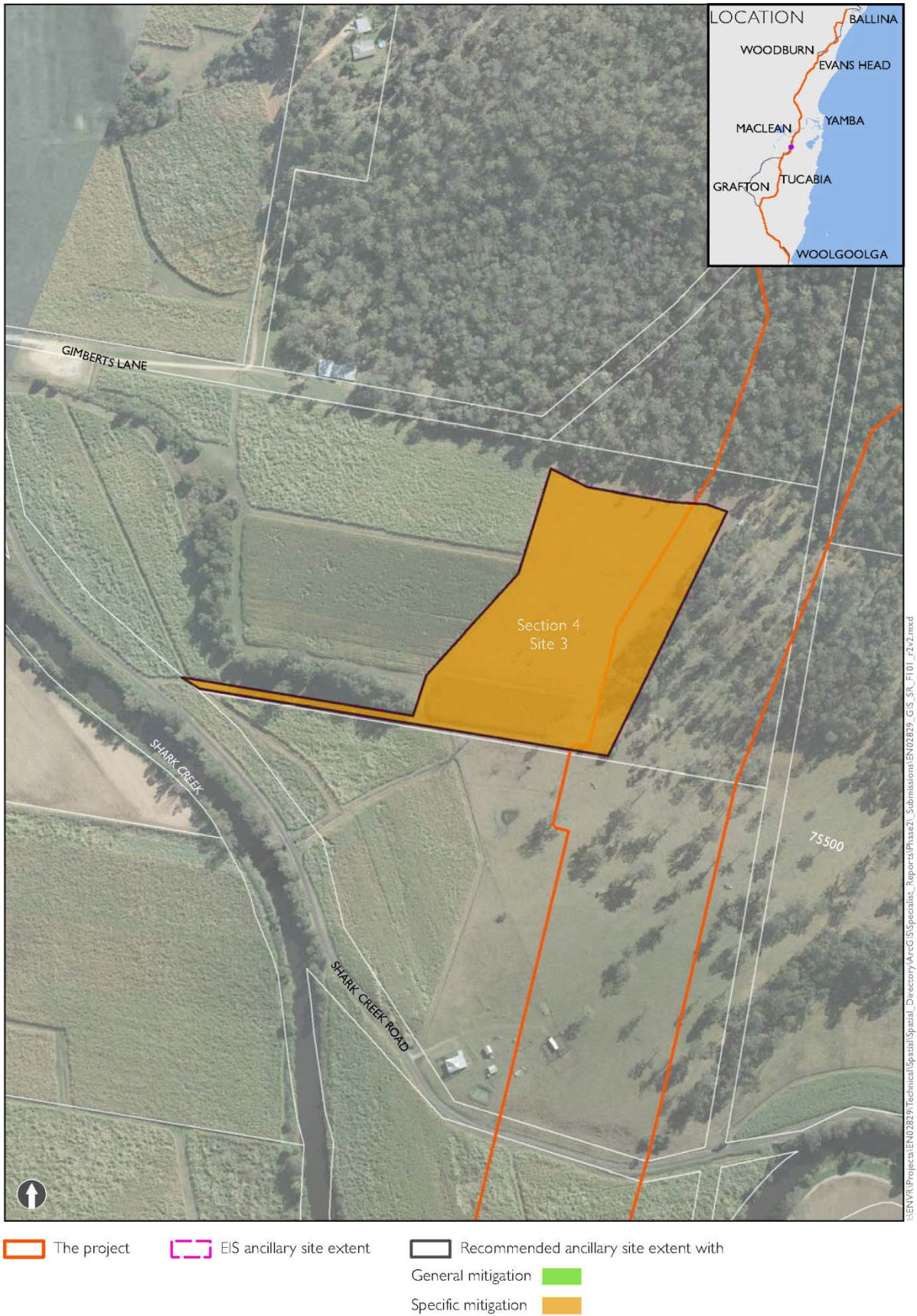
**Figure 4-64: Ancillary facility locations – Section 3 site 10**



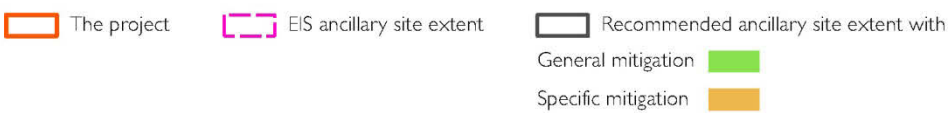
**Figure 4-65: Ancillary facility locations – Section 4 site 1**



