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10. TERRESTRIAL FLORA

10.1. Description of environmental values

This section addresses Section 3.3.2.1 of the ToR, describing the terrestrial flora present or likely to be present at any time during the year in the areas potentially affected by the Project.

10.1.1. Regulatory framework

The assignment of an ecological value to terrestrial flora in this assessment is based on applicable legislation, with a number of non-legislative sources also drawn upon to provide additional context. Assessment of floristic ecological values utilises both state and federal legislation which are described in the following section.

10.1.1.1. Commonwealth legislation

The *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) is described in Chapter 1. Of relevance to terrestrial flora values, the Act provides for:

- identification and listing of species and ecological communities as threatened;
- development of conservation advice and recovery plans for listed species and ecological communities;
- development of a register of critical habitat; and
- recognition of key threatening processes.

The matters of NES that are relevant to the terrestrial flora component of the Project are:

- listed threatened species and ecological communities (of flora); and
- places listed on the Register of National Estate including Brigalow Invertebrate Site, Boggomoss Area No. 1 and Boggomoss Area No. 2 (Section 11.1.1.1 provides further detail on these sites).

10.1.1.2. Queensland legislation

The *Nature Conservation Act 1992* (NC Act) is discussed in Chapter 1. Actions relevant to the description of ecological values include the provision for:

- eleven classes of protected areas – ranging from national parks (scientific), World Heritage management and international agreement areas, to national parks (Aboriginal land), nature refuges and coordinated conservation areas involving private property; and
- seven classes of wildlife — presumed extinct, endangered, vulnerable, near threatened, least concern (these classes collectively relate to native species and are “protected wildlife”), international and prohibited wildlife (these classes relate to non-native species).

The *Nature Conservation (Wildlife) Regulation 2006* (NC Regulation) lists the protected wildlife and states the declared management intent and the principles to be observed in any taking of or destruction for each group.

The *Vegetation Management Act 1999* (VM Act) is the planning initiative underlying regional management of vegetation in Queensland, including clearing of vegetation types (termed regional ecosystems or REs). The regional ecosystem

classification of Sattler and Williams (1999) is a hierarchical system formed by a three part code with the primary subdivision being bioregion, followed by land zone, and then vegetation.

The status of regional ecosystems is based on their pre-clearing and remnant extent, and is gazetted under the VM Act and listed in the Regional Ecosystem Description Database (REDD) maintained by DERM. The status of a regional ecosystem, described as "Vegetation Management (VM) Status" is described as:

Endangered regional ecosystem: a regional ecosystem that is prescribed under a regulation and has either:

- less than 10% of its pre-clearing extent remaining; or
- 10% to 30% of its pre-clearing extent remaining and the remnant vegetation remaining is less than 10,000 ha.

Of Concern regional ecosystem: means a regional ecosystem that is prescribed under a regulation and has either;

- 10% to 30% of its pre-clearing extent remaining; or
- more than 30% of its pre-clearing extent remaining and the remnant vegetation remaining is less than 10,000 ha.

Not of Concern regional ecosystem: means a regional ecosystem that is prescribed under a regulation and has more than 30% of its pre-clearing extent remaining and the remnant vegetation remaining is more than 10,000 ha.

Each regional ecosystems also has a Biodiversity Status listed under the REDD. The Biodiversity Status is based on an assessment of the condition of remnant vegetation in addition to the pre-clearing and remnant extent of a RE. It is used for a range of planning and management applications including the Biodiversity Planning Assessments and to determine environmentally sensitive areas that are used for regulation of the mining industry through provisions in the EP Act. The Biodiversity Status has no statutory relevance for the EIS assessment and approval process for the Project.

The VM Act also protects regrowth vegetation in certain situations. Regulated regrowth includes native woody vegetation within 50 m of identified regrowth watercourses in the Mackay Whitsunday, Burdekin and Wet Tropics reef catchments and high value regrowth in rural areas on freehold, Indigenous and leasehold land for agriculture and grazing.

Regulated regrowth vegetation includes regrowth vegetation that is either:

- identified on the regrowth vegetation map as high value regrowth vegetation;
- located within 50 m of a watercourse identified on the regrowth vegetation map as a regrowth watercourse (regrowth watercourse vegetation); and
- contained in a category C or category 4 area on a property map of assessable vegetation (PMAV).

High value regrowth vegetation is any of the following:

- an endangered RE; an of concern RE; a least concern RE;
- areas which have not been cleared since 31 December 1989; and
- areas shown on a regrowth vegetation map.

Clearing applications for this Project will be assessed against Part S of the Regional Vegetation Management Code (RVMC) for the Brigalow Belt and New England Tablelands bioregions which sets out the requirements for clearing for significant projects. As part of the RVMC there is a requirement to maintain the current extent of assessable vegetation lost as part of the Project. An acceptable solution to this requirement is to provide an offset to compensate for the loss of this vegetation. The provision of an offset will be assessed under the Policy for Vegetation Management Offsets Version 2.4 (DERM, 2009).

Assessment may also be required against the Regrowth Vegetation Code (Version 1, 2009). In certain circumstances clearing regulated regrowth vegetation can only occur where an exchange area that replaces the regulated regrowth vegetation cleared is provided. The provision of an exchange area must be consistent with the performance requirements of the RVMC.

The *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) provides a framework and powers for improved management of weeds, pest animals and the stock route network. The LP Act provides for designation of threat classes to exotic species which;

- degrade natural resources;
- threaten conservation of biodiversity;
- threaten remnant vegetation;
- reduce rural production; and
- interfere with human health and recreational activities.

Exotic species that pose a threat are declared under one of three categories being;

- *Class 1 Pest;* a pest that has potential to become a very serious pest in Queensland in the future.
- *Class 2 Pest;* a pest that has already spread over substantial areas of Queensland, but its impact is considered sufficiently serious to warrant control.
- *Class 3 Pest;* a pest that is commonly established in parts of Queensland but its control by landholders is not warranted unless the pest is impacting, or has potential to impact on a nearby "environmentally significant area".

The mapping of flora species declared under the LP Act provides a measure of vegetation condition, particularly when applied to non-statutory assessment measures as described in Eyre *et al.* (2006).

The *Water Act 2000* protects vegetation within watercourses.

The *Forestry Act 1959* provides for forest reservations, the management, silvicultural treatment and protection of State forests, and the sale and disposal of forest products and quarry material, the property of the Crown on State forests, timber reserves and on other lands.

10.1.1.3. Non-statutory mechanisms

The EPA's Biodiversity Assessment and Mapping Methodology (BAMM) provides for a consistent state wide approach for the assessment of biodiversity values at the landscape scale in Queensland. The assessment is based largely on vegetation mapping data generated or approved by the Queensland Herbarium, and the methodology has been used to generate Biodiversity Planning Assessments (BPA) for each of Queensland's bioregions. Application of the methodology is applied to the identification of areas of significance solely for biodiversity reasons, including threatened ecosystems or taxa, large tracts of habitat in good condition and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes.

Other non-statutory mechanisms include listings for Weeds of National Significance (WONS) which lists 20 species regarded as posing the greatest threat to a range of Australia's natural values and primary industries.

10.1.1.4. Nomenclature and species conservation status

The conservation status of flora refers to species listed under the EPBC Act and NC Regulation. Species that have a conservation status of critically endangered, endangered, vulnerable or near threatened are regarded as species of conservation significance.

Species of "Regional" significance are those identified by the Queensland Department of Environment and Resource Management (DERM) (EPA, 2008d) as threatened priority taxa for the Brigalow Belt South (BBS) subregion.

10.1.2. Methodology

The desktop assessment and field surveys were completed by Chenoweth Environmental Planning and Landscape Architecture (CEPLA) in 2008 and 2010.

10.1.2.1. Desktop review and gap analysis

To assist in identifying likely regional ecosystems and flora species that could be encountered and those that would need to be targeted during field work, a search of relevant literature and databases was undertaken prior to undertaking field investigations.

Regional ecosystem remnant and pre-clearing mapping (Version 6.0) sourced from DERM provided the basis for vegetation community assessment. Also relevant to vegetation mapping were a number of land system mapping products for the area (Speck *et al.,* 1968; Dawson, 1972a; Dawson, 1972b; Gray and Macnish, 1985; Harris *et al.,* 1999). The DERM essential habitat (Version 2.0) and regrowth vegetation mapping (Version 2.0) was also reviewed.

The following databases were assessed to provide a basis for assessment of flora community and species distribution:

- Commonwealth's EPBC Act Online Protected Matters database (DEWHA, 2010a);
- Queensland Herbarium's HerbRecs (EPA, 2005a; DERM, 2009a) & Corveg database (EPA, 2000);
  - Herbrecs: Records of vouchered specimens of vascular terrestrial flora species lodged at the Queensland Herbarium;
  - CORVEG: Provides the results of vegetation survey plots;

- DERM WildNet database (EPA, 2008c; EPA, 2010); and
- other flora assessments within the locale. Of particular relevance were previous studies undertaken for the dam study area including Dowling & Halford (1997) and Fensham & Wilson (1997). Other local records were assessed including *inter alia* HERBRECS and Corveg.

The Supplementary Environmental Assessment Report by AECOM (2009) was reviewed for the pipeline which is based on RE mapping version 5.0 to determine the vegetation communities along the route.

A full description of these resources is included in Appendix 10-B.

The literature and databases identified a number of species of conservation significance that may occur within the study area. The study areas for the purpose of the desktop assessment were:

- dam study area - water storage area (inundation) to Full Supply Level (FSL) and a 2 km buffer. This includes the dam construction footprint, flood margin and associated infrastructure; and
- pipeline route and a 30 m buffer.

10.1.2.2. Aerial photograph analysis and site location

The most recent aerial photography for the study area at the time of the study (2008) was provided by SunWater. Interpretation of SPOT 2.5 m Satellite Imagery (Aug 2006) and SunWater Orthoimagery - 1:25,000 (Aug 1994) allowed the establishment of preliminary vegetation line work and polygon attribution. The line work was completed with reference to the available remnant and pre-clearing regional ecosystem mapping to assign anticipated regional ecosystems.

Polygons of both remnant and regrowth vegetation were identified through aerial photographic review.

10.1.2.3. Vegetation mapping scale

In vegetation survey, scale is determined by sampling intensity, influenced by vegetation complexity and the area of remnant vegetation. The study aimed to collect sufficient data to generate mapping accurate to a scale of 1:10,000.

10.1.2.4. Field survey

Vegetation was mapped at a scale of 1:10,000 as per the methodology developed by the Queensland Herbarium (Neldner *et al.*, 2005). The methods prescribed include a combination of secondary, tertiary and quaternary level sampling procedures. Additional informal site observations were also made. The mapping of vegetation categories across the entire study area was based on the regional ecosystem framework (Sattler & Williams, 1999). This is considered best practice in Queensland for the mapping of vegetation.

Wherever a vegetation community was considered to be potential habitat for a threatened species, the search area was broadened to increase the chance of finding threatened species.

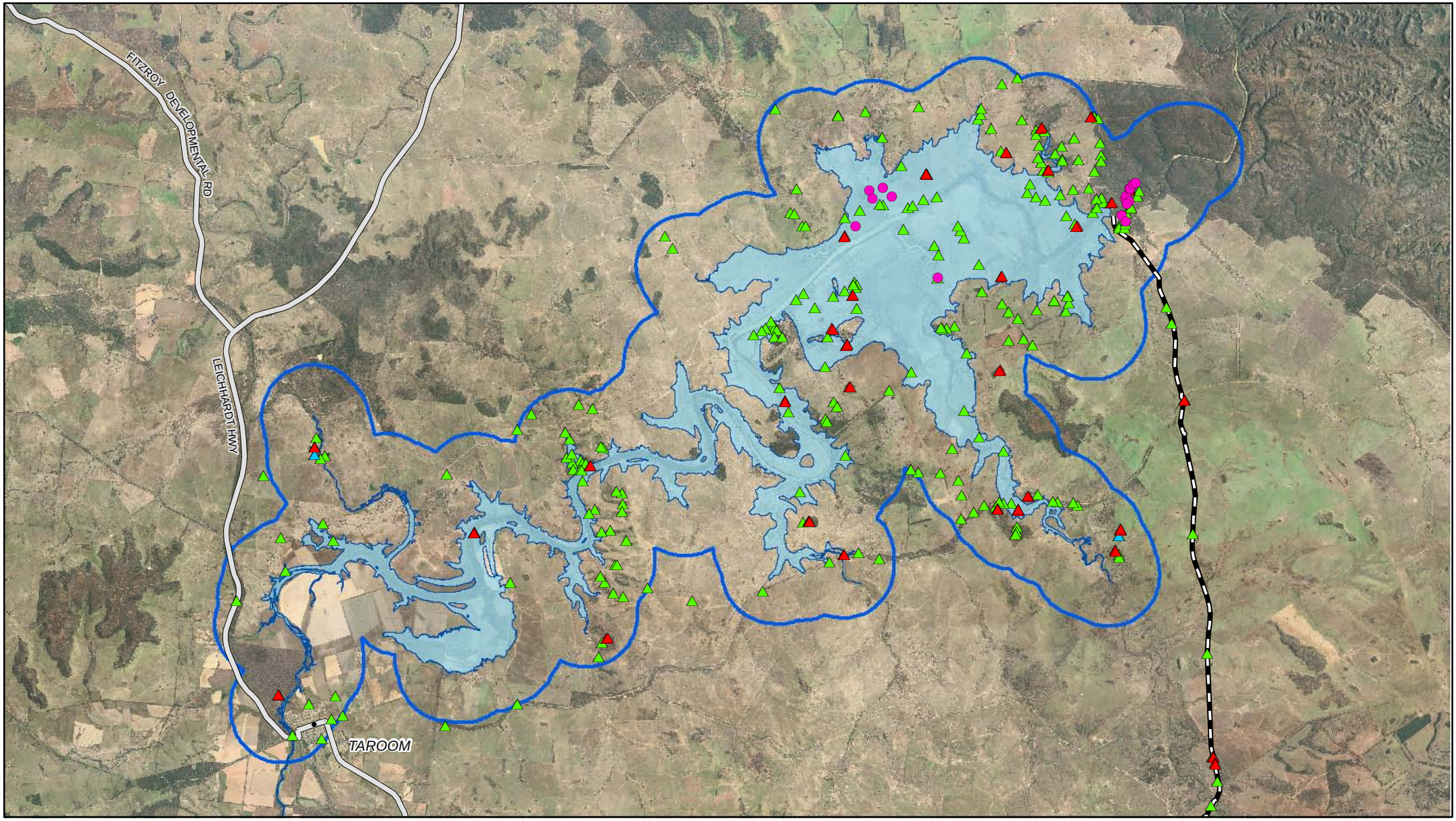
The field survey was completed by Chenoweth Environmental Planning and Landscape Architecture (CEPLA) in a number of phases to capture seasonal variation in floristics. Field surveys were undertaken in summer (26 March – 1 April, 2008), winter (12 June – 18 June, 2008), autumn (29 April, 6 May – 8 May 2008), spring (4 September –

5 September, 2008) and a second summer survey (1 December, 2008). This field work allowed for coverage of the entire Project area. Another survey (15 June - 22 June 2010) of the pipeline route was undertaken to incorporate changes to the route.

