10. TERRESTRIAL ECOLOGY

10.1. Introduction

This Chapter provides information to address submissions referring to terrestrial ecology that were received in response to the Emu Swamp Dam Environmental Impact Statement (EIS). Key issues raised during the submissions process referred to:

- direct and indirect impacts on threatened species/communities and remnant vegetation;
- maintenance of ecological connectivity;
- downstream impacts;
- field survey limitations;
- weed management; and
- proposed environmental offsets.

10.2. Threatened species

Several submissions referred to impacts to threatened species by the Project. Some comments have been addressed by updating or correcting information provided in the EIS, and some of the comments have required more comprehensive discussion and in the case of Prickly bottlebrush (*Melaleuca williamsii* syn. *Callistemon pungens*), additional field surveys to fully address the issues raised. For several species, further description of the impact to each species in local and regional context was required. Sections 10.2.1 to 10.2.4 below present information to address submissions relating to threatened flora species. The dam impact area consists of the FSL, pipelines and Stalling Lane access.

10.2.1. Threatened species database search results

One submission considered that the table of database search results for threatened species in the EIS was misleading. Table 9-3 from the EIS is reproduced and updated here as Table 10-1 with a more accurately descriptive title and the results of the recent Queensland Herbarium records database (HERBRECS) and the Department of Environment and Heritage Protection (DEHP) wildlife database (WildNet) database searches completed in March 2014. The search coordinates for the database searches presented in Table 10-1 were expanded to from those used in the Terrestrial Flora Baseline Study (3D Environmental, 2007) to encompass the pipelines in addition to the FSL. The search area was defined as -28.4999 north, -28.8262 south, 151.9939 east and 151.7298 west.

Where species records were found to be located within Project impact areas, this has been indicated in the last three columns of the table. Species' conservation status have been updated to reflect any changes in status since preparation of the EIS. Species that have been removed from endangered or vulnerable lists have been excluded from the table.

Table 10-1 Threatened flora species recorded in the locality identified by database searches

Species Name	Common Name	NC Act Status	EPBC Act Status	HERBRECS records	WildNet records	Records in the Project Area			
						FSL	Stalling Lane access	Urban Pipeline	Irrigation Pipeline
Acacia latisepala	-	NT	Not listed	14	20	Yes	No	Yes	Yes
Acacia pubifolia	Velvet wattle	V	V	3	6	Yes	Yes	Yes	No
Acacia ruppii[1]	Rupp's wattle	V	E	5	3	No	No	No	No
Allocasuarina rupicola	Rock she-oak	NT	Not listed	4	6	No	No	No	No
Almaleea cambagei	Torrington pea	Not listed	V	0	0	No	No	No	No
Bertya glandulosa	-	V	Not listed	6	5	No	No	Yes	No
Bertya recurvata	-	E	Not listed	5	2	No	No	No	No
Boronia amabilis	-	NT	Not listed	8	8	No	No	No	No
Boronia granitica	Granite boronia	E	E	26	19	No	Yes	Yes	No
Boronia repanda	Repand boronia	E	E	28	23	No	No	Yes	Yes
Caladenia atroclavia	Black-clubbed spider-orchid	E	E	4	4	No	No	No	No
Commersonia salviifolia	-	NT	Not listed	1	0	No	No	No	No
Conospermum burgessiorum	-	NT	Not listed	3	3	No	No	No	No
Cryptandra lanosiflora	Woolly cryptandra	NT	Not listed	3	1	No	No	No	No
Cryptostylis hunteriana	Leafless tongue-orchid	Not listed	V	0	0	No	No	No	No
Digitaria porrecta	Finger panic grass	NT	E	0	0	No	No	No	No
Discaria pubescens	Hairy anchor plant	NT	Not listed	1	0	No	No	No	No
Diuris parvipetala	-	V	Not listed	11	7	No	No	Yes	Yes
Dodonaea hirsuta	Hairy hop-bush	V	Not listed	10	6	No	No	Yes	No
Eucalyptus mckieana	McKie's stringybark	Not listed	V	5	0	No	No	Yes	No
Eucalyptus scoparia	Wallangarra white gum	V	V	1	1	No	No	Yes	No
Euphrasia orthocheila subsp. *peraspera*	Tenterfield eyebright	NT	Not listed	1	0	No	No	No	No
Euphrasia orthocheila subsp. *orthocheila*	-	NT	Not listed	1	0	No	No	No	No
Grevillea scortechinii subsp. *scortechinii*	Black grevillea	V	V	12	9	No	No	Yes	Yes
Hakea macrorrhyncha	-	NT	Not listed	2	4	No	No	No	No
Hibbertia elata	Guinea flower	NT	Not listed	3	2	No	No	No	No
Homoranthus montanus	-	V	V	5	6	Yes	Yes	Yes	No
Kardomia granitica	-	E	V	7	6	No	No	No	No

Species Name	Common Name	NC Act Status	EPBC Act Status	HERBRECS records	WildNet records	Records in the Project Area			
						FSL	Stalling Lane access	Urban Pipeline	Irrigation Pipeline
(syn. *Babingtonia granitica)*									
Macrozamia viridis	-	E	Not listed	4	5	No	No	No	No
Melaleuca flavovirens (syn. *Callistemon flavovirens)*	Green bottlebrush	NT	Not listed	8	6	Yes	Yes	No	No
Melaleuca williamsii (syn. *Callistemon pungens*)	Prickly bottlebrush	V	V	19	16	Yes	No	Yes	No
Mirbelia confertiflora	-	NT	Not listed	6	6	No	No	No	No
Olearia gravis	-	NT	Not listed	3	5	No	No	No	No
Phebalium glandulosum subsp. *elgandilosum*	Rusty desert phebalium	V	V	4	4	Yes	No	No	No
Phebalium whitei	-	V	V	7	7	No	No	No	No
Pterostylis woollsii	Long-tailed greenhood	NT	Not listed	3	3	No	No	Yes	No
Rutidosis glandulosa	-	NT	Not listed	1	0	No	No	No	No
Thelionema grande	Greater rock lily	NT	Not listed	4	4	No	No	No	No
Veronica arenaria	-	NT	Not listed	3	2	No	No	No	No
Wahlenbergia glabra	Native bluebell	NT	Not listed	0	1	No	No	No	No
Westringia amabilis	-	NT	Not listed	4	2	No	No	No	No
Zieria graniticola	-	E	Not listed	17	14	No	No	No	No
Zornia pallida	-	NT	Not listed	1	1	No	No	No	No

Nature Conservation Act 1992 (NC Act) Status: E – Endangered, V – Vulnerable, NT – Near Threatened
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Status: E – Endangered, V – Vulnerable
[1] Not identified in EPBC search although single HERBRECS record in locality from Girraween National Park

10.2.2. Threatened species field survey results

One submission pointed out that Repand boronia (*Boronia repanda*) should be included in the list of threatened flora species that have been recorded within the irrigation pipeline alignment (EIS Table 9-11). The list has been updated to include Repand boronia, as well as more recent records of threatened flora species identified during field surveys undertaken for the Supplementary Report (SKM 2014). The updated list is presented in Table 10-2.

Table 10-2 Threatened flora proximate to Project impact identified in field surveys

Project location	Species	NC Act Status	EPBC Act Status	Number of plants/records	REs in which species occurs
Full supply level (FSL)	*Acacia latisepala*	NT	Not listed	3	13.12.6, 13.3.1
	Green bottlebrush *Melaleuca flavovirens*	NT	Not listed	6	13.3.1, 13.3.1x1, 13.12.2, 13.12.6
	Prickly bottlebrush *Melaleuca williamsii*	V	V	45	13.3.1, 13.3.1x1, 13.12.2, 13.12.6, 13.12.8
	Greater rock lily *Thelionema grande*	NT	Not listed	5	13.3.1, 13.3.1x1, 13.12.6
Stalling Lane Access	Velvet wattle *Acacia pubifolia*	V	V	15	13.12.6
	Prickly bottlebrush *Melaleuca williamsii*	V	V	4	13.3.1
Urban Pipeline	*Acacia latisepala*	NT	Not listed	3	13.12.8
	Eucalyptus mckieana	Not listed	V	1	13.12.2
	Mirbelia confertiflora	NT	Not listed	1	13.12.8
	Prickly bottlebrush *Melaleuca williamsii*	V	V	4	13.12.8
Irrigation Pipeline	*Acacia latisepala*	NT	Not listed	123	13.12.9
	Repand boronia *Boronia repanda*	E	E	50-100 (Donatiu 2006)	13.12.2, 13.12.3, 13.12.4, 13.12.5, 13.12.6
	Grevillea scortechinii subsp. scortechinii	V	V	51	Non remnant
	Prickly bottlebrush *Melaleuca williamsii*	V	V	3	13.3.1x1

Source: Modified from Emu Swamp Dam EIS Chapter 9 (SKM, 2008)
NC Act Status: E – Endangered, V – Vulnerable, NT – Near Threatened
EPBC Act Status: E – Endangered, V – Vulnerable