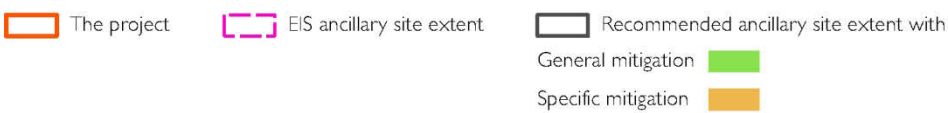
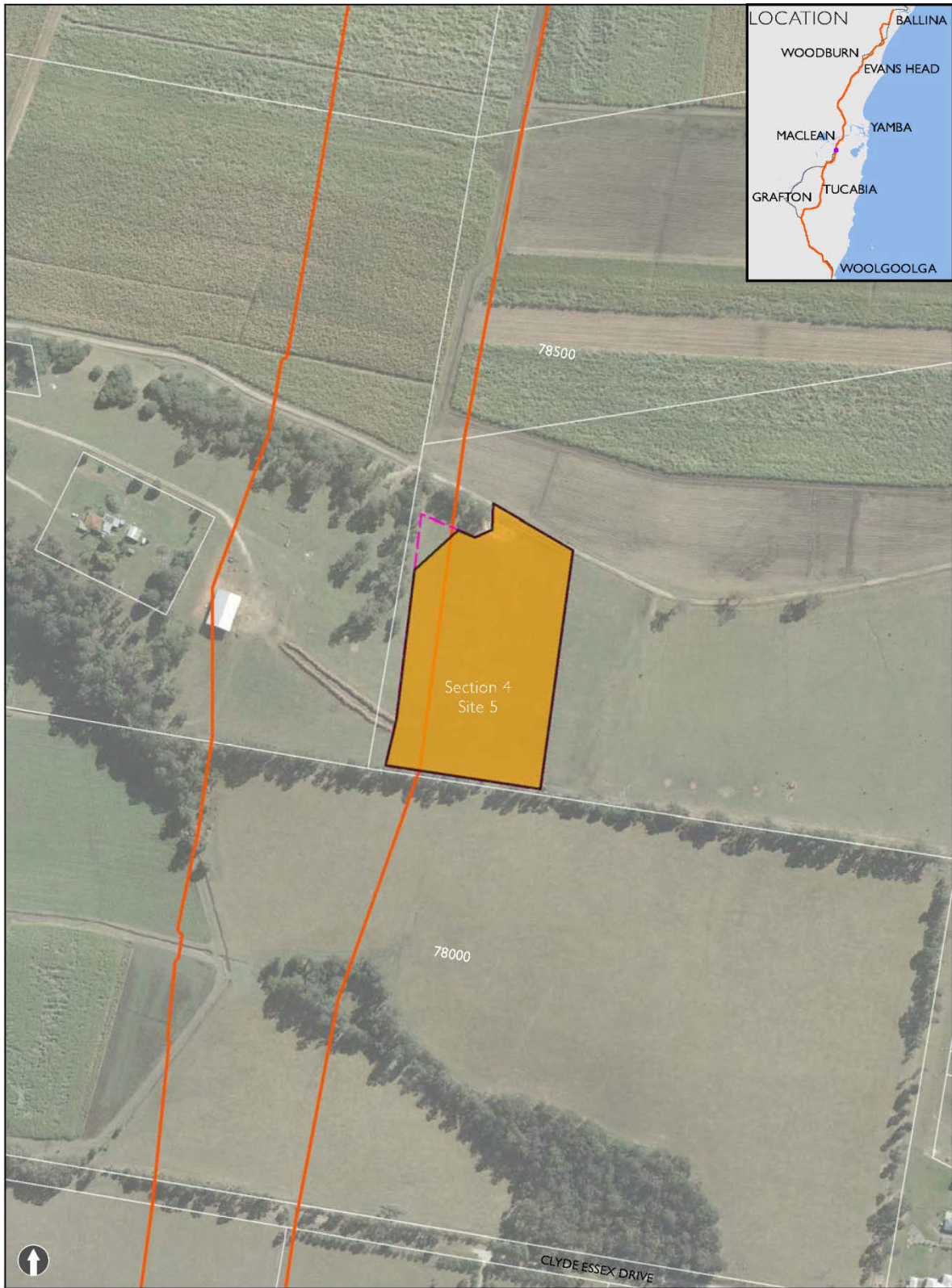
**Figure 4-66: Ancillary facility locations – Section 4 site 2**



**Figure 4-67: Ancillary facility locations – Section 4 site 3**



**Figure 4-68: Ancillary facility locations – Section 4 site 4a**



**Figure 4-69: Ancillary facility locations – Section 4 site 5**