It should be noted that field work was not undertaken for portions of the proposed pipeline between 90 and 110 km, 120 and 130 km, and 130 and 160 km. For these sections the desktop review was utilised.

The location of survey sites is illustrated in Figure 10-1 (for the dam study area) and Figure 10-2 (for the pipeline).

A more detailed description of the methods applied during the field survey is included in Appendix 10-B.



LEGEND

2008 CEPLA Survey Sites
- 2008 CEPLA Secondary Sites
- 2008 CEPLA Tertiary Sites
- 2008 CEPLA Quaternary Sites
- CEPLA Ground-truthed Boggomoss Sites

2010 CEPLA Survey Sites
- 2010 CEPLA Secondary Sites
- 2010 CEPLA Tertiary Sites
- 2010 CEPLA Quaternary Sites

- Towns
- Pipeline Route
- State Controlled Roads
- Full Supply Level (183.5m AHD)
- Dam Study Area

Projection: GDA94 Zone 56

Figure 10-1

0 1 2 4
Kilometres

N

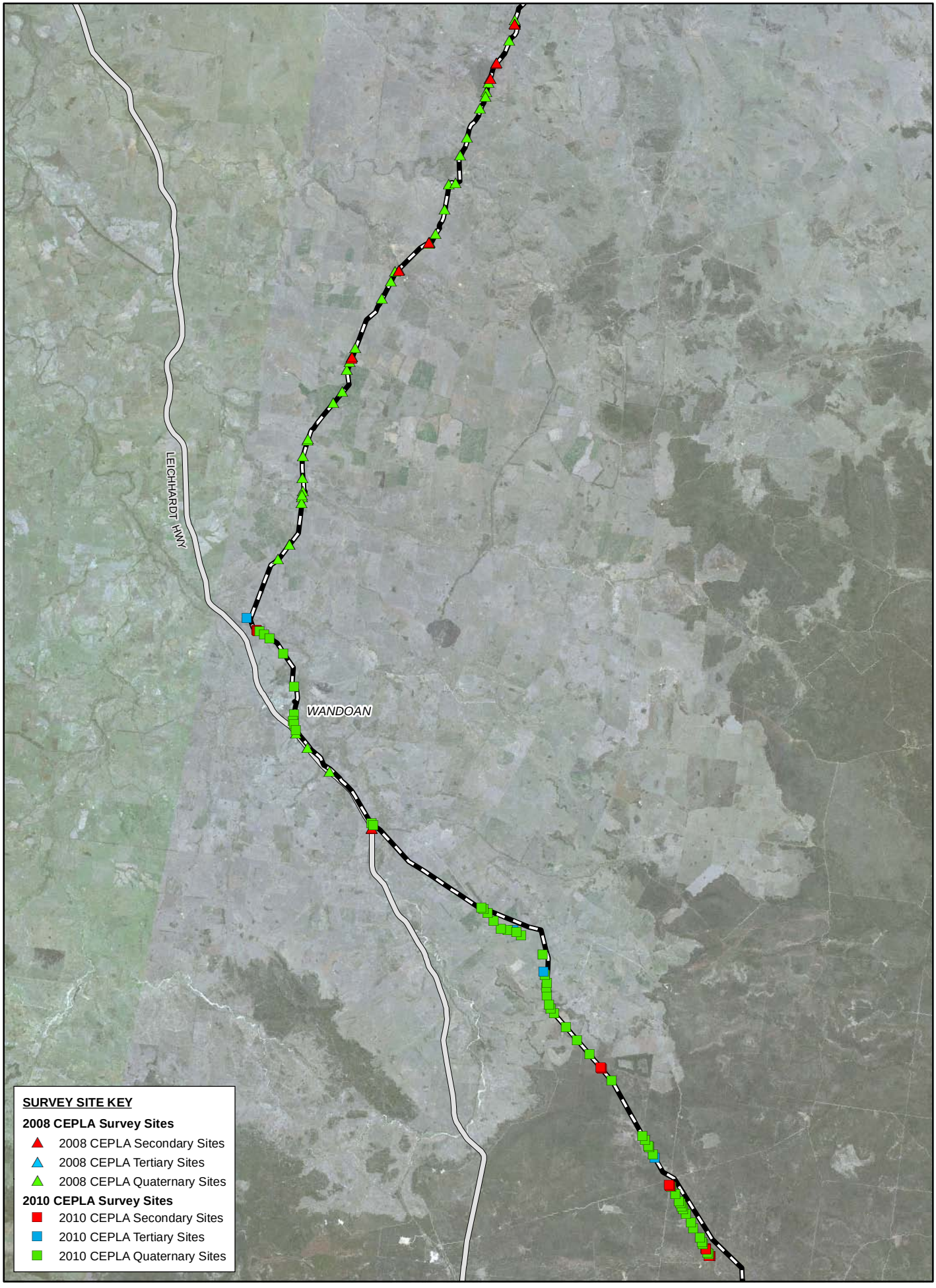
Scale 1:200,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Field survey sites for the dam study area

I:\QENV2\Projects\QE40192\400 - Nathan - Spatial\ArcMXD\Figures\100_Terrestrial_Flora\Figure_10-1_Field_Survey_Sites_Dam_Surrounds.mxd Produced: 22/11/2010



LEGEND

- Towns
- Pipeline Route
- State Controlled Roads
- Full Supply Level (183.5m AHD)

Projection: GDA94 Zone 56

Figure 10-2A

0 1.5 3 6
Kilometres

N

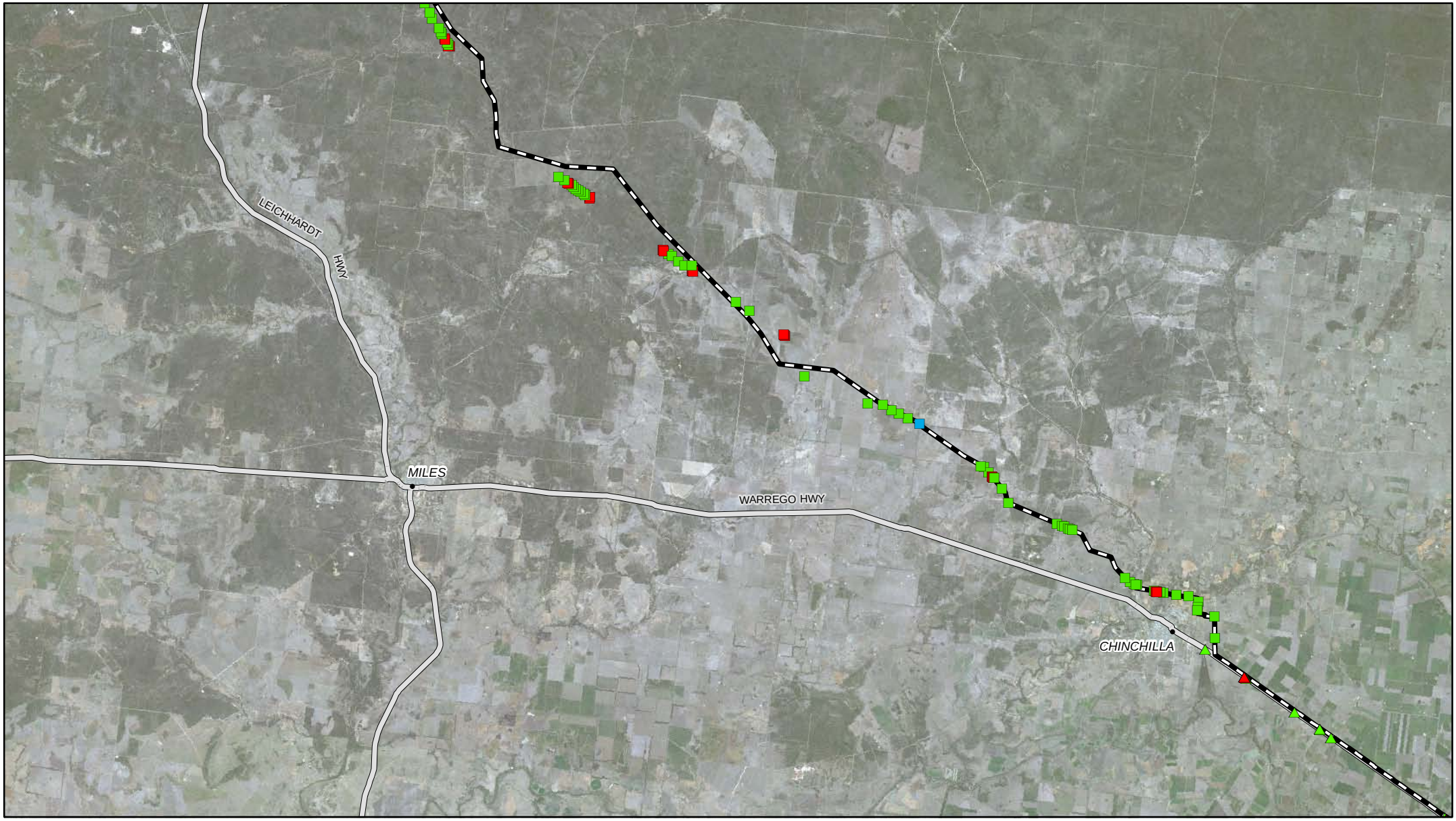
Scale 1:300,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Field survey sites for the pipeline corridor

I:\QENV2\Projects\QE40192\400 - Nathan - Spatial\ArcMXD\Figures\100_Terrestrial_Flora\Figure_10-2A_Field_Survey_Sites_Pipeline.mxd Produced: 9/03/2011



LEGEND

2008 CEPLA Survey Sites
- 2008 CEPLA Secondary Sites
- 2008 CEPLA Tertiary Sites
- 2008 CEPLA Quaternary Sites

2010 CEPLA Survey Sites
- 2010 CEPLA Secondary Sites
- 2010 CEPLA Tertiary Sites
- 2010 CEPLA Quaternary Sites

- Towns
- Pipeline Route
- State Controlled Roads

Projection: GDA94 Zone 56

Figure 10-2B

0 1.5 3 6
Kilometres

N

Scale 1:300,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Field survey sites for the pipeline corridor

I:\QENV2\Projects\QE40192\400 - Nathan - Spatial\ArcMXD\Figures\100_Terrestrial_Flora\Figure_10-2B_Field_Survey_Sites_Pipeline.mxd Produced: 9/03/2011

LEGEND

2008 CEPLA Survey Sites
- 2008 CEPLA Secondary Sites
- 2008 CEPLA Tertiary Sites
- 2008 CEPLA Quaternary Sites

2010 CEPLA Survey Sites
- 2010 CEPLA Secondary Sites
- 2010 CEPLA Tertiary Sites
- 2010 CEPLA Quaternary Sites

- Towns
- Pipeline Route
- State Controlled Roads

Projection: GDA94 Zone 56

Figure 10-2C

0 1.5 3 6
Kilometres

N

Scale 1:300,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Field survey sites for the pipeline corridor

I:\QENV2\Projects\QE40192\400 - Nathan - Spatial\ArcMXD\Figures\100_Terrestrial_Flora\Figure_10-2C_Field_Survey_Sites_Pipeline.mxd Produced: 9/03/2011

10.1.2.5. Reference sites

Reference sites are established in undisturbed or lightly disturbed vegetation communities within the vicinity of the Project area. Data collected from secondary plots at reference sites allow an assessment of the remnant/non-remnant status of a specific regional ecosystem against vegetation height, cover and floristics. The data collected from the reference sites also provides a reference point for the assessment of vegetation community condition.

10.1.2.6. Classification of vegetation communities

- Remnant vegetation

The mapping of remnant vegetation communities across the study area was based on the regional ecosystem framework (Sattler & Williams, 1999).

Native woody vegetation

Vegetation was considered as 'remnant' provided the dominant canopy had greater than 70% of the height and greater than 50% of the cover relative to the undisturbed height and cover of that stratum and was dominated by species characteristic of the vegetation's undisturbed canopy" as defined in Neldner *et al*. (2005).

Native grasslands

As a general rule of thumb, grasslands are not considered remnant by the Queensland Herbarium if they are more than 50% weeds. This definition is reinforced by DEWHA (2010b; DEWHA, 2010c), whereby grasslands currently in poor condition do not form part of the EPBC Act listed threatened ecological community, noting grasslands are considered to be in poor condition if they contain more than 50% weeds or exotic grasses and with the *Dichanthium* spp. occurring only as individual plants or in small clumps.

- Non remnant vegetation

In addition to remnant regional ecosystems, non remnant regional ecosystems (i.e. regrowth or narrow remnant areas) that could potentially achieve remnant status under the VM Act within the next 20 years on the basis of floristics, cover and height were mapped as non-remnant vegetation polygons. Each non-remnant polygon has been assigned with the RE they would achieve if they were managed toward achieving remnant status. Non-remnant regional ecosystems include areas where thinning has occurred leaving scattered trees with intervening regrowth and areas where the vegetation is entirely regrowth in its composition.

- EPBC Act listed communities

The following criteria were used to map the threatened ecological communities.

Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin

The Technical Workshop Report for Natural Grasslands on basalt and fine-texture alluvium DEWHA (2008) was used as a guide to map grasslands.