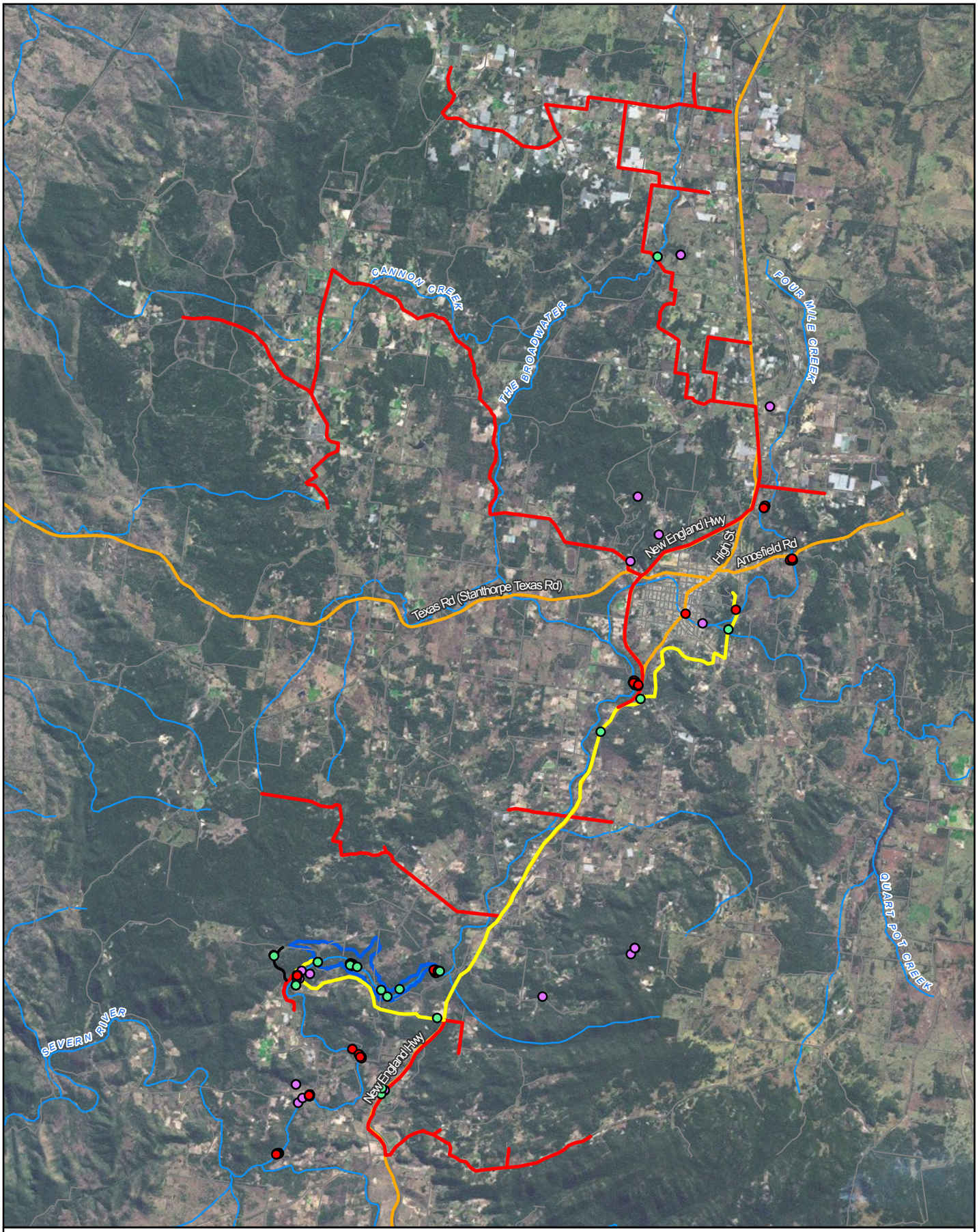
10.2.3. Prickly bottlebrush (Melaleuca williamsii) impacts and additional targeted surveys

Several submissions referred to impacts to Prickly bottlebrush. Additional targeted surveys were undertaken over three weeks in July 2013 for this species, and again between 28-30 October 2013 during the flowering period to confirm the identification of *M. williamsii*. Field surveys concentrated on the area within 5 km of the FSL. Methodology for field surveys is described in the SEIS Appendix E Terrestrial Ecology Field Survey Results (SKM 2014). The total number of individual Prickly bottlebrush plants found outside the FSL was 359. The total number of Prickly bottlebrush found inside the FSL was 38 (Figure 10-1). The terrestrial flora report (3D Environmental 2007) for the EIS reported seven (7) Prickly bottlebrush inside the FSL, four (4) in the Stalling Lane realignment, four (4) in the urban pipeline corridor and three (3) in the irrigation pipeline corridor. One on the plants in the FSL identified by 3D Environmental is very close to a group of Prickly bottlebrush found by SKM and may have been part of the same group.

Plant samples collected in the July 2013 field survey were sent to the Queensland Herbarium for identification. However the Herbarium was unable to provide a species identification due to the absence of flowers with the sampled material. The samples were also sent to a senior botanist in NSW (Tony Rodd) who has provided a species identification based on leaf morphology and location data. Tony Rodd has confirmed the identification of the species as Prickly bottlebrush (*M. williamsii* subsp. *fletcheri*). Additional flowering samples collected in the October 2013 field survey and sent to the Queensland Herbarium were consistent with this identification.

One submission commented that downstream impacts on this species should be considered. Surface water flow statistics presented in the EIS Chapter 7 and this SEIS show that the dam will have no impact on the flow regime upstream and minimal impacts downstream of Accommodation Creek. There will be impacts to medium flows between the dam and the confluence of the Severn River with Accommodation Creek. The proposed environmental release regime (30 ML/day) will mitigate impacts to the extent that the frequent low flows and infrequent high flows will be unchanged.

Field surveys undertaken in 2013 identified three (3) groups of Prickly bottlebrush located approximately 5 km, 7.5 km and 9.5 km downstream of the FSL. The species is well adapted to withstand periods of inundation and drought. It is recommended that ongoing monitoring of Prickly bottlebrush persistence and health is undertaken as part of a threatened species management plan. Threatened species management will be detailed in an offset area management plan as discussed in Section 10.8.



LEGEND

- *Callistemon pungens* (SKM)
- *Callistemon pungens* (3D Environmental)
- *Callistemon pungens* (database) (Atlas of Living Australia 2014)
- Watercourse
- Urban Pipeline
- Irrigation Pipeline
- Road
- Highway
- Stalling Lane Access
- Full Supply Level (738m AHD)

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Projection: GDA94 MGA56

EMU SWAMP DAM
SUPPLEMENTARY REPORT
Figure 10-2
***Melaleuca williamsii* Database Records and Survey Results**

SINCLAIR KNIGHT MERZ
SKM

I:\QENV2\Projects\QE06732\Spatial\ArcGIS\Figures\ECOLOGY_FINAL\04_SEIS\Chapter\QE06732_SEIS_Figure10-1_MelaleucaWilliamsiiDatabaseRecordsAndSurveyResults.mxd Produced: 11/03/2014

10.2.4. Threatened flora species - local and regional context

A submission commented that the terms of reference for the EIS requires that the significance of clearing be discussed for each species listed under the *Nature Conservation Act 1992* according to the impact on local, regional and State populations. Also, the practicality of relocating each species should be discussed in the context of suitable habitat and soil profile requirements, using examples of relocation success elsewhere, where available. Species translocation is discussed in detail in Appendix I. The significance of the impact of the Project on each threatened flora species is discussed below.

Database searches were used to provide a local and regional context for each species and conclusions drawn about the significance of the Projects' impact on these species has been based on the number of records in the locality. It is recognised that that there are limitations to this approach. Database records only show a sample of a species' true occurrence and population size, as demonstrated by the additional *M. williamsii* plants found during field surveys. The significance of impacts to each species may be over-stated as a result of this approach.

Acacia latisepala

Field surveys undertaken by 3D Environmental in 2007 identified three (3) plants in the FSL, three (3) plants along the urban pipeline and four (4) populations along the irrigation pipeline (containing 123 individuals). The Australian Virtual Herbarium (AVH) reports 103 records for this species, with the majority recorded within the New England Tablelands bioregion. *A. latisepala* is known to occur in the Girraween and Bald Rock National Parks and at Torrington (c. 22 km south of the dam site) and has been seen in great abundance (Hunter 1995) in areas recently burnt by fires.

This species was found by 3D Environmental in the FSL in REs 13.3.1, 13.12.6 and non remant vegetation. Along the pipelines it was found in REs 13.12.8, 13.12.9 and non-remnant vegetation. Habitat for *A. latisepala* is described by Kodela and Harden (2013) as heath and dry sclerophyll forest amongst granite outcrops.

Based on the available database and field survey information, the 123 plants along the irrigation pipeline represent a significant proportion of the local and regional population. Where this species occurs near the irrigation and urban pipelines, the alignment and/or method of construction will be adjusted to avoid direct impacts.

The three plants in the FSL are a small proportion of the local population, and impacts to these plants are unavoidable. Offsets for unavoidable impacts area discussed in Section 10.8.

Velvet wattle (*Acacia pubifolia*)

This species is confined to the Darling Downs, between Glen Aplin and Wallangarra, in south-eastern Queensland (Qld) and to northern New South Wales (NSW), where it is less common (Orchard & Wilson 2001). In Qld, it is common in the Wyberba district, south of Stanthorpe and also grows in the drier western part of Girraween National Park (McDonald et al. 1995). This species was found by 3D Environmental in RE 13.12.6, and potential habitat also exists in REs 13.12.2 and 13.12.5. Velvet wattle grows in dry scrubby woodland on granite, sandy, stony, loam and metasediment soils.

Field surveys identified 15 plants in one location in the Project impact area (Stalling Lane access) (3D Environmental 2007). The species was not found in the FSL. A search of records on AVH shows 11

occurrences in the local area, plus one record in Girraween National Park. One of the AVH records is from Stalling Lane and is assumed to be from the same group identified by 3D Environmental in 2007. The Stalling Lane access location will be altered to avoid the 15 individuals.

Repand boronia (*Boronia repanda*)

This species was found by 3D Environmental in 2007 in disturbed roadside vegetation. Repand boronia occurs in REs 13.12.2, 13.12.3, 13.12.4, 13.12.5 and 13.12.6. Habitat for this species consist of heath and woodland on sandy soils in association with granite boulders.

Repand boronia has not been recorded in the FSL, however a group of 50-100 individuals has been recorded on Pozieres Road where the irrigation pipeline is proposed. The total population size of this species is likely to be less than 15,000 individuals (Hunter & Bell 2006). Total size of Queensland populations is estimated to be approximately 1,000 individual plants (Donatiu 2006). As such, impacts on the group on Pozieres Rd are significant for the local, regional and state populations of this species.

Where this species occurs near the irrigation pipeline, the alignment and/or method of construction will be adjusted to avoid direct impacts.

McKie's stringybark (*Eucalyptus mckieana*)

Peacock (1996) lists 18 populations, though two of these are unconfirmed, while Quinn et al. (1995) cites 30 populations, amounting to over 2,000 individuals. The AVH has six (6) records for the species within 20 km of the Project, however population size at each location is unclear. At two locations, the species is described as 'common at location' and 'dominant' respectively. McKie's stringybark occurs in grassy open forest or woodland on poor sandy loams, usually on gently sloping or flat sites. Queensland populations represent the northern limit of distribution.

A HERBRECS record of this species was identified in the terrestrial flora report for the EIS (3D Environmental 2007) although was not recorded during the field survey. The record is in RE 13.12.2, approximately 200 m south of the proposed urban pipeline corridor on Fletcher Road, about 400 m west of the Rhumbalara Railway crossing and is described as 'locally common in tall woodland with Apple box (*Eucalyptus bridgesiana*), on granite'.

At one survey site in the 2013 surveys, McKie's stringybark was found to be dominant in a patch of RE 13.3.1. The survey site was well outside the Project impact areas, approximately 1 km west of the proposed pipeline alignment and 4 km south of the FSL. No individuals of this species were found in the FSL.

As this species is relatively common locally, the impacts due to construction of the proposed pipeline are not considered significant locally or regionally.

Grevillea scortechinii subsp. *scortechinii*

In Queensland this species is endemic to Stanthorpe Plateau, known from several populations between Stanthorpe and Dalveen in non-remnant roadsides with potential habitat in RE's 13.3.1, 13.12.1, 13.12.2, 13.12.6, 13.12.8, 13.12.9. (Donatiu 2006). The species occurs in sclerophyll woodland or remnant roadside associations in granitic, sandy-loamy soils (Olde & Marriott 1995; Makinson 2000).

It is represented in Queensland by 11 herbarium collections, the majority of which are from the Pozieres Rd location. The total number of plants is not known, although Dodd (1991) found 350 plants at two locations and counted about 190 seedlings at a third site.

No populations or individuals of this species was found within the FSL. However, a population of *Grevillea scortechinii* subsp. *scortechinii* was recorded by 3D Environmental (2007) on Pozieres Road in the north of the study area. The population consisted of approximately 50 individuals over a linear distance of approximately 100m (3D Environmental 2007). Plants were found on the northern side of the road in a narrow verge of disturbed regrowth located between the road drain and a Pinus plantation. One plant was observed on the southern side of the road on the immediate road margin adjoining an apple orchard windbreak. The population is highly vulnerable to any form of roadside disturbance.

This is a significant proportion of the local population and as such the Project impact on this species is considered significant at the local and regional scale. The irrigation pipeline alignment and/or method of construction will be adjusted to avoid direct impacts.

Green bottlebrush *(Melaleuca flavovirens)*

There are 68 records for Green bottlebrush in the AVH, mainly from Girraween National Park and Bald Rock National Park. Habitat for this species consists of REs 13.3.1, 13.12.2 and 13.12.6.

Field surveys identified seven (7) plants within the FSL and none along the pipeline alignment. Impacts to the plants in the FSL are unavoidable. This number of plants is significant in terms of the local population, but not in a regional context considering the number of records in the New England Tablelands bioregion.

Impacts to the seven (7) plants in the FSL are unavoidable. Offsets for unavoidable impacts area discussed in Section 10.8.

Mirbelia confertiflora

This species occurs on low heaths of granite pavements in RE 13.12.6. A search on the AVH showed 10 records for this species in the Stanthorpe area. One of the records indicates multiple plants at one location, describing the species as common and occurring in clumps.

Field surveys identified one (1) occurrence along the urban pipeline alignment and none in the FSL. Due to the rarity of records in the local area, this one plant represents a substantial proportion of the local population. Potentially impacts to this plant will be avoided by adjusting the pipeline alignment and/or construction methods.

Greater rock lily (*Thelionema grande*)

Habitat for this species consists of REs 13.3.1 and 13.12.6 on sandy soils associated with granite outcrops. The AVH shows six (6) records for this species in the Stanthorpe area, with an additional nine (9) records in Girraween National Park. Field surveys found five (5) plants in the FSL and none along the pipeline alignments. Considering the number of records for this species in the locality, the five (5) plants in the FSL are considered to be a substantial proportion of the local population.

Impacts to the five (5) plants in the FSL are unavoidable. Offsets for unavoidable impacts area discussed in Appendix I.

10.2.5. Threatened fauna

The following threatened fauna (Table 10-3) were detected during surveys conducted by BAAM during two fauna surveys undertaken in 2007 and 2008. Impacts to this species will be mitigated as described below and the residual loss of habitat will be offset in accordance with Commonwealth and State offset policies (Section 10.8).

One submission comment questioned if there are areas of suitable habitat available for fauna dispersal and relocation surrounding the Project area to enable implementation of the proposed mitigation measures. Vegetation mapping and aerial photography shows suitable woodland and shrubland habitat upstream and downstream of the FSL is available for fauna dispersal. A 200 m wide, 322 ha buffer area will be secured around the FSL and managed for conservation purposes to protect and enhance fauna habitat values. Management will include rehabilitation, fencing, weed and pest control, fire management and grazing management. Staged clearing (as described for Koala mitigation below) allows fauna time to move to these adjacent areas.

Table 10-3 Threatened fauna species detected in field surveys

Scientific name	Common name	NC Act status	EPBC Act status	Potential habitat impacted (ha)
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	88.5
Dasyurus maculatus maculatus	Spotted-Tail Quoll	V	E	84.3
Lophoictinia isura	Square-tailed Kite	NT	Not listed	109.89
Neophema pulchella	Turquoise Parrot	NT	Not listed	109.89
Phascolarctos cinereus	Koala	LC	V	78.75
Tachyglossus aculeatus	Short-beaked Echidna	LC	Not listed	177.78
Uvidicolus sphyrurus	Granite Belt Thick-tailed Gecko	NT	V	88.5

Large-eared Pied Bat

There are no known maternity sites for the Large-eared Pied Bat within the Project area, the record occurs within close proximity (i.e. within 50km) to another record, suggesting genetic exchange between populations and the species is not approaching distributional limits in the Project area. As such, the population present within the Project area is not considered to be an important population of the Large-eared Pied Bat.

The project will cause a loss of 88.5 ha potentially suitable habitat for this species in the inundation area, comprised of 18.1 ha of primary habitat (potential roosting and foraging habitat) and approximately 70.4 ha of supporting or secondary habitat which may provide foraging resources. Any impacts on the population will be minor (regardless of whether or not the population may be considered important) as foraging habitat will remain upstream and downstream of the FSL, and no maternity roosts or habitat will be impacted.

The project will result in loss of 88.5 ha foraging habitat for this species in the FSL. Any impacts on the population will be minor (regardless of whether or not the population may be considered important) as foraging habitat will remain upstream and downstream of the FSL, and no maternity roosts or habitat will be impacted.

There will be limited impact on habitats most likely to support roosting individuals of the Large-eared Pied Bat (rocky areas, caves, overhangs) as these are primarily located to the west of the Project area.

The impact of short term habitat loss within the FSL will be mitigated by the rehabilitation of the 322ha buffer area around the FSL which currently supports a mix of remnant vegetation, non-remnant vegetation and cleared areas. This will provide suitable foraging habitat for the Large-eared Pied Bat.

Similarly, disturbance to remnant vegetation within the FSL will impact on east-west habitat connectivity along the Severn River in the short term. The rehabilitation of the 200m wide buffer area around the FSL will restore landscape connectivity in the medium to long term and will provide for the dispersal of this species. There are no known barriers to the movement of this species, which has been recorded from linear riparian areas within an otherwise cleared landscape. As such, a mosaic of cleared and vegetated land is likely to allow the Large-eared Pied Bat to move between more extensive remnants.

Further, insects attracted to the dam will provide a foraging resource for the species. No population of this highly mobile species will be fragmented due to the Project and foraging habitat will remain upstream and downstream of the dam and will be rehabilitated in the surrounding landscape as part of the OAMP. As a result, the species is unlikely to decline in the region.

The primary mitigation measure for the potential impacts of the Project is the rehabilitation of a 322 ha buffer area around the FSL. The intention is that this buffer be managed for conservation purposes and in the long term it is likely to provide habitat and movement corridors for the Large-eared Pied Bat. This species has been recorded foraging in primarily regrowth habitats (Umwelt 1996) and fragmented woodlands, such as those present within the inundation area itself and it is considered likely that the Large-eared Pied Bat will forage within the proposed buffer area.

Additional mitigation strategies include pre-clearing surveys of suitable habitat within the Project area which aim to relocate individuals out of the impact area and into suitable habitats within the adjacent buffer area.

A weed and pest management plan will be implemented to control the establishment of invasive species in the Project area.

As impacts can be mitigated on site, adverse residual impacts on the local population of the Large-eared Pied Bat are not expected.

Spotted-tail Quoll

The Project will reduce primary habitat for the species (potential denning habitat) by 9.2 ha and reduce secondary habitat (foraging only) by 75.1 ha within the inundation area and will indirectly impact the species from the displacement of prey species and feral predator species into adjacent areas more likely to support Spotted-tail Quoll. These impacts will be mitigated by the implementation of a pest management plan to control and prevent the establishment of feral predator species into adjacent habitat as a result of the Project. By reducing predation and competitive pressure in the immediate locality, the Spotted-tailed Quoll is considered likely to utilise the buffer area surrounding the FSL.

Vegetation along the pipeline corridors is unlikely to provide potential habitat for this species due to the fragmented and disturbed condition of vegetation in the road reserves where the pipelines will be constructed. Population scale movement will be unaffected in the long-term and fragmentation is therefore unlikely.

The Project is not anticipated to impact on sheltering (i.e. breeding) habitat. The Project construction does, however, have the potential to disrupt the breeding cycle of a population from the clearing and inundation of habitat, and disturbance to adjacent habitat from noise and dust.

Clearing and inundation of habitat for the Project has the potential to interfere with the recovery of the species from reduction of female territories. Any such impacts on any local population will be minor and short-term and will be offset by restoration of habitat in the buffer area around the dam.

The project will result in the unavoidable loss of 9.2 ha of primary habitat and 75.1 ha of secondary habitat for the Spotted-tailed Quoll. The primary mitigation measure proposed is the rehabilitation of a 322 ha buffer area around the FSL. The intention is that this buffer be managed for conservation purposes and in the long term it is likely to provide habitat and movement corridors for the Spotted-tailed Quoll. Additional mitigation strategies include the following:

- Development and implementation of a vertebrate pest management plan across the Project area. Dogs and foxes are known to predate Spotted-tailed Quoll, and these species will be targeted by the vertebrate pest management plan.
- Salvage of suitable habitat features such as large rocks and logs from the impact area and placement of these features into suitable habitats within the adjacent buffer area.

Restoration of former habitat was flagged as an appropriate management response for the Spotted-tailed Quoll by Burnett and Marsh (2004) who noted that "Restoration of former habitats includes replanting of cleared habitats, especially where replanting acts to reconnect areas of known or potential quoll habitat. Revegetation needs to proceed hand in hand with other responses, including the control of eutherian camivores and cane toads and reducing the deliberate and accidental killing by humans. Restoration of former habitats might also include control of the above pressures in relatively intact habitats from which *D. maculatus* has disappeared."

The merits of habitat restoration for the Spotted-tailed Quoll have been acknowledged by the Queensland Government, who recently funded a project entitled "Extending habitat for endangered Quolls around D'Aguilar National Park", a restoration project managed by Wildlife Queensland.

The Spotted-tailed Quoll has not been verified as present within the Project area, with only anecdotal records of its occurrence. It is considered unlikely that the Spotted-tailed Quoll is resident within the Project area. It is considered likely to disperse through or forage in the Project area, although unlikely to use the areas within FSL for denning purposes. The area of habitat lost in the short term may form part of the home range of a single adult Spotted-tailed Quoll or individuals dispersing from natal ranges and the habitat loss will be mitigated by the protection and rehabilitation of a 322 ha buffer area around the FSL. The buffer will facilitate movement of Spotted-tailed Quoll and provide habitat in its own right.

As the area of habitat impacted will effectively be replaced on site, and movement corridors re-instated and enhanced (impacts can effectively be mitigated on site), it is considered unlikely that there will be an adverse residual impact on the Spotted-tailed Quoll.

Square-tailed Kite

The Square-tailed Kite occurs in a variety of habitat types including heathlands, woodlands, forests, rainforests, timbered watercourses, hills and gorges (Pizzey and Knight 1997). Most records are from woodlands and forests, particularly those on fertile soils with abundant small birds (Marchant and Higgins 1993).