Brigalow (*Acacia harpophylla* dominant and co-dominant)

The Brigalow ecological community is defined as remnant or regrowth more than 15 years old, or within a declared area of high conservation (Environment Australia, 2001). In Queensland this includes 16 REs (TSSC, 2001) which are characterised by the presence of Brigalow (*Acacia harpophylla*) as one of the three most abundant tree species. Therefore, both Brigalow remnant and regrowth (that is at least 15 years old) was mapped.

The community of native species dependent on natural discharge of groundwater from the Great Artesian basin

The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin (GAB), hereafter referred to as GAB spring wetlands are locally known as "boggomosses". Only those GAB spring communities which are discharge springs are listed as the threatened ecological community under the EPBC Act. SunWater is of the view that springs in this area do not meet the definition of the threatened ecological community.

Springs which are not included in this community are recharge springs which are generally associated with outcropping sandstone, which can form rugged landscapes with springs often situated in gullies and providing the source for streams. Sodic and salty non-wetland areas, although intimately associated with spring wetlands, are not included in the listing. There are also springs within the GAB envelope with water emanating from Tertiary aquifers positioned above the GAB sequence (Habermehl 1982; Fensham *et al*. 2004a) and these are not included in the listing.

The vegetation mapping has been undertaken at a scale of 1:10,000. As GAB spring communities vary in size and vegetation cover, only some of these communities have been mapped as remnant vegetation. Others have been cleared of vegetation and vary in terms of their floristics.

The current study found that the floristics and location of GAB spring communities were recorded to a high standard by Fensham and Wilson (1997) and Fensham and Fairfax (2005), with the exception of some springs located in Nathan Gorge. Survey effort for GAB spring communities therefore focussed on:

- identifying the location and floristics of previously unmapped GAB spring communities directed by aerial photographic interpretation and opportunistic field observations. Floristics for each spring were recorded as Tertiary sites;
- locating threatened flora recorded by Fensham and Wilson (1997) on GAB spring communities; and
- where possible improving the accuracy of mapped locations of GAB spring communities in the Nathan Gorge.

Conservation significance of vegetation communities

The conservation significance of vegetation communities was identified according to its VM Status, Biodiversity Status EPBC Act listing.

Cultivation

Areas of cropping were identified from aerial photographic interpretation. This primarily included lands that were subject to cropping or cultivation (i.e. legumes and cotton in the vicinity of Dalby) and excluded areas that had been historically cropped and are now fallow used for grazing, and minor areas of seeding of species such as *Leucaena leucocephala*.

10.1.2.7. Flora assessment methods

Floristic data was initially recorded according to standard Queensland Herbarium methods on secondary site proformas (Neldner *et al.*, 2005). Nomenclature follows Bostock & Holland (2007).

Targeted surveys for species or communities of conservation significance were undertaken based on a review of preferred habitat types and correlation between habitats mapped and encountered in the field.

10.1.2.8. Weeds

Database searches and consultation with local government pest protection officers provided the opportunity to identify exotic species likely to occur in the study area.

Refer to Appendix 10-B for the full list of weeds, location and pest status.

10.1.2.9. Vegetation condition assessment

Vegetation condition was ascribed according to a four-point scale. This assessment is of particular value when determining the status of Brigalow communities under the EPBC Act. The categories of vegetation, which were devised following completion of field survey, are detailed in Table 10-1.

Table 10-1 Condition assessment

Condition Category	Condition Category Description
1	Vegetation is regarded as Remnant. The subject vegetation community has an intact canopy with structural features of the original community in natural or lightly disturbed condition. Ground cover is in near natural condition although exotic species may occupy specific niches. Patch size >2 ha.
2	Vegetation is regarded as Remnant. The subject vegetation community has an intact canopy with structural features of the original community in natural or lightly disturbed condition. Ground cover is in near natural condition although exotic species may occupy specific niches. Patch size <2 ha. This includes several linear patches associated with road reserves which are frequently subjected to significant edge effects.
3	Vegetation not regarded as remnant, but sufficient structure present to identify climax[1] regional remnant regional ecosystem if facilitated back to a remnant vegetation condition. Patch size >2 ha.
4	Vegetation not regarded as remnant, but sufficient structure present to identify climax regional remnant regional ecosystem if facilitated back to a remnant vegetation condition. Patch size <2 ha. This includes several linear patches associated with road reserves which are frequently subjected to significant edge effects.

1 Climax refers to the eventual remnant regional ecosystem that the regrowth is likely to grow into.
Note - '0' is used as a default for areas of mapped water and crops

10.1.2.10. Timber resource assessment

The assessment of timber resource is based on data collected as part of the standard herbarium plot (500 m^2) and a plotless Bitterlich method for each secondary site. Only species identified as belonging to the T1 (canopy) and T2 (sub canopy) layer were considered as part of the assessment. Species were regarded as suitable timber species if identified as such in Lazarides & Hince (1993).

10.1.3. Dam study area

10.1.3.1. Literature review

- DERM regional ecosystems

Despite the extensive flora list and mapping at a scale of 1:25,000 produced by Dowling & Halford (1997), current remnant (DERM, 2009b) and pre-clearing RE mapping (EPA, 2005c) presented at a scale of 1:100,000 provided the most appropriate reference for identifying likely REs encountered during the field work (Table 10-2 and Figure 10-3).

Current remnant REs, as mapped by DERM, cover 23.8% of the area within the FSL leaving 76.2% as non-remnant land, some of which comprises regrowth vegetation however the majority is cleared and constitutes pasture or cropping.

Table 10-2 Regional Ecosystems within the dam study area (Queensland Herbarium, 2009)

Regional Ecosystem	VM Status	Biodiversity Status	Short Description (EPA, 2007)
11.3.2	Of concern	Of concern	*Eucalyptus populnea* woodland on alluvial plains
11.3.3	Of concern	Of concern	*Eucalyptus coolabah* woodland on alluvial plains
11.3.4	Of concern	Of concern	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains
11.3.18	Least Concern	No concern at present	*Eucalyptus populnea*, *Callitris glaucophylla*, *Allocasuarina luehmannii* shrubby woodland on alluvium
11.3.19	Least Concern	No concern at present	*Callitris glaucophylla*, *Corymbia* spp. and/or *Eucalyptus melanophloia* open-forest to woodland on Cainozoic alluvial plains
11.3.25	Least Concern	Of concern	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines
11.3.27	Least Concern	Of concern	Freshwater wetlands
11.3.27b	Least Concern	Of concern	Vegetation ranges from open water ± aquatics and emergents such as *Potamogeton crispus*, *Myriophyllum verrucosum*, *Chara* spp., *Nitella* spp, *Nymphaea violacea*, *Ottelia ovalifolia*, *Nymphoides indica*, *N. crenata*, *Potamogeton tricarinatus*, *Cyperus difformis*, *Vallisneria caulescens* and *Hydrilla verticillata*. Often with fringing woodland, commonly *Eucalyptus camaldulensis* or *E. coolabah* but also a wide range of other species including *Eucalyptus platyphylla*, *E. tereticornis*, *Melaleuca* spp., *Acacia holosericea* or other *Acacia* spp. Occurs on billabongs no longer connected to the channel flow.
11.3.39	Least Concern	No concern at present	*Eucalyptus melanophloia* ± *E. chloroclada* open-woodland on undulating plains and valleys with sandy soils
11.7.5	Least Concern	No concern at present	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks
11.9.1	Endangered	Endangered	*Acacia harpophylla-Eucalyptus cambageana* open forest to woodland on fine-grained sedimentary rocks
11.9.4a	Endangered	Endangered	Semi-evergreen vine thicket, generally dominated by a low tree layer (5-10m high) which is floristically diverse and variable. Common co dominant species include *Croton insularis*, *Denhamia oleaster*. There is also a tall and low shrub layer (2-6m high) dominated by species such as *Ehretia membranifolia*, *Apophyllum anomalum*, *Geijera parviflora*, *Capparis* spp., *Croton phebalioides*, *Erythroxylum australe*, *Alectryon diversifolius* and *Carissa ovata*. Emergents (16-25m high) are usually present including species such as *Cadellia pentastylis* and *Brachychiton* spp. usually on better sites, and *Eucalyptus orgadophila* and *Casuarina cristata* on

Regional Ecosystem	VM Status	Biodiversity Status	Short Description (EPA, 2007)
			drier, poorer sites. Vines are frequent. The ground layer is very sparse, and is most frequently composed of *Ancistrachne uncinulat*a and *Eragrostis megalosperma*. Occurs on steep upper and middle slopes where heavy clay soils have formed from sediments. It may grade into *Acacia harpophylla*, softwood spp. (11.9.4) on the lower slopes. It is prominent on the steep slopes of sandstone ranges, where shale has been exposed, and aspect, rainfall and runoff provide sufficient available water for its development. The soils are generally shallow, brown or grey-brown loams or light clays grading into medium or heavy clays. The soil reaction may become strongly acidic or alkaline at depth, depending on the acidity of parent material. May also occur on deep texture contrast soils, where a thin sandy colluvium overlies the clay subsoil. Loose fragments of sandstone may be present over the soil surface
11.9.5	Endangered	Endangered	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks
11.9.5a	Endangered	Endangered	*Acacia harpophylla* predominates and forms a fairly continuous canopy (10-18m high). Other tree species such as *Eucalyptus populnea, Casuarina cristata, Cadellia pentastylis and Brachychiton spp.* may also be present in some areas and form part of the canopy or emerge above it. Scattered *Eucalyptus orgadophila* may occur, especially on upper slopes and crests. A dense tall shrub layer dominated by a range of species is usually present, while a more open low shrub layer often occurs. Common species in these layers include *Croton insularis, Denhamia oleaster, Apophyllum anomalum, Croton phebalioides, Alectryon diversifolius* and *Carissa ovata.* The ground layer is sparse, most frequently composed of *Ancistrachne uncinulata and Eragrostis megalosperma* and varies with the density of the shrub layers. Occurs on undulating plains and rises formed mainly on shales. The soils are predominantly cracking clay soils, which are strongly alkaline at or near the surface and acidic beneath, or dark brown and grey-brown gradational soils, with a coarse-textured surface grading into an alkaline, clayey subsoil.
11.9.7	Of concern	Of concern	*Eucalyptus populnea*, *Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks
11.9.10	Of concern	Endangered	*Acacia harpophylla*, *Eucalyptus populnea* open forest on fine-grained sedimentary rocks
11.9.12	Endangered	Endangered	*Dichanthium sericeum* grassland with clumps of *Acacia harpophylla* on fine-grained sedimentary rocks
11.10.1	Least Concern	No concern at present	*Corymbia citriodora* open forest on coarse-grained sedimentary rocks
11.10.3	Least Concern	No concern at present	*Acacia catenulata* or *A. shirleyi* open forest on coarse-grained sedimentary rocks. Crests and scarps
11.10.7	Least Concern	No concern at present	*Eucalyptus crebra* woodland on coarse-grained sedimentary rocks
11.10.7a	Least Concern	No concern at present	*Eucalyptus crebra* ± *Callitris glaucophylla* ± *Angophora leiocarpa* ± *Eucalyptus* spp woodland. *Eucalyptus crebra* predominates and forms a distinct but discontinuous canopy (16-20 m high). In places, *Angophora leiocarpa* forms part of the canopy. The low tree layer (12-16 m high) is dominated by *Callitris glaucophylla*. Scattered tall and low shrubs may be present. The ground layer is open to dense, and dominated by perennial grasses, usually Aristida spp. or *Themeda triandra*.

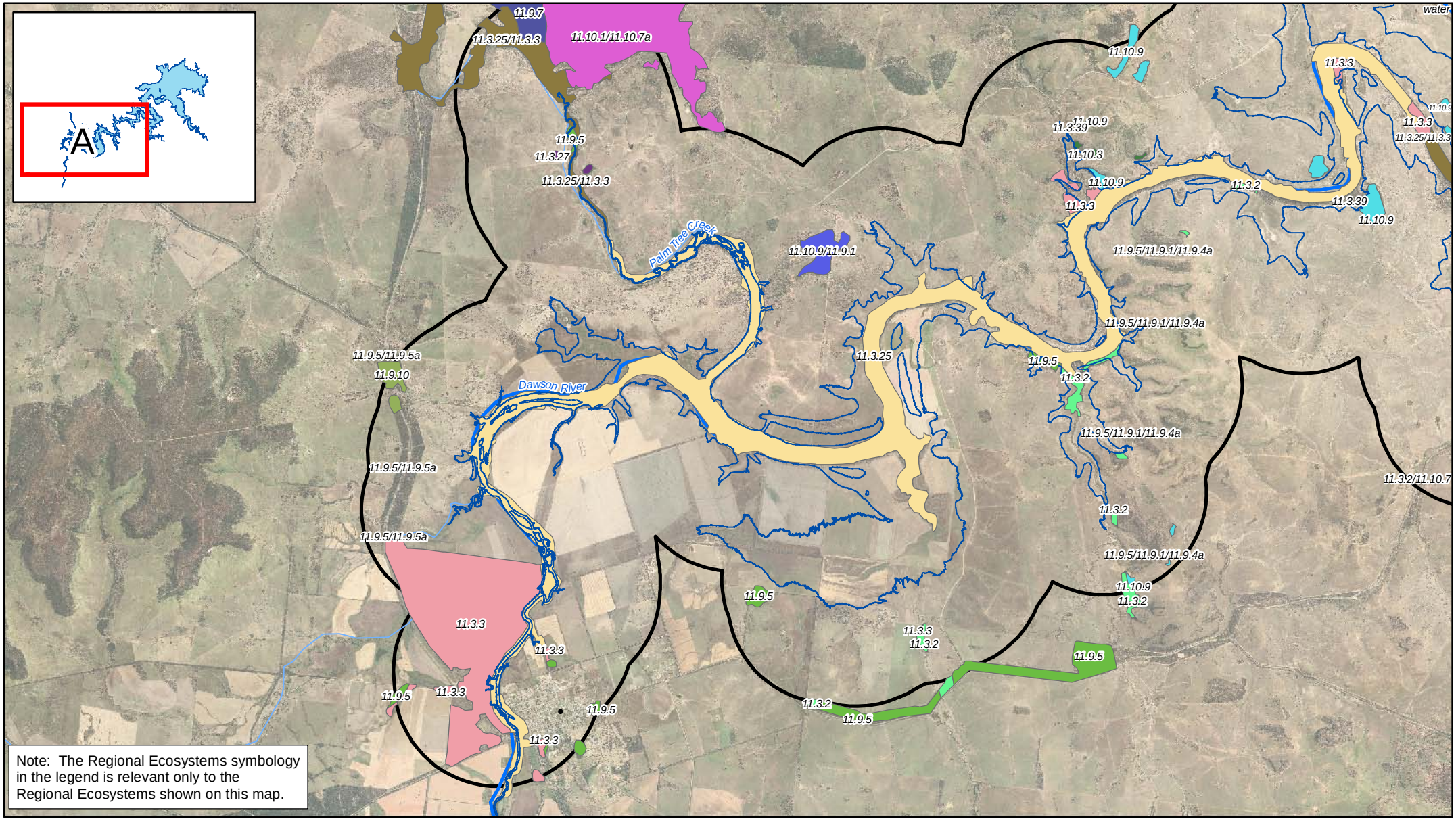
Regional Ecosystem	VM Status	Biodiversity Status	Short Description (EPA, 2007)
11.10.9	Least Concern	No concern at present	*Callitris glaucophylla* woodland on coarse-grained sedimentary rocks
11.10.11	Least Concern	No concern at present	*Eucalyptus populnea, E. melanophloia +/- Callitris glaucophylla* woodland on coarse-grained sedimentary rocks
11.10.13a	Least Concern	No concern at present	*Eucalyptus cloeziana* ± *E. melanoleuca* ± *Corymbia bunites* ± *E. sphaerocarpa* woodland to open-forest.