One juvenile individual was observed in the FSL, which may have been dispersing from a breeding area (BAAM 2008). REs within the FSL that provide potential habitat for this species are 13.3.1, 13.12.6, 13.12.8 and 13.12.9. The Project will result in loss of 109.89 ha potential habitat for breeding and foraging in the FSL, 10.62 ha in the pipeline construction corridors and 1.41 ha in the Stalling Lane Access. Impacts to potential habitat along the pipeline corridors will be temporary as native groundcovers and shrubs will be progressively reinstated along the construction corridors. As this is a highly mobile species with a large home range, loss of this amout of foraging habitat is not likely to significantly impact on the species survival.

The project will result in the unavoidable but temporary loss of 121.92 ha of breeding and foraging habitat for the Square-tailed Kite. The primary mitigation measure proposed is the rehabilitation of a 322 ha buffer area around the FSL. The intention is that this buffer be managed for conservation purposes and in the long term it is likely to provide habitat and movement corridors for the Square-tailed Kite.Progressive rehabilitation will also be undertaken along the pipeline construction corridors.

Additional mitigation strategies include:

- Pre-clearing surveys of suitable habitat within the Project area which aim to relocate individuals out of the impact area and into suitable habitats within the adjacent buffer area.
- Retention (where possible) of large, mature trees in the FSL.
- A weed and pest management plan to control the establishment of invasive species in the Project area.

Rehabilitation of the buffer area and pipeline construction corridors will reduce the residual impact on breeding and foraging habitat. There will still be a residual impact due to the time lag between impact and revegetation achieving habitat value. However, this is unlikely to be significant for Square-tailed Kite within the Project area as this is a highly mobile species with a large home range, and will be able to breed and forage in suitable habitat in the locality until the rehabilitation areas provide habitat value.

Turquoise Parrot

Turquoise Parrots occur in eucalypt woodlands and open forests with grassy ground cover or a low shrub understorey. This species forages on the ground, feeding on seeds, grasses and herbs. It is commonly found on forest edges, in clearings, remnant trees in farmland, orchards and golf courses. It nests in hollows in trees, logs and posts (Higgins 1999).

Turquoise Parrots were observed throughout the inundation area (BAAM 2007). The mosaic of cleared and wooded areas in the FSL provide sheltering, foraging and breeding habitat for this species.

Potential breeding and foraging habitat for Turquoise Parrot in the Project area includes REs 13.3.1, 13.12.2, 13.12.5, 13.12.8, 13.12.9 and cleared grassland areas. The Project will result in the loss of 109.89 ha of habitat for Turquoise Parrot in the FSL, 10.62 ha in the pipeline construction corridors and 1.41 ha in the Stalling Lane Access. Impacts to potential habitat along the pipeline corridors will be temporary as native groundcovers and shrubs will be progressively reinstated along the construction corridors.

The project will result in the unavoidable but temporary loss of 121.92 ha of breeding and foraging habitat for the Turquoise Parrot. The primary mitigation measure proposed is the rehabilitation of a 322 ha buffer area around the FSL. The intention is that this buffer be managed for conservation purposes and in the long term it is likely to

provide habitat and movement corridors for the Turquoise Parrot. Progressive rehabilitation will also be undertaken along the pipeline construction corridors.

Additional mitigation strategies include:

- Pre-clearing surveys of suitable habitat within the Project area which aim to relocate individuals out of the impact area and into suitable habitats within the adjacent buffer area.
- Retention (where possible) of large, mature trees in the FSL.
- A weed and pest management plan to control the establishment of invasive species in the Project area.

Rehabilitation of the buffer area and pipeline construction corridors will reduce the residual impact on breeding and foraging habitat for the Turquoise Parrot. There will still be a residual impact due to the time lag between impact and revegetation achieving habitat value. However, this is unlikely to be significant for Turquoise Parrot within the Project area as this is a highly mobile species, which utilises cleared and wooded areas and is expected to be able to use the rehabilitation areas immediately.

Koala

Koalas are found in tall open forest to open woodland vegetation with suitable food trees. Koalas use a variety of trees, including many non-eucalypts for feeding, shelter and breeding purposes.

One Koala was heard calling at a survey site in the FSL (BAAM 2008); none were recorded along the pipeline alignments.

There will be some loss of koala habitat in the FSL, however the habitat does not contain primary koala food trees, only secondary and supplementary koala food trees, therefore the regional population is expected to be present in low density. Marginal habitat will be lost within the pipeline construction corridors. Clearing within the road reserves will not be sufficient to preclude movement across existing roads.

According to the Interim koala referral guidelines (SEWPAC 2012), critical habitat for Koala in the Project area includes REs 13.3.1, 13.12.8 and 13.12.9. The Project will result in the loss of 78.75 ha of critical habitat for Koala in the FSL, 7.03 ha in the pipeline construction corridors and 0.34 ha in the Stalling Lane Access.

The Project will result in the unavoidable loss of 78.75 ha of habitat for the Koala. The primary mitigation measure proposed is the rehabilitation of a 322 ha buffer area around the FSL. The intention is that this buffer be managed for conservation purposes and in the long term it is likely to provide habitat and movement corridors for the Koala. Additional mitigation strategies include the following:

- Development and implementation of a vertebrate pest management plan across the Project area. Dogs and are known to predate Koalas, and these species will be targeted.
- Koala spotter inspection of clearing areas.
- Sequential and staged clearing.
- Signage to reduce vehicle speed on construction access roads.

A qualified and experienced Koala spotter will be required on site prior to and during any vegetation removal works. The Koala spotter will conduct a pre-clear survey prior to the commencement of any vegetation clearing. The purpose of the pre-clear survey is to identify the presence or potential presence of Koalas in the area of proposed clearing. Surveys for evidence of site utilisation by Koalas consists of inspecting all suitable Koala shelter and food trees (*Angophora, Eucalyptus, Lophostemon* and *Melaleuca* spp.), with a minimum diameter of

10cm at 1.3 m from the ground. Active searches for Koalas or evidence of Koalas will involve scanning the crown by eye and with binoculars for resting Koalas, searching the trunk for characteristic scratches, searching the base of trees for Koala scats. If a Koala is present, the tree containing the Koala, as well as any trees with canopies overlapping the tree the Koala is in (in case the Koala moves) are to be clearly marked. These trees will not be cleared until the observed Koala has vacated them on its own accord. The Koala spotter is responsible for passing on information on the location of Koalas to the person/s undertaking the clearing works. The role of the spotter-catcher is to provide continual surveillance and protection of Koalas on site, during vegetation clearing works. Ideally construction will be programmed to avoid the Koala birthing season which occurs in December and January.

There will be one Koala spotter per excavating machine during vegetation clearance, except where two machines are working in tandem in an area where one Koala spotter can reasonably inspect and view all trees being cleared, in accordance with DERM Koala spotter requirements (DERM, 2008). The Koala spotter will not be involved in the clearing of vegetation while they are responsible for identifying Koalas present on the site, in accordance with EPA (2006). A Koala spotter is not to physically move Koalas from a tree in which they reside to another location. Each tree identified by the koala spotter as being a risk to koalas if felled, should not be felled, damaged or interfered with until the koala has moved from the felling site of its own volition. In the event that an animal is injured and requires care, it will be taken to an experienced and licensed wildlife carer.

Vegetation clearing will follow a sequential clearing technique. Sequential clearing is described in Policy 6 of the EPA (2006) as:

1) clearing of trees is carried out in a way that ensures koalas living in or near the area being cleared (the clearing site) have enough time to move out of the clearing site without human intervention, including in particular, for a clearing site with an area of more than 6ha, by:
    a) carrying out the clearing in stages; and
    b) ensuring not more than the following is cleared in any one stage:
        i. for a clearing site with an area of 6ha or less—50% of the site's area;
        ii. for a clearing site with an area of more than 6 ha—3 ha or 3% of the site's area, whichever is the greater; and
    c) ensuring that between each stage there is at least one period of 12 hours that starts at 6p.m. on a day and ends at 6a.m. on the following day, during which no trees are cleared on the site; and
2) clearing of trees is carried out in a way that ensures, while the clearing is being carried out, appropriate habitat links are maintained within the clearing site and between the site and its adjacent areas, to allow koalas living on the site to move out of the site; and
3) no tree in which a koala is present, and no tree with a crown overlapping a tree in which a koala is present, is cleared.

Sequential clearing can be achieved by following methods outlined in EPA (2006):

1) The thinning, or partial removal, of vegetation on a site that has a known koala presence is recommended, at least for the initial stage of clearing. This provides the opportunity for koalas utilising the site to occupy some of their current home range and allow animals an extended period of adjustment to the clearing. This can be achieved, particularly at future development sites, by:

a) the sequential thinning of trees in each progressive stage of development, where the density of vegetation on the site is reduced (by approximately 50 to 70 percent), the remainder of which is retained throughout the site and is removed only when construction commences;

b) timing the thinning so that a minimum of one month of no disturbance is achieved after thinning and before total clearing; and staging the thinning so that there is compliance with the sequential clearing provisions of the Nature Conservation (Koala) Conservation Plan 2006.

2) The direction of sequential clearing should be away from threatening processes or hostile environments, and towards any retained vegetation or habitat links, ensuring:

   a) koalas are not pressured, through loss of habitat, to cross roads or move through developed or disturbed areas, such as residential areas or areas that require movement of greater than 100m over cleared ground to reach suitable habitat;

   b) koalas are not left occupying an 'island' of habitat between hostile environments, such as a road and a cleared area, unless there are no other more suitable habitat areas in which to direct koalas; and

   c) koalas can safely leave the site of clearing and relocate to adjacent habitat.

Notwithstanding the fact that the Project will result in a net increase in habitat for the local population of the Koala over the longer term (within the proposed buffer area), there remains a risk associated with the lag time between the commencement of rehabilitation activities and the point at which the habitat becomes suitable for the species.

A resident population will be displaced from habitat which is currently suitable and occupied and displaced individuals may not successfully inhabit the buffer area. As such, it is considered likely that there will be a residual impact of the project on 78.75 ha of suitable habitat for the Koala.

Short-beaked Echidna

The Short-beaked Echidna is specialised for feeding on ants, termites and beetle larvae and, as such, occurs in almost all terrestrial habitats except intensively managed farms. The species is active both by day and night and shelters in logs, crevices, burrows and leaf litter (Menkhorst and Knight 2001).

Due to the generalist habitat requirement of this species, it has been assumed that all remnant and regrowth vegetation in the impact areas constitute habitat for the species. The project will cause a loss of 153.98 ha of habitat for this species in the FSL. Any consequences of this loss will be minimal for any local population and the impoundment will not restrict the movements of any individuals however it will reduce the area of occupancy of the local population in the short term. The impact of short term habitat loss will be mitigated by the rehabilitation of the 322 ha buffer area around the FSL which currently supports a mix of remnant vegetation, non-remnant vegetation and cleared areas.

Impacts to potential habitat along the pipeline corridors will be temporary as native groundcovers and shrubs will be progressively reinstated along the construction corridors and ants and termites are known to recolonise quickly. The project will cause a loss of 1.40 ha of habitat for this species in Stalling Lane access and 22.36 ha of habitat in the urban and irrigation pipelines. Construction of the Stalling Lane access and the pipelines is not anticipated to significantly reduce the amount of suitable habitat for this species nor will they restrict the movements of any individuals. Clearing within the road reserves will not be sufficient to preclude movement

across existing roads and may actually decrease the likelihood of vehicle strike through increased visibility for motorists.

Predation by introduced carnivores (particularly dingoes) is a threatening process which is likely to currently impact the Short-beaked Echidna within the Study area. Implementation of a pest management plan will immediately reduce predation pressure for the local population for this species, thereby increasing long-term viability.

In addition, a weed management plan will be implemented for the entire Project area, including pipeline construction areas, to prevent invasive species becoming established in vulnerable species habitat. Site hygiene protocols will be implemented in accordance with an environmental management plan (EMP) to prevent introduction of disease.

The Project will result in the unavoidable loss of 177.74 ha of foraging habitat for the Short-beaked Echidna. The primary mitigation measure proposed is the rehabilitation of a 322 ha buffer area around the FSL. The intention is that this buffer be managed for conservation purposes and in the long term it is likely to provide habitat and movement corridors for the Short-beaked Echidna. Additional mitigation strategies include the following:

- Development and implementation of a vertebrate pest management plan across the Project area. Dogs/dingoes are known to predate Short-beaked Echidna, and these species will be targeted by the vertebrate pest management plan.
- Pre-clearing surveys of suitable habitat within the Project area which aim to relocate individuals out of the impact area and into suitable habitats within the adjacent buffer area.
- Salvage of suitable habitat features such as large rocks and logs from the impact area and placement of these features into suitable habitats within the adjacent buffer area.
- Signage on roads and speed limits for construction vehicles.

As the Short-beaked Echidna occurs in almost all terrestrial habitats, rehabilitation of the buffer will provide suitable habitat for displaced individuals almost immediately. Their main prey – ants, termites and beetle larvae – colonise disturbed areas quickly.

Rehabilitation of the buffer area and pipeline construction corridors will effectively be replaced any habitat lost due to the Project and movement corridors will be re-instated and enhanced (impacts can effectively be mitigated on site). It is considered unlikely that there will be an adverse residual impact on the Short-beaked Echidna. It is possible that there will be a residual impact due to the time lag between impact and revegetation achieving optimal habitat value, however as the Short-beaked Echidna is known to inhabit almost all terrestrial habitats, this is ulikely to have a significant effect.

Granite Belt Thick-tailed Gecko

As the population within the Project area falls between two large conservation reserves which are known to support the species, it may be important to dispersal and the maintenance of genetic diversity of the species. The population is therefore considered an important population of the Granite Belt Thick tailed Gecko.

The project will cause a loss of 88.5 ha potentially suitable habitat for this species in the inundation area, comprised of 18.1 ha of primary, rocky habitat and approximately 70.4 ha of supporting or secondary habitat which may connect rocky areas and provide some foraging resources. This will reduce the area of occupancy of the local population in the short term. The impact of short term habitat loss will be mitigated by the rehabilitation

of the 322 ha buffer area around the FSL which currently supports a mix of remnant vegetation, non-remnant vegetation and cleared areas.

Similarly, disturbance to remnant vegetation within the FSL will impact on east-west habitat connectivity along the Severn River. The rehabilitation of the 200 m wide buffer area around the FSL will restore landscape connectivity in the medium to long term and will provide for the dispersal of this species.

Predation by introduced carnivores (particularly foxes and cats) is a threatening process which is likely to currently impact the Granite Belt Thick-tailed Gecko within the Study area. Implementation of a pest management plan will immediately reduce predation pressure for the local population for this species, thereby increasing long-term viability.

In addition, a weed management plan will be implemented for the entire Project area, including pipeline construction areas, to prevent invasive species becoming established in vulnerable species habitat. Site hygiene protocols will be implemented in accordance with an environmental management plan (EMP) to prevent introduction of disease.

The Project will result in the unavoidable loss of suitable habitat for an important population of the Granite Belt Thick-tailed Gecko. The primary mitigation measure proposed is the rehabilitation of a 322 ha buffer area around the FSL. The intention is that this buffer be managed for conservation purposes and in the long term it is likely to provide both habitat and movement corridors for the Granite Belt Thick-tailed Gecko. Additional mitigation strategies include the following:

- Pre-clearing surveys of suitable habitat within the Project area which aim to relocate individuals of the Granite-belt Thick-tailed Gecko out of the impact area and into suitable habitats within the adjacent buffer area;
- Salvage of suitable habitat features such as large rocks and logs from the impact area and placement of these features into suitable habitats within the adjacent buffer area; and
- Gas-fired or electric barbeques in the recreation area to avoid firewood collection around the inundation area.

Notwithstanding the fact that the Project will result in a net increase in habitat for the local population of the Granite Belt Thick-tailed Gecko over the longer term (within the proposed buffer area), there remains a risk associated with the lag time between the commencement of rehabilitation activities and the point at which the habitat becomes suitable for the species.

A resident population will be displaced from habitat which is currently suitable and occupied and displaced individuals may not successfully inhabit the buffer area. It is considered likely that there will be a residual impact from the Project on 18.1 ha of primary habitat for the Granite Belt Thick-tailed Gecko.

10.3. Box-Gum Grassy Woodland

10.3.1. Direct impacts

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Grassy Woodland) is listed under the EPBC Act as critically endangered. The community occurs along the western slopes and tablelands of the Great Dividing Range from Southern Queensland through NSW to central Victoria

(Beadle 1981). In Queensland the ecological community is a primary component of the following Regional Ecosystems: 11.8.2a, 11.8.8, 11.9.9a, 13.3.1, 13.11.8, 13.12.8 and 13.12.9 (TSSC 2006).

Box-Gum Grassy Woodland occurs on moderate to highly fertile soils at altitudes from 170 m to 1,200 m where rainfall is between 400 mm and 1,200 mm per year (NSW Scientific Committee 2002). In the New England Tablelands bioregion, this community has a canopy layer dominated by White box (*Eucalyptus albens*), Yellow box (*E. melliodora*) or Blakely's red gum (*E. blakelyi*), a ground layer of tussock grasses and a sparse shrub layer. In the Nandewar bioregion, Grey Box (*E. microcarpa* and/or *E. moluccana*) may also be dominant. Plate 10-1 shows an example of the Box-Gum Grassy Woodland identified during field surveys.

Plate 10-1 Box-Gum Grassy Woodland identified during field surveys

The Project will reduce the extent of Box-Gum Grassy Woodland by 83.76 ha. The most recent estimate of the extent of the community quoted in the Recovery Plan states 416,325 ha of the community (in various condition states) remain. Based on this extent, the Project will impact on at least 0.02% of the community.

Clearing of the community will occur within the inundation area of the dam and along the urban and irrigation pipelines. Clearing along the pipelines will occur along Fletcher's Road, the New England Highway south of Mount Stirling Road, the New England Highway between Fletcher's Road and Eukey Road. The Box-Gum Grassy Woodland will also be affected by habitat loss due to inundation.

Table 10-4 Direct impacts to Box-Gum Grassy Woodland

Impact location	Area (ha)
FSL	71.55
Stalling Lane	0.74
Urban and irrigation pipelines (12.5 wide and 5 m wide construction corridor)	11.47

TOTAL	83.76

Downstream river flows will be altered as a result of the Project. Frequent low flows and infrequent high flows will be unchanged; however medium flows will be impacted for the section of the Severn River between the dam and Accommodation Creek.

Apart from direct clearing of the community within the Project impact areas, the construction and operation of the dam and pipelines is unlikely to cause a substantial decline in quality of the community.

The impact of the Project on the Box-Gum Grassy Woodland within the inundation area of the dam cannot be avoided, as the location of the impact area is a result of the placement of the dam wall. Alternate dam sites have been investigated, as described in Section 2.4. The Emu Swamp Dam causes a smaller impact to the Box-Gum Grassy Woodland compared with the Fletcher/Ballandean option. The Emu Swamp Dam will result in the inundation of 71.55 ha compared to the Fletcher/Ballandean option, which will impact on 89 ha. The creation of a buffer area around the dam will be used to allow the community to regenerate through natural regeneration, weed control and some planting of overstorey and understorey species.

The impact of the urban and irrigation pipelines has been minimised by locating the pipelines in a manner that avoids the clearing of vegetation within the road reserve. The small diameter of the pipelines allows for the flexible placement of the pipeline, with the ability to avoid vegetation. The corridor for the pipeline has been reduced to the narrowest width possible for the safe and effective construction of the pipeline. The clearing width for the pipeline will range from 5 m to 12.5 m. This is a significant reduction compared with standard clearing width for pipelines in Australia, that typically range between 20 m and 40 m. Once the pipeline is constructed, a vital component of the community, grasses, herbs and shrubs will be permitted to regrow over the corridor.

The Project will reduce the extent of Box-Gum Grassy Woodland by 83.76 ha. Direct impacts to this threatened ecological community are summarised in Table 10-1. Direct impacts will result from clearing of the FSL and pipeline construction areas. Areas below are calculated based on the FSL at 738 m AHD, and pipeline construction corridor widths of 12.5 m and 5 m respectively for the urban and irrigation pipelines.

10.3.2. Indirect impacts

Waterlogging

Potential indirect impacts include alteration to native vegetation around the FSL where soils may become water logged at times. Modelling of the dam storage capability undertaken as part of the surface water studies for the Supplementary Report (refer to Section 7.4) indicated the dam could be above, at, or near full capacity (i.e. less than 1 m below the FSL) for 55% of the time. Vegetation dominated by species that naturally occur in riparian areas (e.g. Blakely's Red Gum) is unlikely to be adversely impacted by soil saturation.

Investigation of vegetation attrition around Glenlyon Dam (which supports a landscape and suite of tree species ecologically similar to that found within the Project area), found that there is limited or no evidence of plant death above FSL. Vegetation above FSL on Glenlyon Dam retains its remnant structure and is indistinguishable from vegetation further upslope in terms of structure and species composition. This supports the view that waterlogging is not likely to result in the loss of vegetation above FSL or at least, that impacts on adjacent vegetation due to waterlogging will be relatively insignificant.

Plate 10-2 Vegetation above the full supply level at Glenlyon Dam

Downstream impacts

Field surveys undertaken in 2013 identified that much of the vegetation along the Severn River from the proposed dam downstream to Accommodation Creek contains Box-Gum Grassy Woodland dominated by Blakely's Red Gum.