DERM regrowth vegetation

The dam study area also contains areas mapped by DERM (DERM, 2010) as high value regrowth vegetation (Figure 10-4).

Essential habitat

There are a couple of patches of essential habitat for *Rutidosis crispata* located in the dam study area. This habitat is associated with REs 11.10.1, 11.10.3, 11.10.9 and 11.10.13.



Note: The Regional Ecosystems symbology in the legend is relevant only to the Regional Ecosystems shown on this map.

LEGEND

- Towns
- Waterway
- Pipeline Route
- Full Supply Level (183.5m AHD)
- Dam Study Area

Remnant Regional Ecosystems (DERM Ver 6.0b)

11.10.1/11.10.7a	11.3.2	11.3.3
11.10.3	11.3.25	11.9.10
11.10.9	11.3.25/11.3.3	11.9.5
11.10.9/11.9.1	11.3.27	11.9.7

Projection: GDA94 Zone 56

Figure 10-3A

0 0.5 1 2
Kilometres

N

Scale 1:100,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Regional ecosystems within the dam study area

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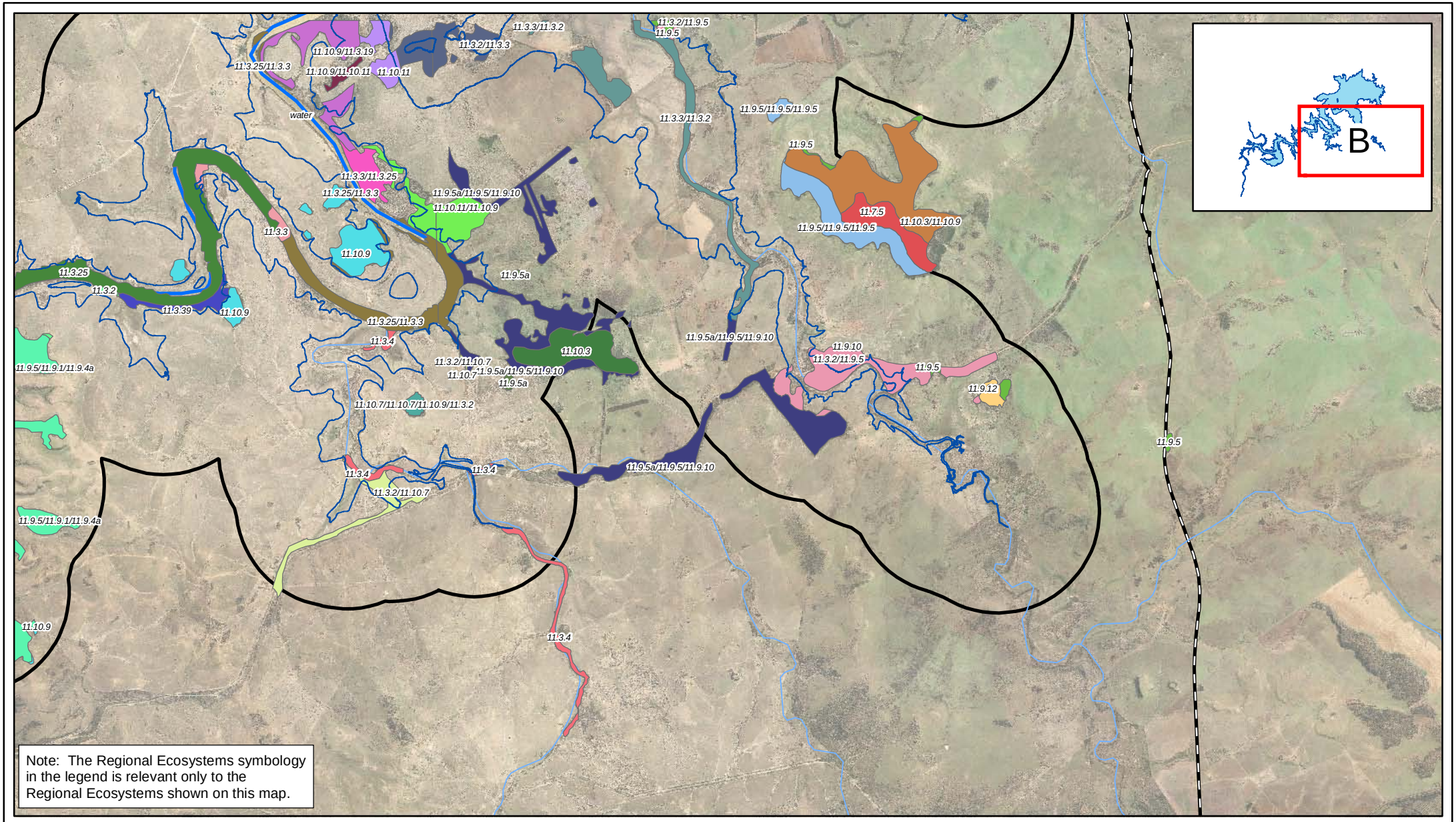


LEGEND

- Towns
- Waterway
- Pipeline Route
- Full Supply Level (183.5m AHD)
- Dam Study Area

Remnant Regional Ecosystems (DERM Ver 6.0b)

11.10.11	11.10.9	11.3.2/11.9.5	11.3.39	11.9.5/11.9.1/11.9.4a
11.10.11/11.10.9	11.10.9/11.10.11	11.3.25	11.3.4	11.9.5/11.9.5/11.9.5
11.10.3	11.10.9/11.3.19	11.3.25/11.3.3	11.7.5	11.9.5a
11.10.3/11.10.9	11.3.2	11.3.3	11.9.10	11.9.5a/11.9.5/11.9.10
11.10.7	11.3.2/11.10.7	11.3.3/11.3.2	11.9.12	
11.10.7/11.10.7/11.10.9/11.3.2	11.3.2/11.3.3	11.3.3/11.3.25	11.9.5	

Projection: GDA94 Zone 56

Figure 10-3B

0 0.5 1 2
Kilometres

N

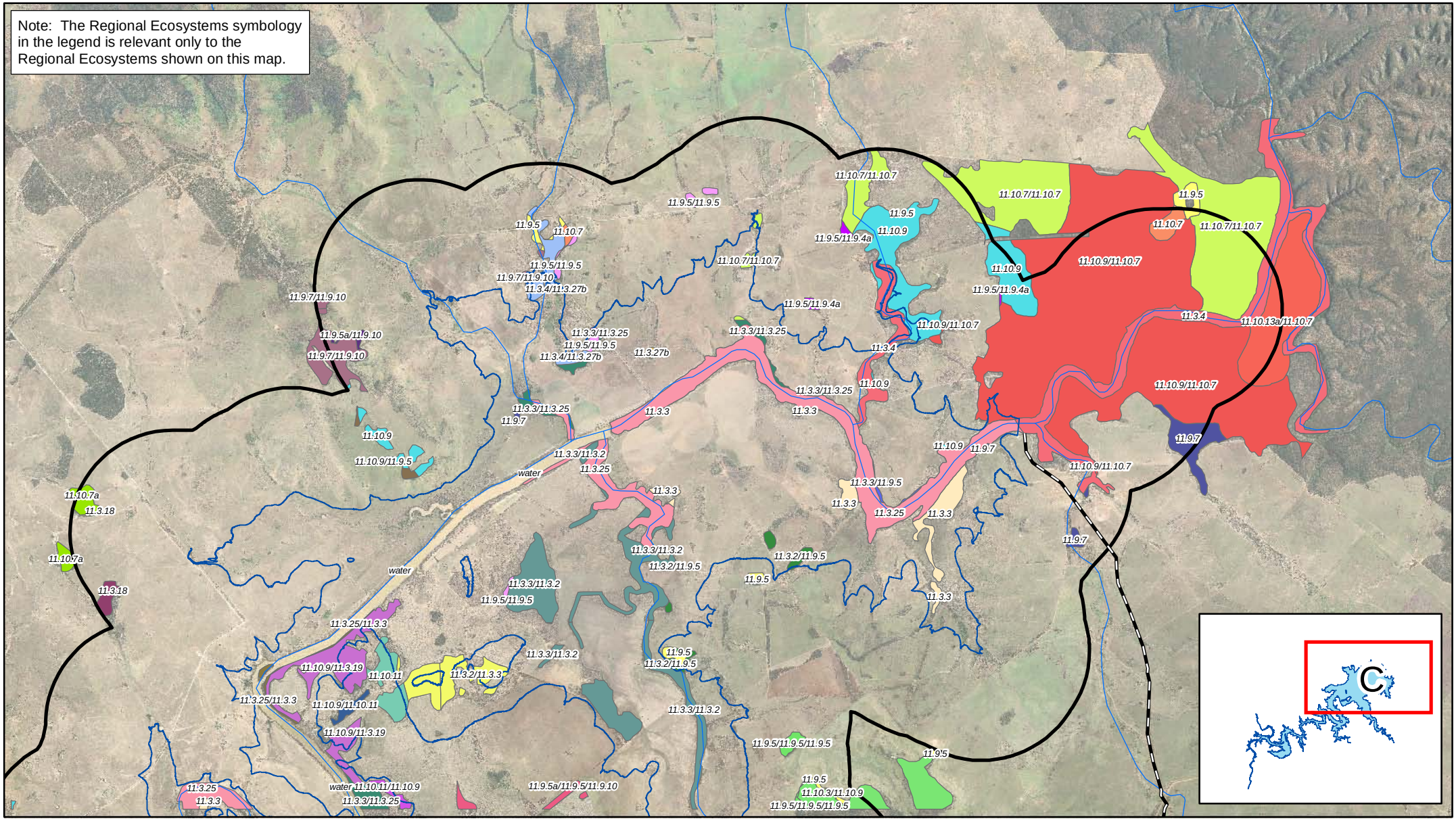
Scale 1:100,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Regional ecosystems within the dam study area

Note: The Regional Ecosystems symbology in the legend is relevant only to the Regional Ecosystems shown on this map.



LEGEND

- Towns
- Waterway
- Pipeline Route
- Full Supply Level (183.5m AHD)
- Dam Study Area

Remnant Regional Ecosystems (DERM Ver6.0b)

11.10.11	11.10.9	11.3.2/11.9.5	11.3.3/11.9.5	11.9.5a/11.9.10
11.10.11/11.10.9	11.10.9/11.10.11	11.3.25	11.3.4	11.9.5a/11.9.5/11.9.10
11.10.13a/11.10.7	11.10.9/11.10.7	11.3.25/11.3.3	11.3.4/11.3.27b	11.9.7
11.10.3/11.10.9	11.10.9/11.3.19	11.3.27b	11.9.5	11.9.7/11.9.10
11.10.7	11.10.9/11.9.5	11.3.3	11.9.5/11.9.4a	
11.10.7/11.10.7	11.3.18	11.3.3/11.3.2	11.9.5/11.9.5	
11.10.7a	11.3.2/11.3.3	11.3.3/11.3.25	11.9.5/11.9.5/11.9.5	

Projection: GDA94 Zone 56

Figure 10-3C

0 0.5 1 2 Kilometres

N

Scale 1:100,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Regional ecosystems within the dam study area