The proposed dam may change the current flow regime in the river by reducing flow in the river downstream of the dam site and altering the timing, frequency and size of seasonal flow events. The number of existing weirs downstream of the dam site could also exacerbate any decrease in flow downstream of the proposed dam. Potential impacts associated with a change in the existing flow regime may include: a decrease in the persistence of and connectivity between some pool – run / riffle habitat sequences; a reduction in the availability and suitability of aquatic habitat for native flora and fauna; and altered migratory or breeding cues for some aquatic fauna (particularly fish). However, the proposed release regime from the dam includes environmental releases and modelling indicates the decrease in water depth will be small.

Environmental flows from the dam will comprise a release equivalent to the inflow, up to 30 ML/day, in order to maintain the natural flow regime for low flows and the ephemeral nature of the Severn River. For example, if 8 ML/day enters the storage then 8 ML/day will be released downstream, but if flow greater than 30 ML/day enters the storage then 30 ML/day will be released downstream. Modelling for the SEIS indicates that the dam will spill for 46 days of the year, with an average of 0.4 of a year (i.e. 4-5 months) between spills. The average duration of spills is predicted to be 14 days. The proposed combination of environmental releases and spills will contribute to maintaining a flow regime consistent with the current flow regime and will mitigate impacts to flora and fauna. In particular, the combination of low flow releases and high flow spills are expected to provide suitable conditions to trigger migration and reproduction in aquatic fauna.

Hydrology modelling presented in Section 7.4 indicates that between the proposed dam site and the confluence of the Severn River and Accommodation Creek, changes to the stream flows would only represent a change in water depth of up to 100 mm compared to 500 to 800 mm depth without the dam.

The Severn River is an ephemeral river characterised by a rocky bottom, pools and riffles. There is significant monthly variability in the daily flow in the Severn River. Flood events of up to 5.51 m gauge depth have been recorded at Ballandean. There has already been considerable development on the Severn River with a number of in-stream weirs. The predicted change in water depth of up to 100 mm is not considered to be a significant in relation to the natural variability in water depth and there is significant reduction water flows following development within the catchment.

Edge effects

Clearing of the FSL and pipeline corridors will expose vegetation to edge effects. Edge effects are associated with altered microclimates at forest edges that result in higher levels of light, temperature and wind disturbance. This can create more favourable conditions for weed growth, decreases in native plant diversity and an increase in aggressive edge specialist species such as Noisy Miner (*Manorina melanocephala*) which exclude other native woodland birds. Given the partially cleared nature of both the inundation area and the pipeline alignments, it is considered that these areas would already have incurred edge effects. The nature of woodland habitats (relatively few, scattered trees and wide canopy separation) renders them less susceptible to edge effects than closed forest types such as rainforest, where microclimates are much more sensitive to change.

Fragmentation

Fragmentation is the breaking apart of continuous woodland into many small patches. It typically leads to lower species diversity and lower population sizes, for both animals and plants (Rawlings et al. 2010). Construction of the dam will reduce the size of the native vegetation on the Severn River and thus contribute to the further fragmentation of the vegetation communities. Vegetation communities on the Severn River are already fragmented and the project will not fragment a continuous woodland area. A buffer area of approximately 200 m width is proposed surrounding the dam to protect the water quality within the dam and also to maintain ecological connectivity.

Construction of the urban and irrigation pipelines may also contribute to fragmentation, but as these pipelines are to be constructed within cleared road reserves and trenchless construction methods used where possible, they will result in a minimal contribution to fragmentation.

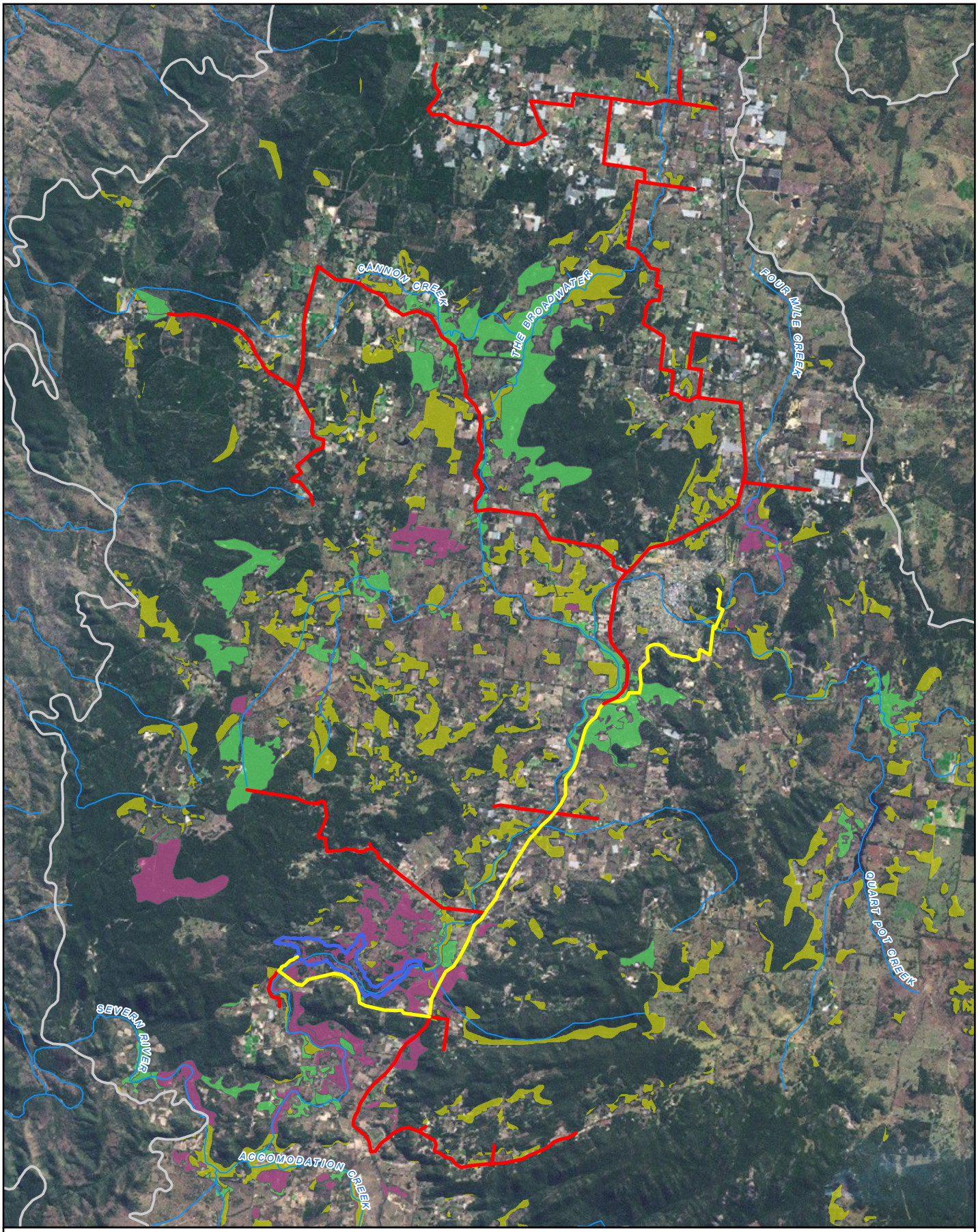
10.3.3. Regional and local context

The community is widespread, with high levels of fragmentation, especially on high quality and fertile soils. In Queensland, the TEC is found in a range of landzones that includes alluvial flats, and hills and lowlands on metamorphic or granitic rocks.

Spatial analysis and field surveys have confirmed the presence of 1,611 ha of Box-gum Grassy Woodland in the Stanthorpe Plateau sub-bioregion. A further 5,073 ha Box-gum Grassy Woodland has been identified as potentially occurring in this bio-region. The location of confirmed and potential Box-gum Grassy Woodland in the Stanthorpe Plateau sub-bioregion is presented in Figure 10-2. Less than half (44%) vegetation surveyed was surveyed contained the listed community. Conservatively assuming 40% of the potential Box-gum Grassy Woodland (2,672 ha) meets the EPBC criteria there is a further 2,029 ha of this community. It is estimated that approximately 3,640 ha of Box-gum Grassy Woodland is present [1,611 ha (confirmed) + 2,029 ha (potential)] in the in the Stanthorpe Plateau sub-bioregion (SKM 2014).

Current estimates indicate that a total of 416,325 ha of the ecological community (in various condition states) remain (DECCW 2010). As such, the extent of the community within the Stanthorpe Plateau sub-bioregion represents around 1% of the total remaining extent of Box-Gum Grassy Woodland.

The impacted area of 83.76 ha is approximately 2.3% of the TEC in the Stanthorpe Plateau sub-bioregion.



LEGEND

- Watercourse
- Urban Pipeline
- Irrigation Pipeline
- Stanthorpe Plateau Sub-bioregion
- Full Supply Level (738m AHD)

Box-Gum Grassy Woodlands

- EPBC community confirmed
- EPBC community not present
- EPBC community presence not confirmed

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Kilometres

Scale - 1:150,000

Projection: GDA94 MGA56

EMU SWAMP DAM
SUPPLEMENTARY REPORT
Figure 10-2
Regional Distribution of Box-Gum Grassy Woodland Threatened Ecological Community (SKM, 2014)

SINCLAIR KNIGHT MERZ
SKM

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10.3.4. Avoidance and Mitigation Measures

The impact of the Project on the Box-Gum Grassy Woodland within the inundation area of the dam cannot be avoided, as the location of the impact area is a result of the placement of the dam wall. The Emu Swamp Dam causes a smaller impact to the Box-Gum Grassy Woodland compared with the Fletcher/Ballandean option. The Emu Swamp Dam will result in the inundation of 71.55 ha compared to the Fletcher/Ballandean option, which will impact on 89 ha. The creation of a buffer area around the dam will be used to allow the community to regenerate through natural regeneration, weed control and some planting of overstorey and understorey species.

The impact of the urban and irrigation pipelines has been minimised by locating the pipelines in a manner that avoids the clearing of vegetation within the road reserve. The small diameter of the pipelines allows for the flexible placement of the pipeline, with the ability to avoid vegetation. The corridor for the pipeline has been reduced to the narrowest width possible for the safe and effective construction of the pipeline. The clearing width for the pipeline will range from 5 m to 12.5 m. This is a significant reduction compared with standard clearing width for pipelines in Australia, that typically range between 20 m and 40 m. Once the pipeline is constructed, a vital component of the community, grasses, herbs and shrubs will be permitted to regrow over the corridor.

Weed pest management

Weed infestation within the Box-Gum Grassy Woodland is a main threatening process, with introduced species often smothering native grasses, herbs and forbs. The removal of weeds from the Box-Gum Grassy Woodland will help address the decline in the understorey of the community and provide the space for native species to increase coverage and vigour in the community. In the Stanthorpe area, the main weed found in the Box-Gum Grassy Woodland is African Lovegrass (*Eragrostis curvula*). Control and management of African Lovegrass and other weeds will be necessary to see the improvement in the coverage and health of the understorey. The weed management techniques to be used to manage weeds will include herbicides, applied specifically to weeds that pose a threat to the community.

Other weed management techniques such as limited grazing and fire may be used and will be assessed in relation to the threat posed by weeds and relative advantage of these techniques compared to herbicide use.

Regeneration and Revegetation

The Box-Gum Grassy Woodland will be encouraged to regenerate within the buffer area of the Dam. Areas of the woodland are located within the buffer area and will not be affected by the Dam and these areas will be used as the source of seed for the regenerating community. Rehabilitation of Box-Gum Grassy Woodland will be undertaken in accordance with *A Guideline of Managing Box-Gum Grassy Woodlands* (Rawlings *et al*. 2010).

Material from the cleared Box-Gum Grassy Woodland from the inundation area will be spread over sites where the community will regenerate. This will provide seeds and plants that will be used to form the start of the regenerating community. Mulch and fallen timber will also be used to start regeneration and will be spread across the regeneration sites.

Prior to starting the regeneration of the community, an assessment of the regeneration sites will be completed to determine whether the ground will be treatment in preparation of the spreading of cleared material. For example it may be necessary to remove weeds, loosen top soil or burn the regeneration sites to improve the success rate of establishing the community.

10.3.5. Residual impacts

The residual impact of the Project on the Box-Gum Grassy Woodland within the inundation area will be a loss of 71.55 ha. The impact of the loss of the community from the inundation area will be significant, on the basis that the dam will remove an area of vegetation along and adjacent to the Severn River of about 5 km in length. The residual impact of the Project on the Box-Gum Grassy Woodland within Stalling Lane will be a loss of 0.74 ha.

The residual impact of a loss of the Box-Gum Grassy Woodland along the pipeline route will not be significant as the loss of vegetation along the alignment of the pipeline will be at the edges of vegetation which are adjacent to cleared areas and roads. Consequently, clearing for the pipelines will not further fragment areas of the community. Once the pipeline is constructed, a vital component of the community, grasses, herbs and shrubs will be permitted to regrow over the corridor. The canopy coverage of the community is typically in the range of 20% to 50%, with the crowns of the overstorey trees being widely separated.

The residual impact of the Project on the Box-Gum Grassy Woodland is 72.29 ha.

10.3.6. Offsetting of residual impacts

Condition data was collected from impact areas by SKM during July 2013. A total of 25 BioCondition sites were surveyed in accordance with the methodology described in Eyre *et al* (2011). This survey method enables collection of data regarding the quality and condition of vegetation that will be impacted, and hence can be used in the calculation of an offset area that will meet the requirements of the EPBC Act Environmental Offset Policy (EOP). Condition of surveyed vegetation varied from heavily grazed paddocks with only canopy trees remaining to relatively intact mature native vegetation. Impacts of frequent fire were observed at a number of survey locations, indicated by a high proportion of shrubs and pioneer species.

Offset areas and management are discussed in further detail in Appendix I.

10.4. Survey limitations

Fauna surveys for the EIS were conducted in summer (December 2006) and autumn/winter (2007). The summer fauna survey was suitable for maximising the potential to detect fauna that are most active during warmer months. This includes reptiles, amphibians, mammals and most birds. The winter fauna surveys were suitable for detecting migratory bird species such as Swift Parrot and Regent Honeyeater. The flora surveys for the EIS were undertaken in December 2006 and June 2007. 3D Environmental (2007) noted there were some limitation in identifyin *Melaleuca williamsii* (syn *Callistemon pungens*), the rare listed *Melaleuca flavovirens* (syn. *Callistemon flavovirens*).

For the flora surveys undertaken for the Supplementary Report plant samples collected in July were sent to a senior botanist in NSW (Tony Rodd) who identified the species as *M. williamsii* subsp. *fletcheri*. Flowering samples collected in October 2013 were sent to the Queensland Herbarium who also identified the species as *M. williamsii* subsp. *fletcheri*.

10.5. Ecological corridors

10.5.1. Impacts

One submission relating to ecological corridors stated that the dam will sever a bioregional corridor (Figure 10-3). The Terrestrial Flora report for the EIS (3D Environmental, 2007) describes the continuous riparian corridor linking riparian habitats to adjacent woodland communities along the Severn River. The Project will result in removal of an approximately 5 km section of riparian habitat along the Severn River. While there will be loss of the direct connection between the riparian and higher woodland communities, the Project will not sever the linkage between the Severn River and the adjacent woodland areas. An east-west vegetated linkage will remain intact just south of the FSL (Figure 10-3). The offset strategy for the Project will prioritise acquisition of land within a 200 m buffer around the FSL and offset areas will be managed to enhance connectivity and habitat values.

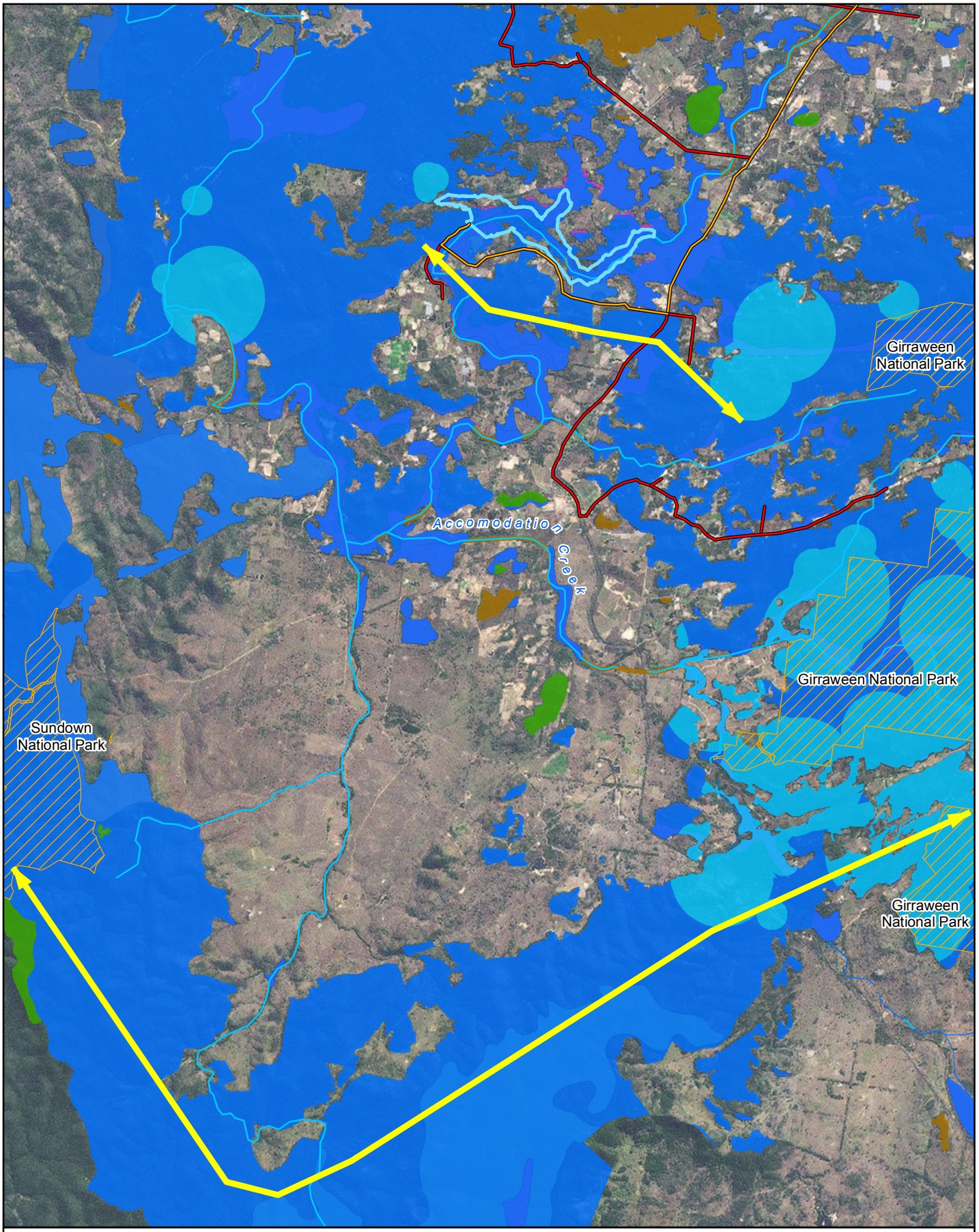
Remnant vegetation in the Project area does not directly link the Girraween and Sundown National Parks. Native vegetation approximately 14 km south of the Project area provides a broad linkage between these protected areas (Figure 10-3) and this vegetation will remain unaffected by the Project.

Disturbance associated with constructing the urban and irrigation pipelines will be limited to maximum widths of 12.5 m and 5 m wide respectively. This will be a barrier to small ground dwelling fauna during construction, but will be revegetated with native ground covers and shrubs post-construction. Where possible trenchless construction techniques will be used to minimise disturbance. As such, impacts to the function of the remnant vegetation as an ecological corridor will be temporary and minor.

The impoundment will impact on riparian vegetation for approximately 4.4 km of the Severn River which potentially provides dispersal pathways for terrestrial fauna. The width of riparian habitat within the inundation area ranges from less than 100 m wide at one location (refer to Figure 10-4) to over 500 m wide in others. The clearing of this riparian habitat has the potential to isolate patches of remnant vegetation and impact on local ecological connectivity.

SDRC will revegetate and manage the buffer area around the inundation area of the dam to reconnect patches of vegetation to mitigate potential impacts on local connectivity. The size of the buffer area is approximately 200 m in width, approximately 5 km in length with a total area of 322 ha (refer to Figure 10-4Error! Reference source not found.). Rehabilitation and management of the buffer will create a movement corridor of similar width to the current riparian habitat in the inundation area. Cleared and degraded areas in the buffer area will regrow to achieve native vegetation. The proposed buffer area will ultimately provide a contiguous corridor around the inundation area maintaining connectivity with existing remnant vegetation.

Rehabilitation and management of the buffer area will create a movement corridor of at least similar value to the existing riparian habitat in the inundation area. The Project is not expected to have residual impacts on local connectivity.