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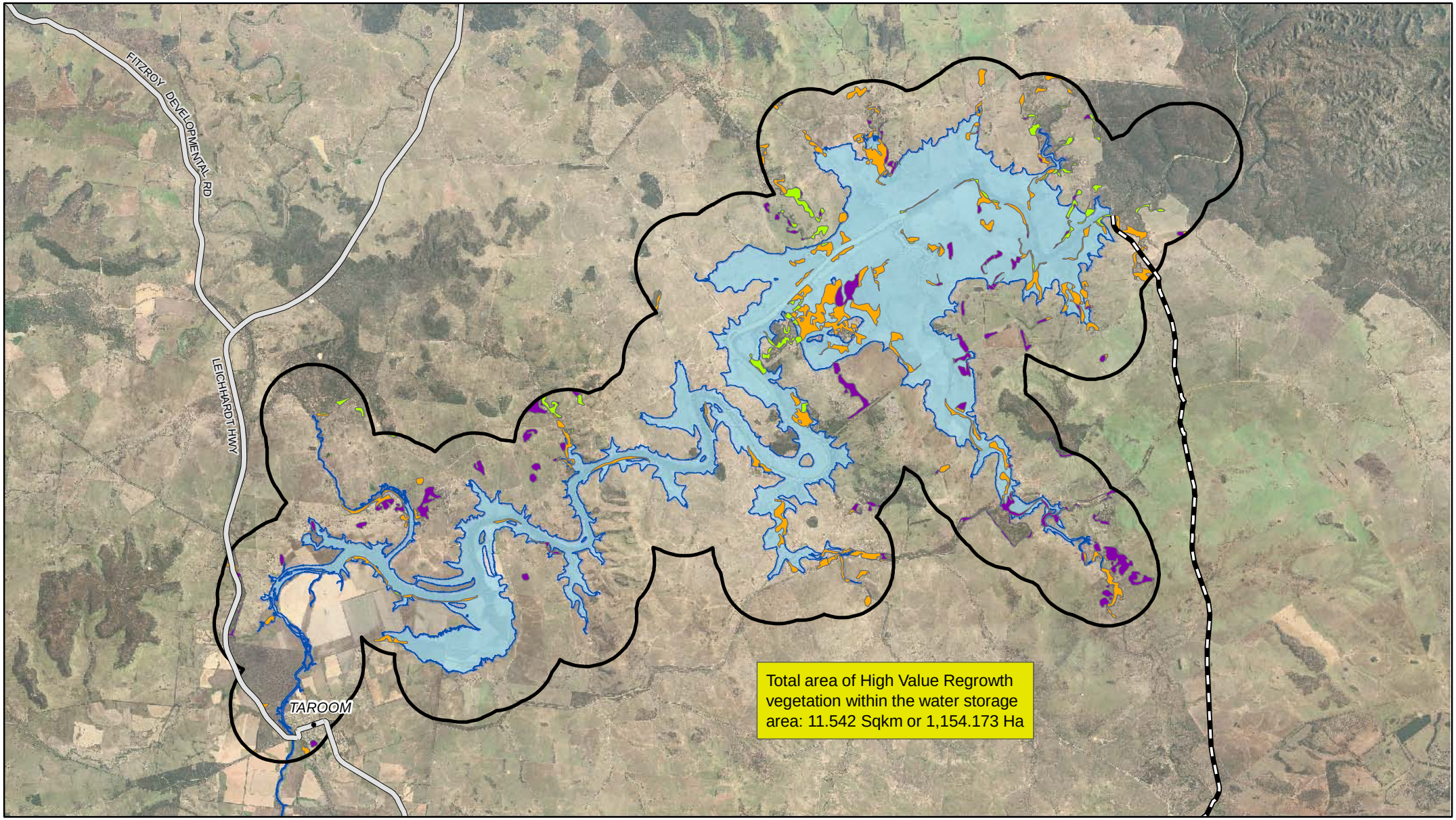

LEGEND

- Towns
- Pipeline Route
- State Controlled Roads
- Full Supply Level (183.5m AHD)
- Dam Study Area

High Value Regrowth Vegetation (DERM Version 2.0)

- Containing Endangered regional ecosystems
- Containing Of Concern regional ecosystems
- Is a Least Concern regional ecosystem

Projection: GDA94 Zone 56

Figure 10-4

0 1 2 4
Kilometres

N

Scale 1:200,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

DERM regrowth vegetation in the dam study area

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EPBC Act listed communities

The Terms of Reference (ToR) and the EPBC Act Online Protected Matters database (DEWHA, 2010a) identified seven threatened ecological communities that may potentially occur within the dam study area:

- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin;
- Brigalow (*Acacia harpophylla* dominant and co-dominant);
- the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin (GAB discharge spring wetlands);
- semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions;
- Weeping Myall woodlands; and
- White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland.

Species of conservation significance

A number of references covering a broad area surrounding the study area were reviewed to ascertain the likely occurrence of threatened species. Dowling and Halford (1997) and Fensham and Wilson (1997) provide a valuable resource to identify likely species occurring in the study area. Also of value were higher precision records from Queensland Herbarium databases, however, some Queensland Herbarium records have low levels of precision and therefore have been regarded as an unreliable record. The EPBC Act Protected Matters database provided a general guide to the presence of species covered by the EPBC Act, as the accuracy of location information from this database is low (DEWHA, 2004; DEWHA, 2010a). Table 10-3 summarises threatened species identified in these databases/studies along with the habitat requirements of each species.

Table 10-3 Threatened species identified in the database search results

Species Name	Common Name	Status		Reference of Record	Habitat Description	Potential Habitat
		NC Act	EPBC Act			
Acacia calantha		NT		Ison, H	This 1-3m tall shrub occurs in open parts of hardwood forests. It has been recorded from the lower parts of shallowly sloping hillsides and flat areas of these slopes in well drained soils (Williams, 1999).	Approximate location mapped in RE 11.3.4
Acacia islana	Isla Gorge Wattle	V		H	Spreading shrub often forming dense communities as understorey plants in open, light, hardwood forest. Often associated with some grass species, mainly *Triodia sp.* (Williams, 1999).	Approximate location mapped in RE 11.7.6 /11.3.26 /11.7.7
Acacia tenuinervis	Scrub Wattle	NT		H	Occurs mainly on red earths with pure stands occurring on ridges. It also occurs in eucalypt scrub and forest and has been recorded with *Eucalyptus panda, E. crebra* and *E. populnea*. In the Chinchilla area it is common on roadsides. It has also been recorded in vegetation containing *Acacia harpophylla (*QPWS, 2001)	Approximate location mapped in RE 11.5.1 /11.7.7
Arthraxon hispidus	Hairy Joint Grass	V	V	EPBC, HE, RF/BW	Found in the eastern parts of south-eastern Queensland, often in damp, shady places (Stanley and Ross, 1989).	Species recorded by CEPLA in 11.3.27b
Bertya pedicellata		NT		HE, W (d)	Occurs in open and closed forests on rocky hills with shallow, skeletal or sandy soils (QPWS, 2001).	REs 11.5.15, 11.7.4, 11.8.4, 11.8.5, 11.10.3 (NRMW)
Cadellia pentastylis	Ooline	V	V	EPBC, W (d)	Occurs in Queensland and New South Wales. It grows in four main habitats. In Queensland it may be found as a tall emergent in semi-evergreen vine thickets, in pure stands or mixed communities on residual sandstone ranges and scarps (associated with *Acacia harpophylla*, and *Casuarina cristata*), or localised clumps among *Acacia harpophylla/Casuarina cristata* communities on undulating clay plains and low hills (Leigh and Briggs, 1992).	REs 11.4.9, 11.5.15, 11.7.1, 11.9.4, 11.9.5, 11.9.11, 11.11.14 (NRMW)
Callitris baileyi		NT		H	A slender green tree occurring on hilly or mountainous areas (Stanley and Ross, 1989).	REs 11.8.8, 11.9.9a (REDD)

Species Name	Common Name	Status		Reference of Record	Habitat Description	Potential Habitat
		NC Act	EPBC Act			
Commersonia argentea (syn. Commersonia sp. Cadarga (G.P.Guymer 1642)			V	EPBC	Recorded from north of Chinchilla on stony ridges in eucalypt forest (Stanley and Ross, 1986). Species overlaps with the following EPBC Act listed threatened ecological communities: o Semi-evergreen vine thickets of Brigalow Belt (North and South) and Nandewar bioregions; o The community of native species dependent on natural discharge of groundwater from the GAB; o Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin; o Brigalow (*Acacia harpophylla* dominant and co-dominant); and o White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland (Threatened Species Scientific Committee, 2008).	Eucalypt forest potentially supporting stony ridges north of Chinchilla may include REs 11.7.6, 11.5.21, 11.5.20, 11.7.7, 11.7.4, 11.5.1, 11.12.5, 11.12.3, 11.7.5 & 11.5.4
Cryptandra ciliata		NT		HE, H	Sandstone	Species recorded by CEPLA in 11.10.9, 11.10.9 /11.10.7 and 11.3.3 /11.3.4 /11.9.1 /11.3.1.
Dichanthium queenslandicum	King Blue-grass		V	EPBC	Known in the region from northern Darling Downs district on heavy black soils (Stanley and Ross, 1989).	Grassland REs including 11.9.12.
Digitaria porrecta	Finger Panic Grass	NT	E	EPBC	Occurs in Queensland and New South Wales. Finger panic grass can be found in native grasslands, woodlands or open forest with grassy understorey on richer soils. It is often found along roadsides and travelling stock routes where there is light grazing and occasional fire (DEC (NSW), 2005).	Grassland REs including 11.9.12.
Eucalyptus beaniana	an Ironbark	V	V	H	Grows on skeletal, sandy soils on sandstone cliff tops and stony ridges in open eucalypt forests including gum, spotted gum and ironbark (QPWS, 2001).	REs 11.3.1, 11.4.3, 11.9.1, 11.9.4, 11.9.5, 11.9.6 and 11.8.2a, 11.8.8, 11.9.9a.

Species Name	Common Name	Status		Reference of Record	Habitat Description	Potential Habitat
		NC Act	EPBC Act			
Leucopogon grandiflorus		NT		W (d)	Occurs in eucalypt forest or woodland on sandstone cliffs or sandy valley floors. It is found at altitudes between 200m and 720m (QPWS, 2001).	REs 11.10.1, 11.10.7, 11.10.13 (NRMW).
Livistona nitida	Carnarvon Fan Palm	NT		HE, W (d)	Confined to banks and channels of larger, semipermanent stream in sandy, silty or gravely alluvium. It is frequently associated with *Eucalyptus tereticornis, E. microtheca, E. melanophloia, Corymbia maculata, C. citriodora, Angophora floribunda* and *Macrozamia moorei* (Rodd, 1998).	Species recorded by CEPLA in REs 11.3.25, 11.3.3, 11.3.27.
Notelaea pungens		NT		W (d)	Occurs in undulating to hilly terrain, on either sandstone or granite ridges. Occurs in open forest and woodland communities on well drained, mostly shallow, gravelly clay-loam or sandy soils (QPWS, 2001).	REs 11.7.4, 11.7.7, 11.10.1, 11.10.7, 11.10.13, 11.12.6, 11.12.20 (NRMW).
Prostanthera sp. (Dunmore D.M. Gordon 8A)		V	V	H	A shrub that has been recorded in *Eucalyptus decorticans* woodland/open forest on stony sandstone ridges. Also recorded from among rocks on flat top hills (QPWS, 2001).	REs 11.3.1, 11.4.3, 11.9.1, 11.9.5, 11.9.6, 11.8.2a, 11.8.8, 11.9.9a (NRMW).
Rutidosis crispata		V		HE, W (d), H (d)	Occurs in *Eucalyptus crebra* open forest with hilly terrain, dark brown fine sandy loam or sandstone substrate and a SW aspect (Queensland Herbarium AQ 656964).	REs 11.10.1, 11.10.3, 11.10.9, 11.10.13 (NRMW); Species recorded by CEPLA in REs 11.10.9/11.9.1, 11.10.7, 11.10.9.
Sannantha brachypoda		NT		W (d)	A shrub to 4m high (SGAP, 2008).	
Senna acclinis	Rainforest Cassia	NT		H	A shrub found in or on the edges of subtropical and dry rainforest. Easily mistaken for the introduced Senna species which are environmental weeds (DEC (NSW), 2005).	Approximate location mapped in RE 11.7.6.

Species Name	Common Name	Status		Reference of Record	Habitat Description	Potential Habitat
		NC Act	EPBC Act			
Solanum stenopterum		V		H	A semi-erect, straggling herb found in brown clay with some sand content. Collected growing in grassland in a slashed area (Queensland Herbarium, AQ 717921).	Approximate location mapped in non-remnant vegetation.
Thelypteris confluens		V		W (d), H (d), RF/BW	In Australia this fern is found in Queensland and Victoria in areas of wet swampy ground (S.B. Andrews, 1990).	Species recorded by CEPLA in 11.3.4, 11.3.27.
Wahlenbergia islensis	Australian Bluebell	NT		W (d)	Occurs in crevices on rock outcrops and also has been recorded on sandstone slopes situated below cliffs in *Eucalyptus cloeziana* and *Corymbia maculata* woodland (QPWS, 2001).	*Eucalyptus cloeziana* and *Corymbia spp* occur in RE 11.10.13 (REDD).
Zieria verrucosa		V	V	H	A shrub occurring in semi-evergreen vine thickets on red soil (Queensland Herbarium AQ 506989).	Most occurrences confined to road reserve or private land in non-remnant vegetation (DEWHA, 2008).

E= Endangered; V= Vulnerable; NT= Near Threatened.

W = Wildnet; H = Herbrecs database (EPA, 2005a; DERM, 2009a); Corveg = EPA (2000); HE= Dowling & Halford (2007); Ison = Ison Environmental Planners (1996); RF/BW = Fensham and Wilson (1997); EPBC = EPBC Protected Matters Search (the search polygon was defined by the following four corners: 149 43 38, -25 21 25;150 13 6, -25 21 16;150 12 49, -25 39 54; and149 44 3, 25 40 27); NMRW = NMRW (2008) Essential Habitat Mapping; REDD = Regional Ecosystem Description Database (EPA, 2007); CEPLA = Chenoweth Environmental Planning & Landscape Architecture

10.1.3.2. Observed regional ecosystems

Remnant regional ecosystems

A total of 23 remnant REs were identified by field survey within the dam study area; 14 within the FSL and nine outside FSL. These are illustrated in Figure 10-5 and described in Appendix 10-B.

Only RE 11.3.39 which was previously mapped at a scale of 1:100,000 (EPA, 2005b) was not recorded at the finer scale of mapping. Two REs were mapped at a scale of 1:10,000 that were not previously mapped the EPA (2005b) at a scale of 1:100,000 including:

- 11.3.1 - *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains; and
- 11.3.22 – Springs associated with recent alluvia, but also including those on fine-grained sedimentary rocks, basalt, ancient alluvia and metamorphic rocks.

GAB spring communities are classified under the regional ecosystem framework as either RE 11.3.22 (as described above) or RE 11.10.14 Springs associated with sandstone. Both these REs have a VM status of Of Concern and a Biodiversity Status of Endangered irrespective of whether they are recharge or discharge. GAB spring communities vary in size and vegetation cover, and those forming heterogeneous polygons with freshwater wetlands have been mapped as RE 11.3.22. The finer scale mapping for the EIS also allowed for all GAB spring communities to be identified as points; with each spring associated with either RE 11.3.22 or RE 11.10.14, depending on geology (Figure 10-8). Sites are based on Fensham & Wilson (1997) and refined by Chenoweth (2008).