LEGEND

- Urban Pipeline
- Irrigation Pipeline
- Watercourse
- Full Supply Level (738m AHD)

Biodiversity Significance

- State Habitat for EVR taxa
- State
- Regional
- Local or Other Values

Remnant Vegetation

- Endangered (dominant)
- Endangered (sub-dominant)
- Of Concern (dominant)
- Of Concern (sub-dominant)
- Least of Concern
- Non-Remnant
- Ecological connectivity retained

N
W E
S

0 0.8 1.6 2.4 3.2

Kilometres

Scale - 1:100,000

Projection: GDA94 MGA56

EMU SWAMP DAM
SUPPLEMENTARY REPORT

Figure 10-3

Ecological Corridors

SINCLAIR KNIGHT MERZ
SKM

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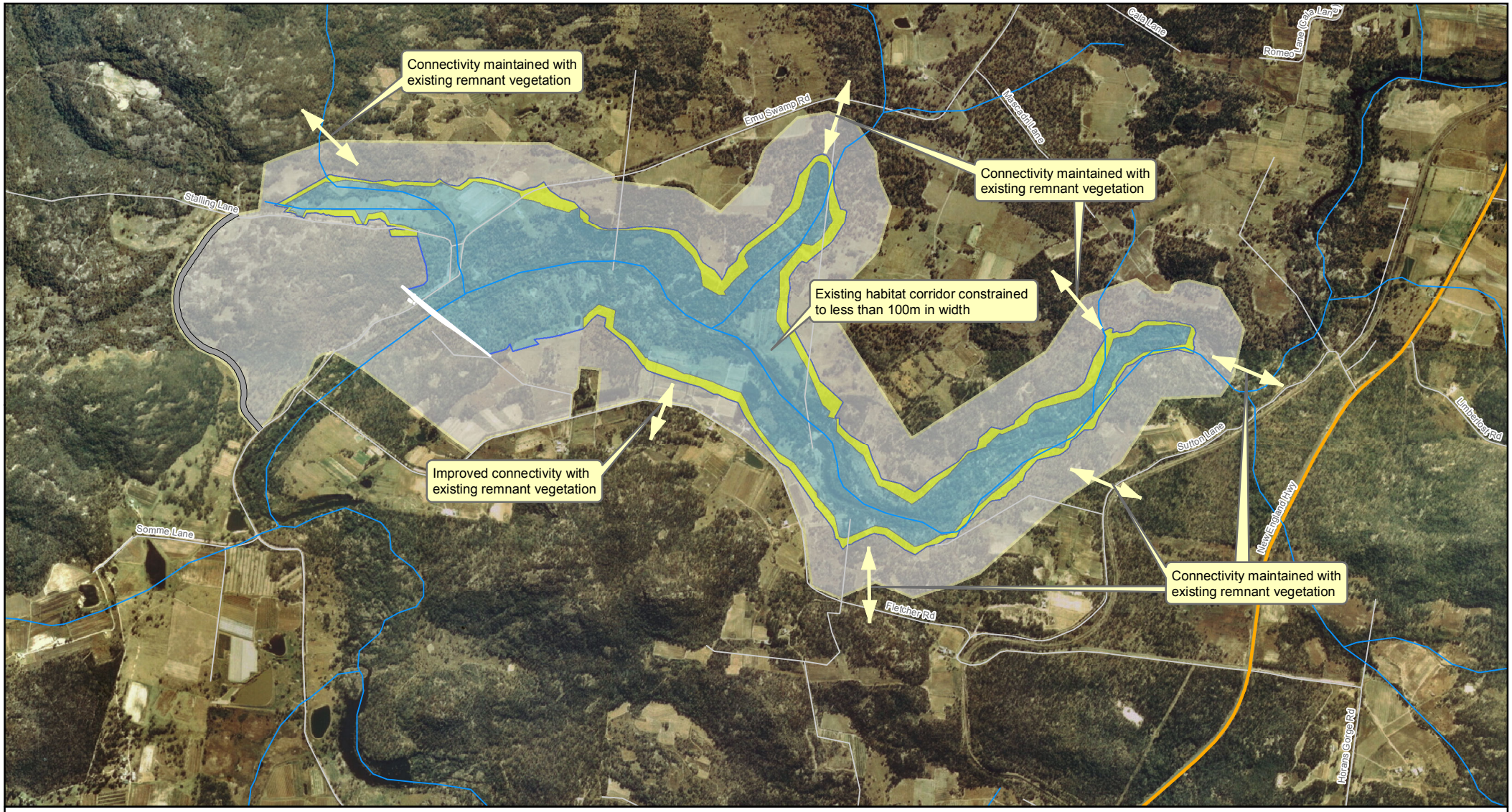

LEGEND

- Watercourse
- Road
- Highway
- Stalling Land Access
- Regeneration Area
- Retained Vegetation in Inundation Area
- Full Supply Level (738m AHD)

N
W E
S

0 250 500 750 1,000

Metres

Scale - 1:25,000

Projection: GDA94 MGA56

EMU SWAMP DAM SUPPLEMENTARY REPORT

Figure 10-4

Local Connectivity

SINCLAIR KNIGHT MERZ SKM

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10.5.2. Mitigation

Mitigation measures proposed in the EIS relating to ecological corridors and wildlife movement are:

- Implementation of a feral predator and weed control management plan in the buffer area around the FSL and along pipeline corridors;
- Exclusion of livestock from the buffer area around the FSL;
- Installation of signage on roads to indicated fauna crossing points and speed limits for construction vehicles;
- Revegetation and assisted regeneration of pipeline corridors using local native gound covers and shrubs;
- Revegetation and rehabilitation of water bodies and watercourses disturbed during construction;
- Revegetation of dam edges and exclusion of livestock;
- Retention of large trees, including within FSL for nesting and roosting;
- Enhancement of alternative local movement corridors by habitat restoration, installation of nest boxes and weed management; and
- Retention, where possible, of large, dead trees in impact areas.

One submission states that these mitigation measures will take considerable time and are not sufficient to reinstate the bioregional corridor, maintain habitats and wildlife movement opportunities. However many of these measures can be undertaken prior to and during construction. It is acknowledged that revegetation and assisted regeneration can take several years to achieve a stable self-sustaining vegetation community, however there are existing ecological corridors within the vicinity of the Project that can be enhanced in the short term.

10.6. Endangered and of concern vegetation

The extent of native vegetation impacted by the Project was quantified by 3D Environmental in 2007, including clearing associated with both the FSL and pipeline.

Calculations of impacts to Endangered and Of Concern vegetation have been re-calculated in response to a submission from DEHP that stated the areas quoted in the EIS were different from the areas shown on the EIS figures. Areas of vegetation impacted in the FSL, pipelines corridors and Stalling Lane Access have been calculated based on the FSL at 738 m AHD and urban and irrigation pipeline construction widths of 12.5 m and 5 m respectively. Re-calculated areas are summarised in Table 10-5.

Table 10-5 Updated impact calculations for endangered and of concern regional ecosystems

RE	VM Status	Area (ha)			
		FSL	Urban and irrigation pipeline	Stalling Lane Access	Total
13.3.1	Endangered	26.01	0.34	0.21	26.56
13.3.1x1	Endangered	20.52	0	0.3	20.82
13.12.6	Of Concern	4.66	0	0.3	4.96
13.12.8	Endangered	0	0	3.83	3.83
13.12.9	Endangered	52.74	0	2.87	55.61
13.12.8/13.12.9	Endangered	0	0	0.12	0.12
Total		103.93	0.34	7.63	111.9

Mitigation of direct and indirect impacts to native vegetation will be achieved by:

- Progressive rehabilitation of pipeline construction corridors with native ground covers and shrubs
- Establishment of a 200 m wide (322 ha) buffer area around the FSL. Management will be implemented to reconnect patches of remnant vegetation and contribute to connectivity, including revegetation and assisted regeneration in the buffer area
- Weed control throughout the buffer area and along pipeline corridors in accordance with a weed management plan.

Mitigation measures (rehabilitation in the buffer area and pipeline construction corridors, and weed control) are considered sufficient to mitigate direct impacts on native vegetation within the urban and irrigation pipelines, as well as potential indirect impacts from waterlogging around the FSL. Residual impacts will remain within the FSL and Stalling Lane Access, totalling a loss of 99.6 ha of endangered and 4.66 ha of concern REs.

10.7. Weed management

Several submissions comments referred to potential issues with invasive species that could occur as a result of the Project. The terrestrial flora technical report prepared by 3D Environmental (2007) Section 4.2.4 provides discussion of the invasiveness of the exotic species recorded during field surveys:

> *More highly invasive species were limited to isolated occurrences with survey records of Mother of Millions (*Bryophyllum myriophyllum*), Prickly Pear (*Opuntia stricta*), Blackberry (Rubus spp.), Japanese Honeysuckle (*Lonicera japonica*), Small-Leaved Privet (*Ligustrum sinense*), and Pampas Grass (*Cortaderia selloana*). These species have the ability to completely dominate and severely alter the ecosystems in which they invade.*

In addition to the abovementioned species, infestations of African Lovegrass (*Eragrostis curvula*) were observed during field surveys undertaken by SKM in 2013.

One of the mitigation measures described in the EIS was the development and implementation of a weed management plan (WMP) for the Project. Specific control techniques for the highly invasive species identified in the locality will be incorporated into the WMP. Fact sheets describing control techniques for each of these species are published by the Queensland and New South Wales governments. Only trialled, successful methods will be incorporated into the WMP.

The Environmental Managemetn Plan (Appendix J) contains a construction environmental management plan (CEMP) that addresses weed management. The CEMP includes measures to deal with movement of vehicles and equipment in and out of weed affected areas to reduce the spread of weeds. These measures incorporate:

- Weed hygiene protocols for vehicles, equipment and mulch;
- Minimisation of soil disturbance;
- Effective disposal of weed material; and
- Induction training for staff incorporating information about declared and invasive weeds.

In addition to the measures specified in the CEMP, surveys of the construction area will be conducted to determine the location and extent of weed infestations. Weeds will be removed as part of clearing for construction and only weed free material will be used in construction areas. Ongoing weed control will be undertaken throughout construction within the FSL and along the pipeline corridors.

Weed control techniques will be in accordance with Department of Primary Industry (DPI) fact sheets for specific weeds and the Weeds of Southern Queensland (3rd Ed. Weed Society of Queensland Staff 2011).

A regular monitoring regime will be implemented to detect weeds on construction areas and the stretch of the Severn River immediately downstream of the FSL. Monitoring and reporting will be undertaken monthly and after significant rain events.

10.8. Biodiversity offsets

A Biodiversity Offset Strategy (Appendix I) for the Project has been developed to offset residual impacts on matters of national environmental significance (MNES) which cannot be avoided or minimised, under the EPBC Act Environmental Offset Policy. The strategy also proposes voluntary offsets for residual impacts on matters of state environmental significance (MSES), and are not being offset by Commonwealth Government offset policy.

10.9. Summary

Corrections and additional information have been provided in this chapter to address submissions comments received for the EIS relating to terrestrial ecology. Additional survey work was carried out in 2013 including targeted surveys for Prickly bottlebrush, assessment of the extent of the EPBC listed Box-Gum Grassy Woodland community in the locality of the Project and collection of vegetation condition data to inform biodiversity offset calculations. The surveys are described in the Terrestrial flora survey report (SKM, 2014) (Appendix E).