Each remnant RE recorded within the study area (taking into consideration heterogeneous polygons) is listed in Table 10-4 along with their VM and Biodiversity status. The bioregional extent and representation of significant REs in the dam study area are listed in Appendix 10-C.

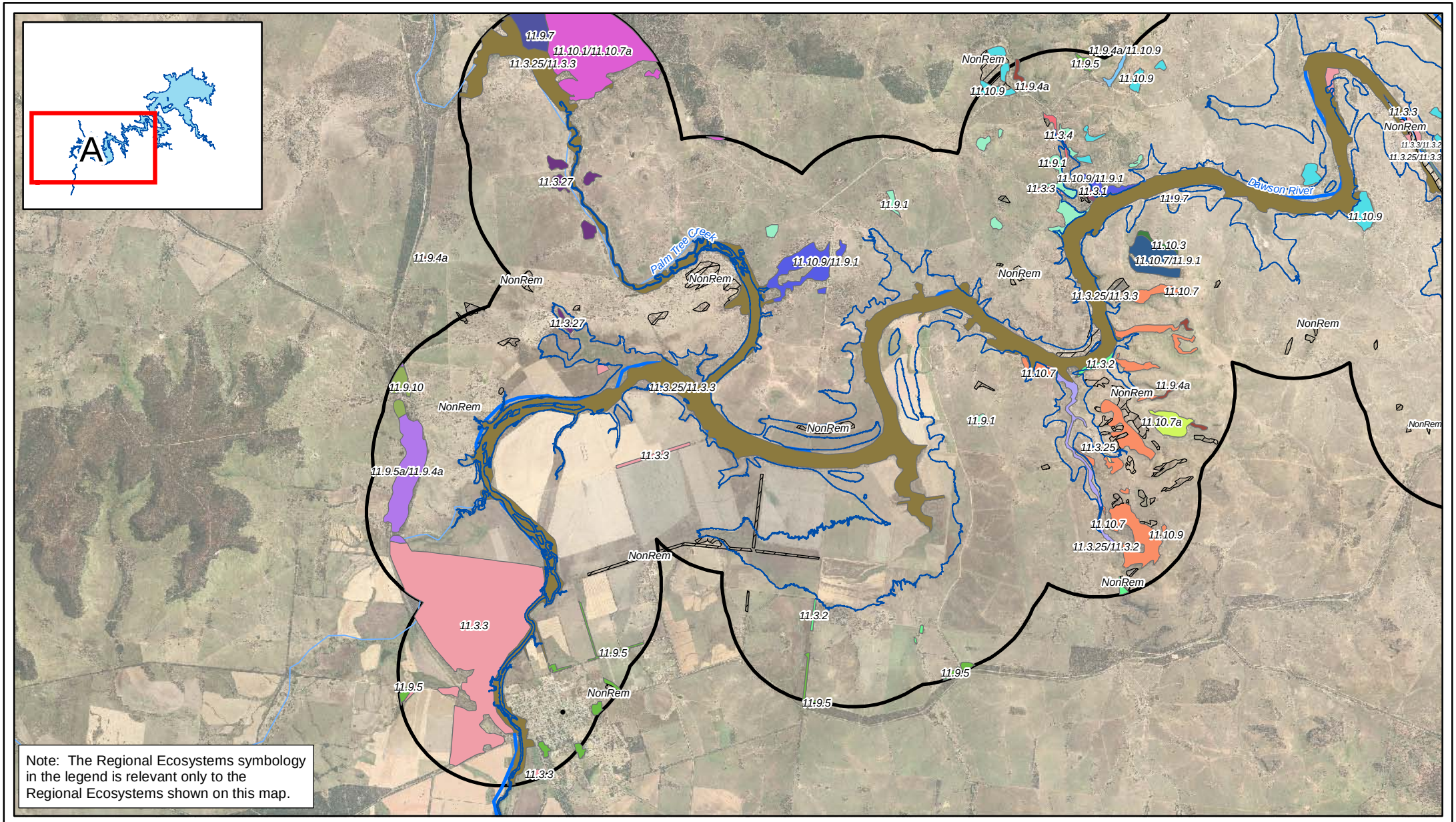
Table 10-4 Regional ecosystems as mapped at a 1:10,000 scale within the dam study area

Regional Ecosystem	VM Status	Biodiversity Status	Short Description
11.3.1	Endangered	Endangered	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains
11.3.2	Of concern	Of concern	*Eucalyptus populnea* woodland on alluvial plains
11.3.3	Of concern	Of concern	*Eucalyptus coolabah* woodland on alluvial plains
11.3.4	Of concern	Of concern	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains
11.3.19	Least concern	No concern at present	*Callitris glaucophylla*, *Corymbia* spp. and/or *Eucalyptus melanophloia* open-forest to woodland on Cainozoic alluvial plains
11.3.22	Of concern	Endangered	Springs associated with recent alluvia, but also including those on fine-grained sedimentary rocks, basalt, ancient alluvia and metamorphic rocks
11.3.25	Least concern	Of concern	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines
11.9.1	Endangered	Endangered	*Acacia harpophylla-Eucalyptus cambageana* open forest to woodland on fine-grained sedimentary rocks

Regional Ecosystem	VM Status	Biodiversity Status	Short Description
11.9.5	Endangered	Endangered	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks
11.9.5a	Endangered	Endangered	*Acacia harpophylla* predominates and forms a fairly continuous canopy.
11.9.7	Of concern	Of concern	*Eucalyptus populnea*, *Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks
11.9.10	Of concern	Endangered	*Acacia harpophylla*, *Eucalyptus populnea* open forest on fine-grained sedimentary rocks
11.10.7	Least Concern	No concern at present	*Eucalyptus crebra* woodland on coarse-grained sedimentary rocks
11.10.7a	Least Concern	No concern at present	*Eucalyptus crebra* ± *Callitris glaucophylla* ± *Angophora leiocarpa* ± *Eucalyptus* spp woodland.
11.10.9	Least Concern	No concern at present	*Callitris glaucophylla* woodland on coarse-grained sedimentary rocks

Non remnant vegetation

Non remnant vegetation mapped by Chenoweth, comprising regrowth vegetation that would achieve remnant status within approximately 20 years if adequately managed, is described in Appendix 10-B and shown on Figure 10-5.



LEGEND

- Towns
- Waterway
- Pipeline Route
- Full Supply Level (183.5m AHD)
- Dam Study Area

Regional Ecosystems (CEPLA, 2010)

11.10.1/11.10.7a	11.10.9	11.3.25/11.3.2	11.3.4	11.9.5
11.10.3	11.10.9/11.9.1	11.3.25/11.3.3	11.9.1	11.9.5a/11.9.4a
11.10.7	11.3.1	11.3.27	11.9.10	11.9.7
11.10.7/11.9.1	11.3.2	11.3.3	11.9.4a	NonRem
11.10.7a	11.3.25	11.3.3/11.3.2	11.9.4a/11.10.9	

Projection: GDA94 Zone 56

Figure 10-5A

0 0.5 1 2 Kilometres

N

Scale 1:100,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Regional ecosystems mapped in the dam study area at a scale of 1:10 000

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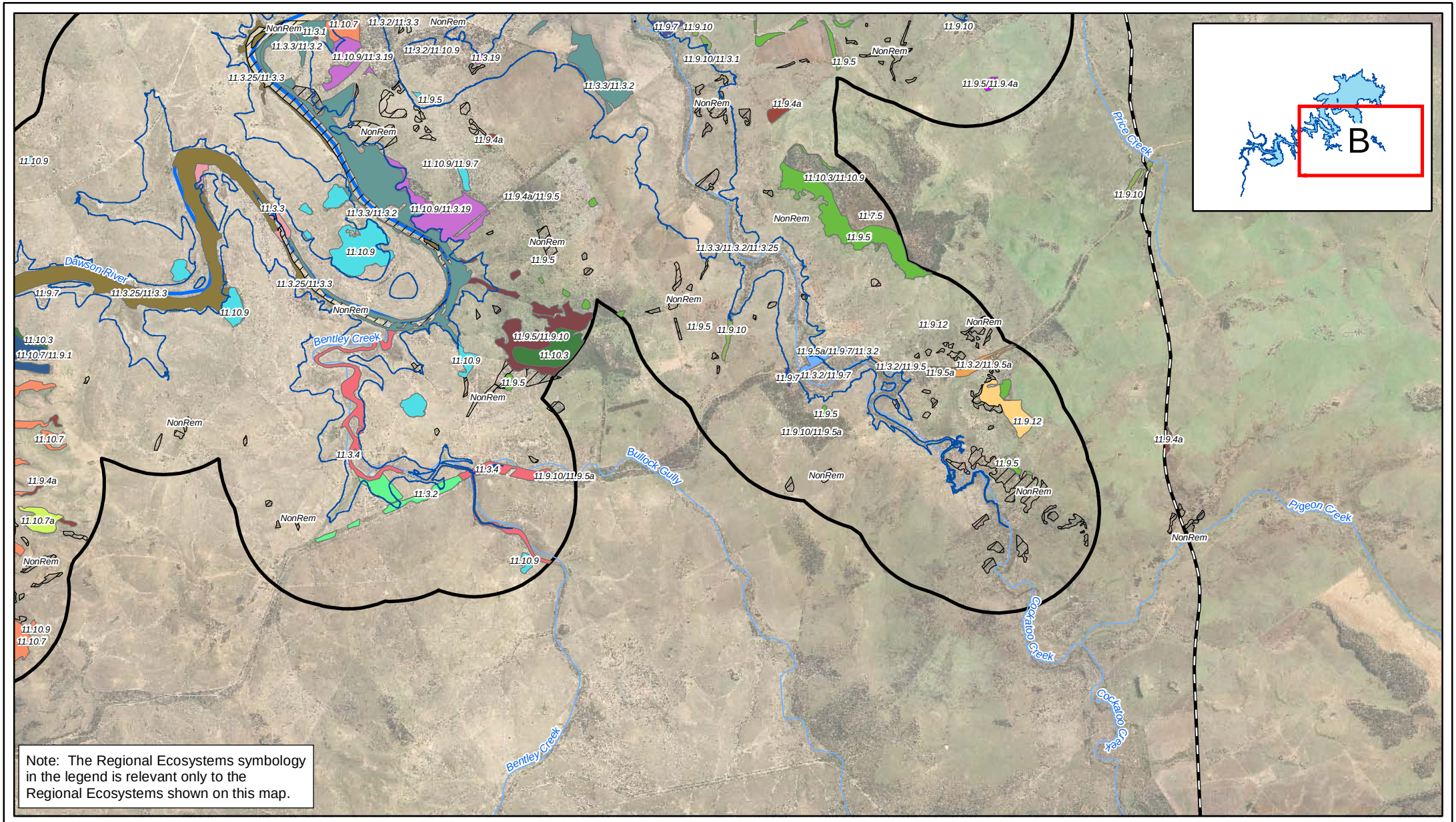


Note: The Regional Ecosystems symbology in the legend is relevant only to the Regional Ecosystems shown on this map.

LEGEND

- Towns
- Waterway
- Pipeline Route
- Full Supply Level (183.5m AHD)
- Dam Study Area

Regional Ecosystems (CEPLA, 2010)

11.10.3	11.10.9/11.3.19	11.3.2/11.9.5a	11.9.1	11.9.5/11.9.10	NonRem
11.10.7	11.10.9/11.9.1	11.3.25/11.3.3	11.9.10	11.9.5/11.9.4a	
11.10.7/11.9.1	11.3.1	11.3.3	11.9.12	11.9.5a	
11.10.7a	11.3.19	11.3.3/11.3.2	11.9.4a	11.9.5a/11.9.7/11.3.2	
11.10.9	11.3.2	11.3.4	11.9.5	11.9.7	

Projection: GDA94 Zone 56

Figure 10-5B

0 0.5 1 2 Kilometres

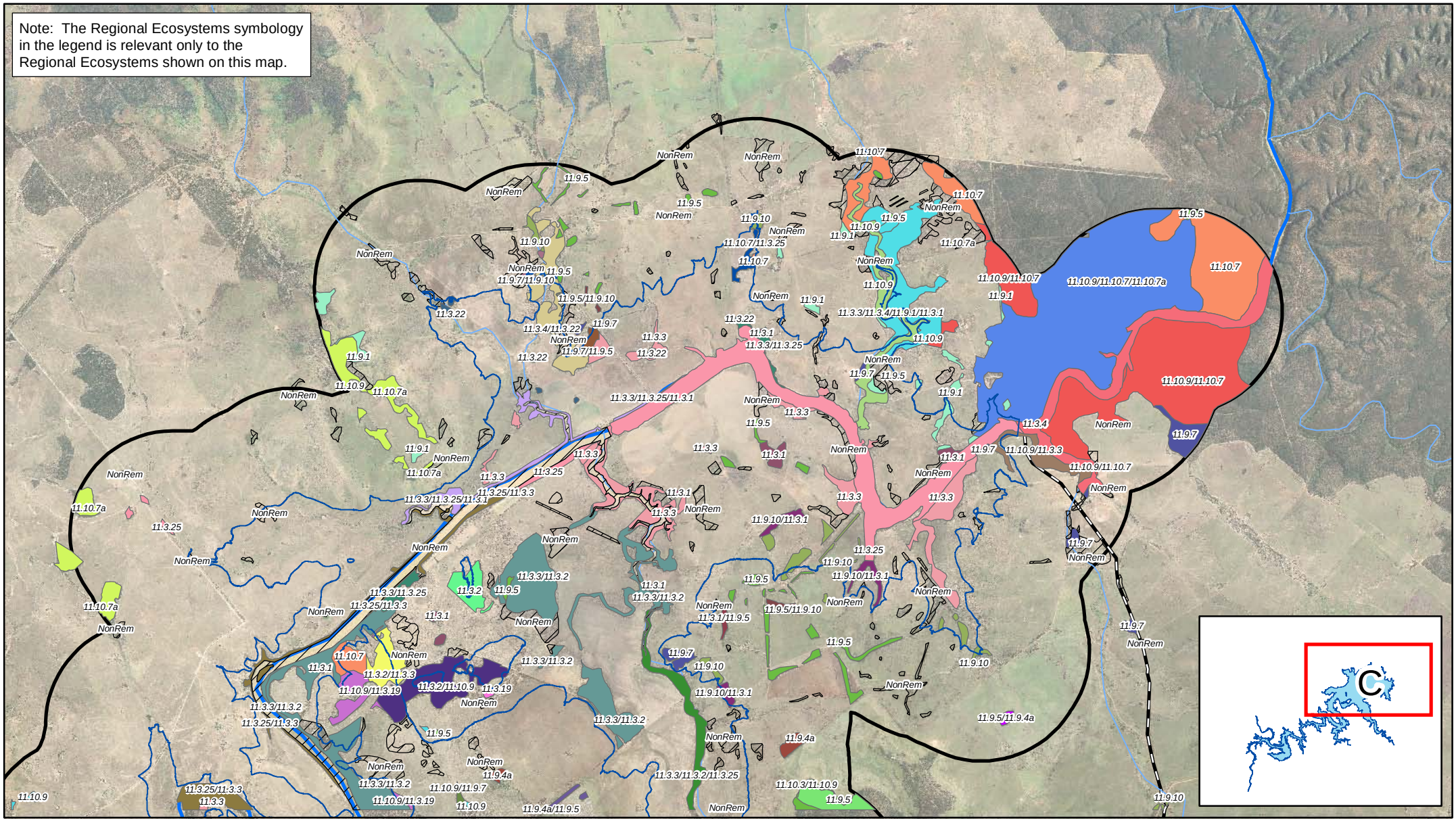
N

Scale 1:100,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Regional ecosystems mapped in the dam study area at a scale of 1:10 000



LEGEND

- Towns
- Waterway
- Pipeline Route
- Full Supply Level (183.5m AHD)
- Dam Study Area

Regional Ecosystems (CEPLA, 2010)

11.10.3/11.10.9	11.10.9/11.3.19	11.3.2/11.10.9	11.3.3/11.3.2/11.3.25	11.9.10	11.9.7
11.10.7	11.10.9/11.3.3	11.3.2/11.3.3	11.3.3/11.3.25	11.9.10/11.3.1	11.9.7/11.9.10
11.10.7/11.3.25	11.10.9/11.9.7	11.3.22	11.3.3/11.3.25/11.3.1	11.9.4a	11.9.7/11.9.5
11.10.7a	11.3.1	11.3.25	11.3.3/11.3.4/11.9.1/11.3.1	11.9.4a/11.9.5	NonRem
11.10.9	11.3.1/11.9.5	11.3.25/11.3.3	11.3.4	11.9.5	
11.10.9/11.10.7	11.3.19	11.3.3	11.3.4/11.3.22	11.9.5/11.9.10	
11.10.9/11.10.7/11.10.7a	11.3.2	11.3.3/11.3.2	11.9.1	11.9.5/11.9.4a	

Projection: GDA94 Zone 56

Figure 10-5C

0 0.5 1 2 Kilometres

N

Scale 1:100,000 (at A4)

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NATHAN DAM AND PIPELINES EIS

Regional ecosystems mapped in the dam study area at a scale of 1:10 000

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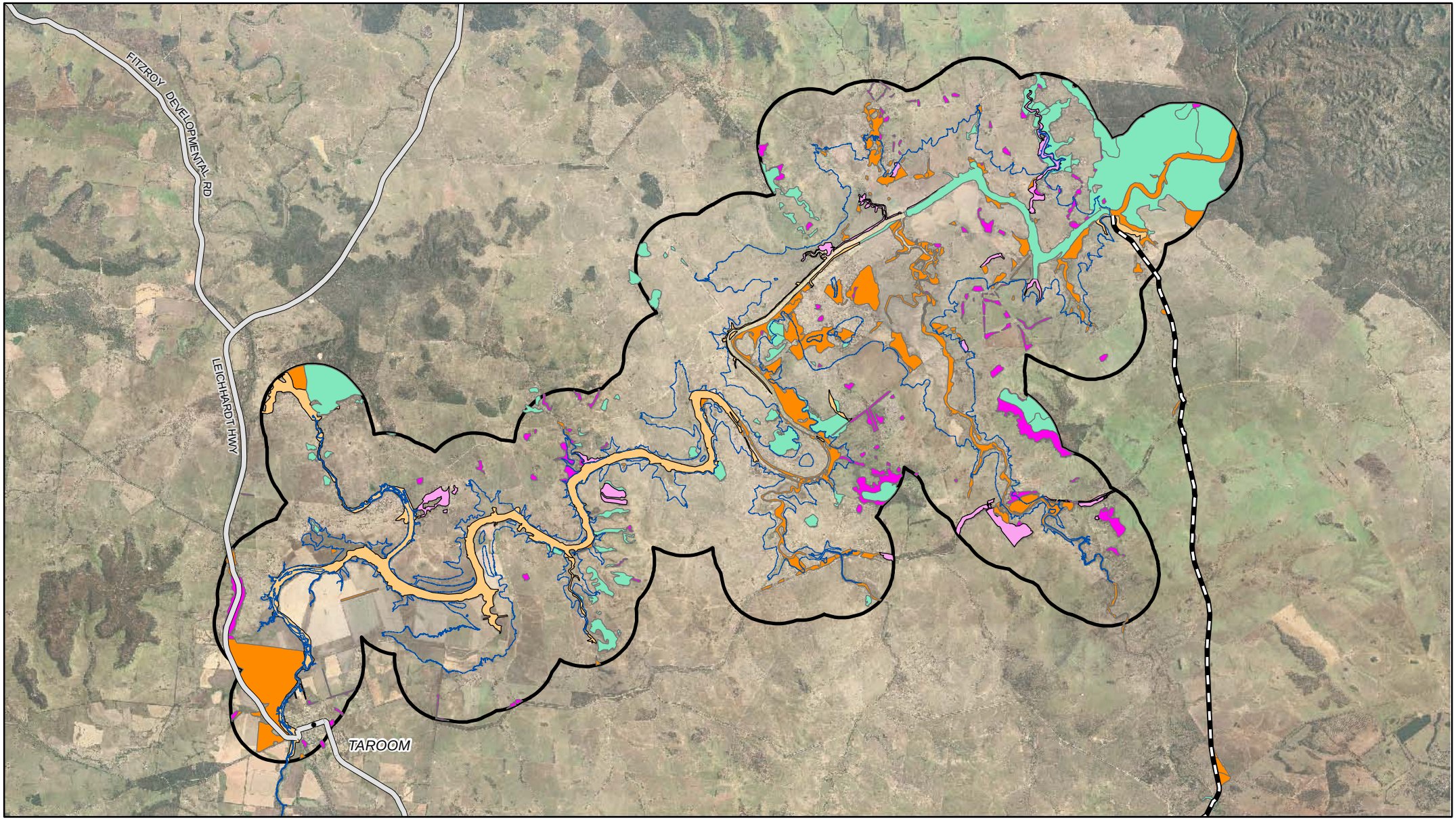


LEGEND

- Towns
- Pipeline Route
- State Controlled Roads
- Full Supply Level (183.5m AHD)
- Dam Study Area

Regional Ecosystems (Vegetation Management Status)

- Endangered - Dominant
- Endangered - Sub Dominant
- Of Concern -Dominant
- Of Concern - Sub-dominant
- Least Concern

Projection: GDA94 Zone 56

Figure 10-6

0 1 2 4
Kilometres

N

Scale 1:200,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Extent of 'Endangered' and Of Concern' regional ecosystems (VM Status) as mapped at a 1:10 000 scale within the dam study area

I:\QENV2\Projects\QE40192\400 - Nathan - Spatial\ArcMXD\Figures\100_Terrestrial_Flora\Figure_10-6_Spatial_Extent_Endangered_Regional_Ecosystems_Dam_v2.mxd Produced: 30/05/2011

10.1.3.3. GAB spring communities

Field investigations by CEPLA identified an additional six GAB spring communities not mapped by Fensham & Fairafx (2005) and the location of GAB spring communities was refined. Broad areas of wetland vegetation are frequently associated with the GAB spring communities within Nathan Gorge. Numerous springs were found to be supported within the bed and banks of the Dawson River in the Nathan Gorge and Price Creek, several of which were no more than a few metres in diameter. It is possible these smaller springs were regarded by Fensham & Wilson (1997) as 'outbreaks' of the much larger GAB spring communities (up to 300 m x 50 m as measured in GIS) and therefore were not recorded separately by Fensham & Fairfax (2005). Therefore they may not be additional springs, but rather outbreaks of the larger GAB spring communities.

The distribution of GAB spring communities are listed in Table 10-5 and mapped in Figure 10-8. CEPLA (2008) mapped an additional 17 GAB spring communities within the dam study area, with 11 outside of the FSL.

Table 10-5 GAB spring communities recorded within the dam study area

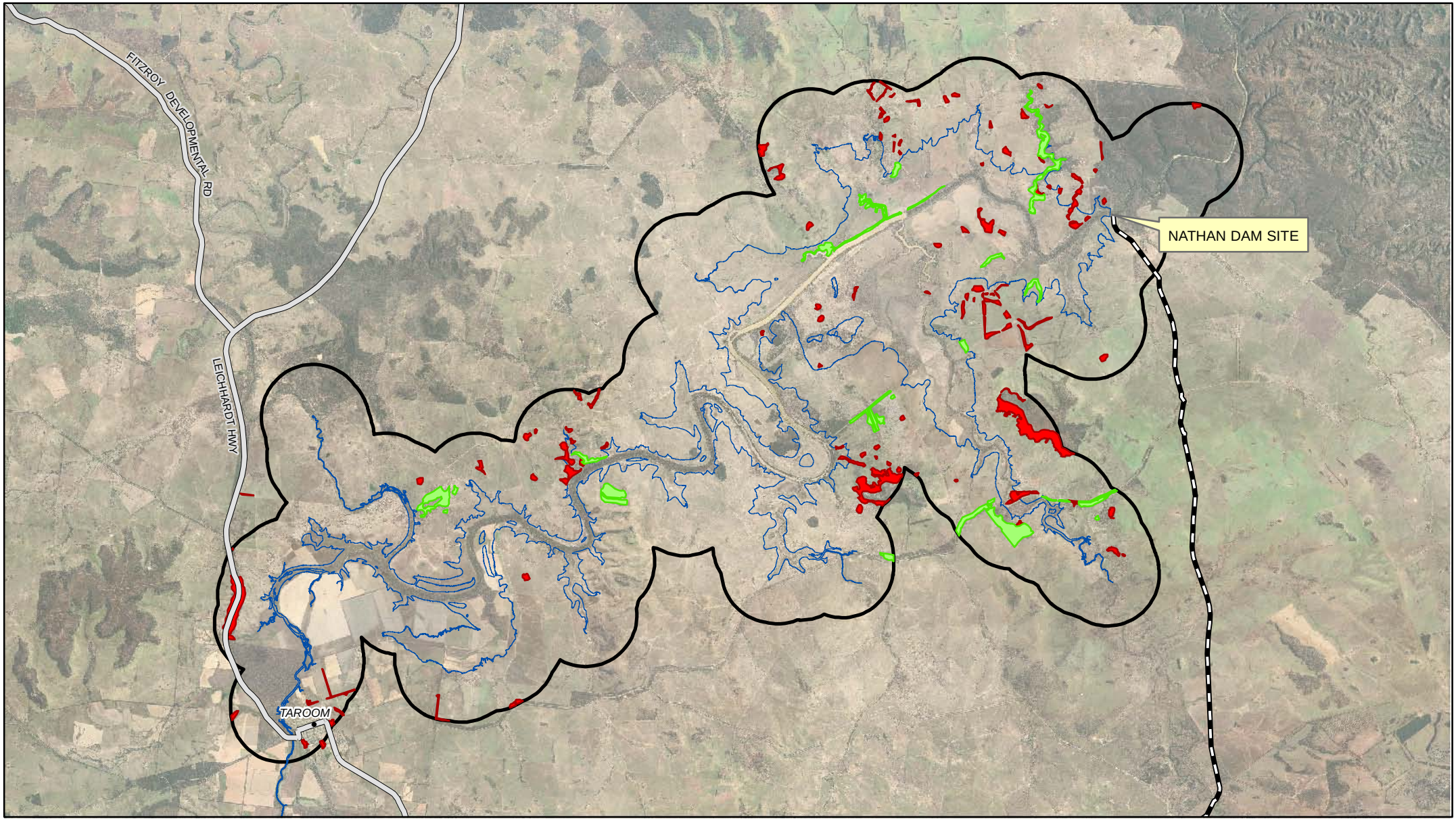
Impact Area	Spring ID	RE	Total
Water Storage	2, 3, 4, 11, 12 13, 14, 25, 29, 30, 31, 32, 33, 37, 42, 43, 44, 53, 54, 59, 61, 63	11.3.22	28
	B1, B2, B3, B4, B5, B6	Non Remnant	
Surrounding FSL	B7, B8, B9, B10, B11, B12, B13, B14, B15, B16, B17	11.3.4	55
	1,5, 6, 7, 8,9, 10, 15, 16, 17, 18, 19, 20, 21, 22, 23,24, 26, 27, 28, 34, 35, 36, 38, 39, 40, 41, 45, 46, 47, 48, 49, 50, 51, 52, 55, 56, 57, 58, 60, 62, 67, 68, 69	11.3.22	
Total			83

10.1.3.4. EPBC Act listed communities

The Brigalow (*Acacia harpophylla* dominant and co-dominant) was the only vegetation communities, mapped at a scale of 1:10,000, found within the dam study area are listed as threatened under the EPBC Act.

Although the ToR made specific reference to the Critically Endangered community GAB spring wetlands, White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland and Weeping Myall Woodlands, these communities were not found in the study area. Only the Brigalow community was found within the FSL.

The EPBC Act recognises Brigalow regrowth as meeting the definition of the ecological community depending on whether the vegetation achieves certain age and/or condition thresholds. Patches of remnant and regrowth Brigalow ecological communities are mapped in Figure 10-7. Remnant Brigalow includes REs 11.3.1, 11.9.1, 11.9.5 and 11.9.5a.



LEGEND

- Towns
- Pipeline Route
- State Controlled Roads
- Dam Study Area
- Full Supply Level (183.5m AHD)

Brigalow Ecological Communities

- Dominant Endangered - Brigalow
- Sub-dominant Endangered - Brigalow

Projection: GDA94 Zone 56

Figure 10-7

0 1 2 4
Kilometres

N

Scale 1:200,000 (at A4)

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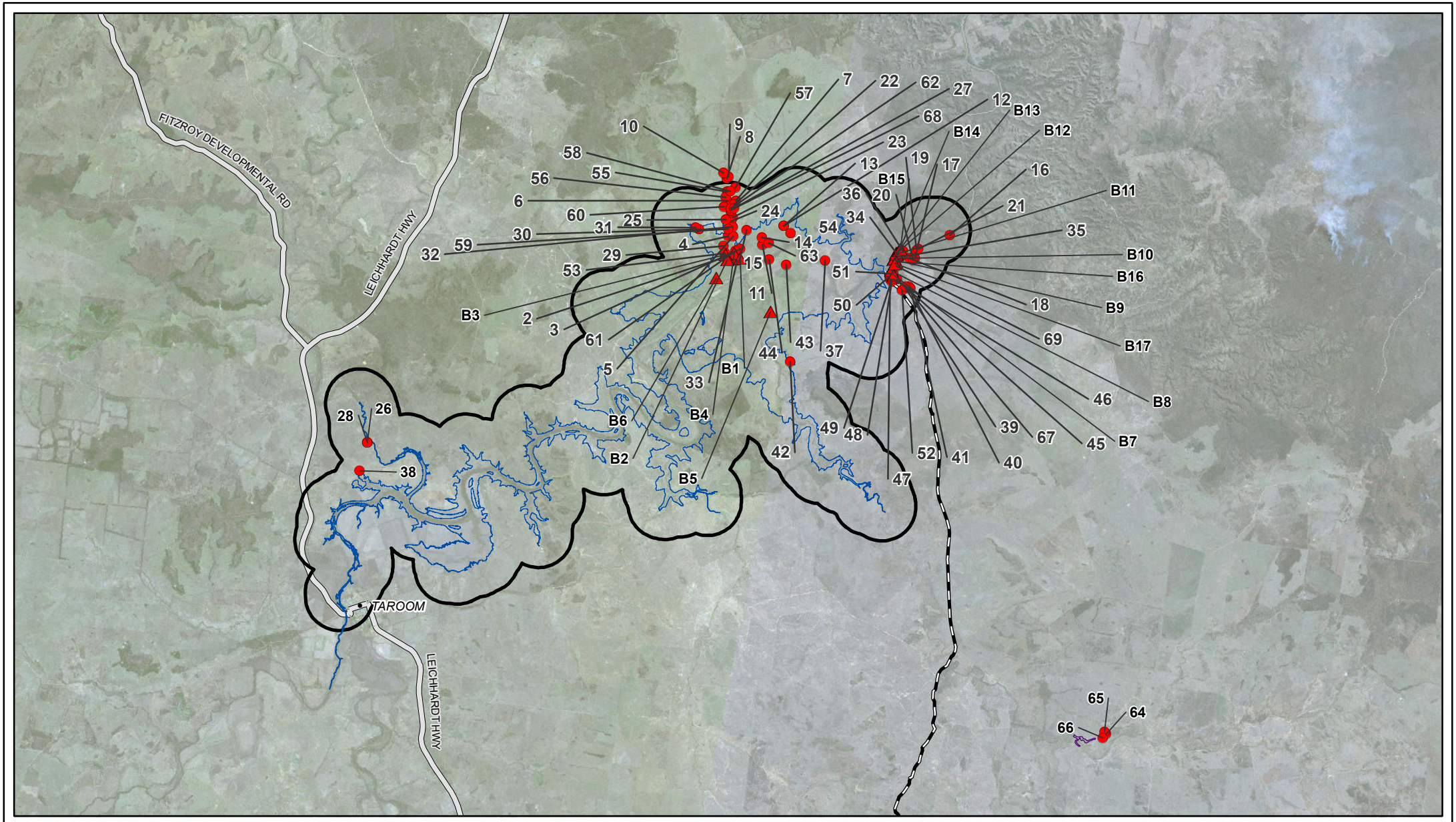
NATHAN DAM AND PIPELINES EIS

Brigalow ecological community as mapped at a 1:10 000 scale within the dam study area

I:\QENV2\Projects\QE40192\400 - Nathan - Spatial\ArcMXD\Figures\100_Terrestrial_Flora\Figure_10-7_EPBC_Threatened_Ecological_Communities_Dam.mxd Produced: 8/06/2011



LEGEND

- Towns
- Pipeline Route
- State Controlled Roads
- Other Infrastructure
- Full Supply Level (183.5m AHD)
- GAB springs mapped by Fensham and Fairfax (2005)
- GAB springs mapped by CEPLA 2008

Projection: GDA94 Zone 56

Figure 10-8

0 1.5 3 6
Kilometres

N

Scale 1:300,000 (at A4)

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NATHAN DAM AND PIPELINES EIS

Location of GAB spring communities within the dam study area

I:\QENV2\Projects\QE40192\400 - Nathan - Spatial\ArcMXD\Figures\100_Terrestrial_Flora\Figure_10-8_GAB_Communities_Dam_V2.mxd Produced: 11/01/2012

10.1.3.5. Floristics

Seven hundred and forty (740) species were located in the dam study area (inclusive of species recorded by Dowling and Halford (1997)).

10.1.3.6. Species of conservation significance

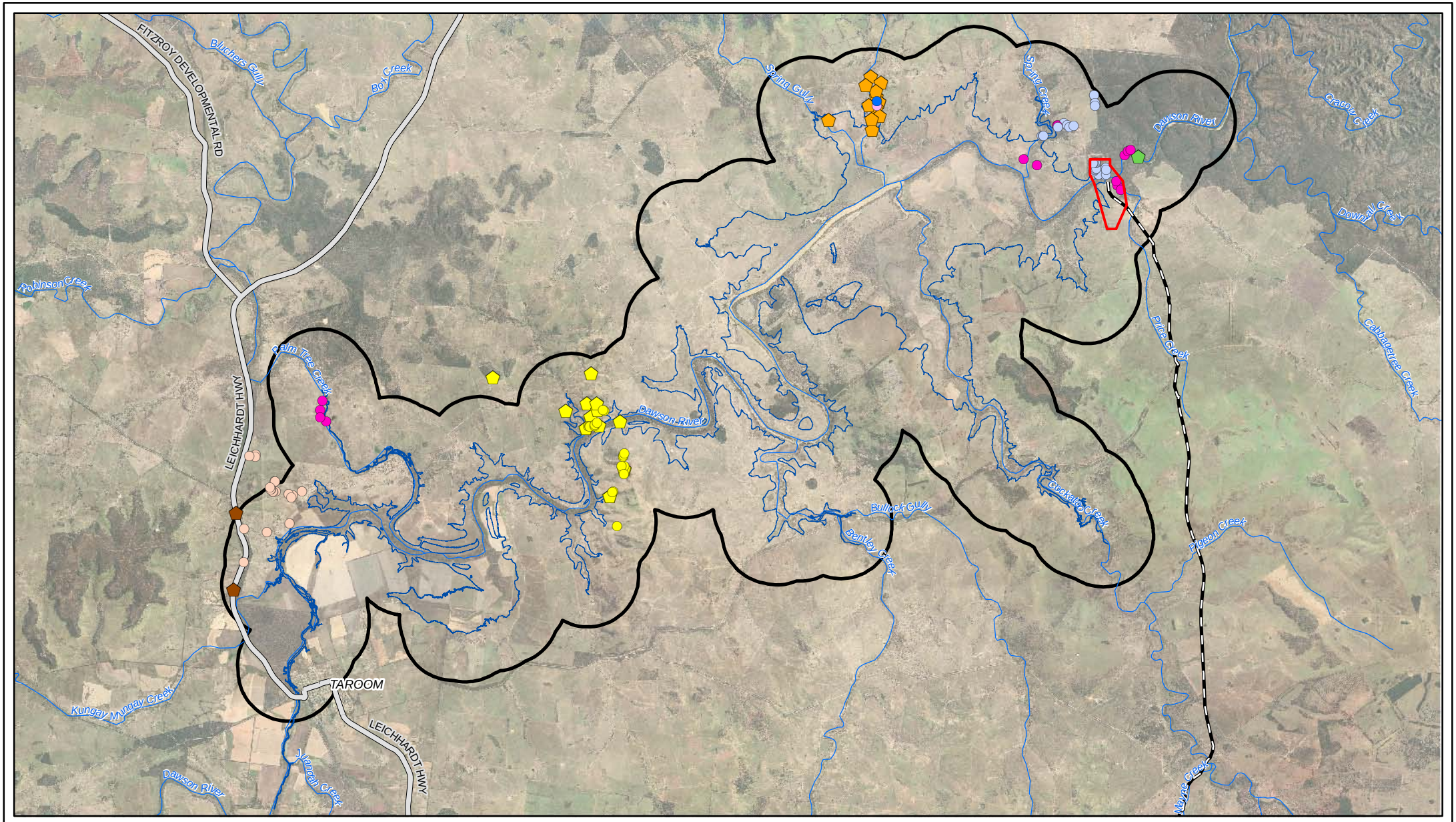
Literature review identified the potential for 23 threatened species to occur in the dam and surrounds. Field surveys identified four species listed under the NC Regulations, one of which is also listed under the EPBC Act within the water storage. Furthermore a highly reliable record for the state Vulnerable *Thelypteris confluens* was made by Fensham and Wilson (1997). The locations of the records of these species are illustrated in Figure 10-9.

The likelihood of occurrence of threatened flora species in the dam impact area is evaluated in Table 10-6. The likelihood that a species is present within the impact area was determined according to:

- Known – Species has been positively recorded in this survey or other survey by qualified ecologists during past 30 years;
- Likely - Remnant vegetation or sites likely to support the species because there is habitat containing essential resources of a size capable of supporting a significant number of individuals. Available habitat which is proximal to and buffering a known occurrence of a population;
- Possible - Remnant vegetation may provide suitable habitat which is potentially important however may be known to be suboptimal and there have been no reported records or sightings;
- Unlikely - Remnant vegetation is unlikely to support the species because there have been no reported sightings of individuals and/or the habitat is considered unsuitable based on consideration of literature and field knowledge; and
- Absence Known or Suspected - Absences consistently recorded based on intensive targeted survey and consideration of habitat and distribution from literature.

An index of confidence is applied to the assessment being:

- High – personal observations or records from other reputable sources (for example, 90% certainty);
- Medium – information from sources of reasonable/mixed reliability (location accuracy / taxa identification) (for example, 70% certainty); and
- Low – information from sources of unknown reliability (for example, 50% certainty).



LEGEND

- Towns
- Pipeline Route
- State Controlled Roads
- Watercourses
- Other Infrastructure
- Full Supply Level (183.5m AHD)
- Dam Construction Footprint

Higher Precision Records from External Sources

- *Acacia calantha*
- *Arthraxon hispidus*
- *Digitana porrecta*
- *Eriocaulon carsonii*
- *Cadellia pentastylis*
- *Myriophyllum artesium*
- *Rutidosis crispata*
- *Thelypteris confluens*
- *Thesium australe*

Species Recorded by CEPLA (2008)

- *Acacia tenuinervis*
- *Arthraxon hispidulis*
- *Cadellia pentastylis*
- *Cryptandra ciliata*
- *Dodonaea biloba*
- *Eriocaulon carsonii*
- *Livistona nitida*
- *Myriophyllum artesium*
- *Rutidosis crispata*
- *Rutidosis lanata*
- *Thelypteris confluens*

Projection: GDA94 Zone 56

Figure 10-9

0 1 2 4 Kilometres

N

Scale 1:200,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Location of threatened species within the dam study area

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Table 10-6 Likelihood of occurrence of significant flora in the dam impact area

Likelihood of Occurrence	Species Name	Common Name	Status		Likelihood of Occurrence Explanatory Notes	Index of Confidence
			NC Act	EPBC Act		
Known	*Cryptandra ciliata*		NT		*Cryptandra ciliata* was abundant in the sandstone forests on the northern bank of the Dawson River near the dam wall, but also identified a number of other large populations around Spring Creek associated with REs 11.10.9, 11.10.9/11.10.7 and 11.3.3 /11.3.4 /11.9.1 /11.3.1.	High
Known	*Livistona nitida*	Carnarvon Fan Palm	NT		Recorded in several locations across the water storage in waterways in REs 11.3.25, 11.3.3 and 11.3.22. Dense occurrence on Palm Tree Creek, Spring Creek, Price Creek and Nathan Gorge.	High
Known	*Rutidosis crispata*		V		Recorded in REs 11.10.9/11.9.1, 11.10.7, 11.10.9.on the north and south sides of the Dawson River within the water storage. Occurs in relative abundance on south facing sandstone slopes to the immediate west of Blackboy Creek in RE 11.10.7 and in areas directly north of this and the Dawson River in RE 11.10.9.	High
Likely	*Arthraxon hispidus*	Hairy Joint Grass	V	V	Recorded in GAB spring communities 1 and 27 in RE 11.3.4/11.3.22 located outside the FSL. Given the historical records of this species in GAB spring communities within the water storage by Fensham and Wilson (1997) it is likely to occur inGAB spring communities) within the dam impact area.	High
Likely	*Thelypteris confluens*		V		No survey records as part of the current study, but previously recorded by Fensham and Wilson (1997) in GAB spring community 23 (RE 11.3.4/11.3.22) outside the FSL. Likely to occur in GAB spring communities within the dam impact area.	High
Possible	*Acacia calantha*		NT		No survey records. Potential to occur in RE 11.3.4 near the dam wall site.	Medium
Possible	*Acacia islana*	Isla Gorge Wattle	V		No survey records. Potential to occur in RE 11.3.26, 11.7.6 and 11.7.7.	Medium
Possible	*Bertya pedicellata*		NT		No survey records. Previously recorded by Halford (1997) on Mount Glebe outside of the water storage. Potential to occur within RE 11.10.3.	High

Likelihood of Occurrence	Species Name	Common Name	Status		Likelihood of Occurrence Explanatory Notes	Index of Confidence
			NC Act	EPBC Act		
Possible	*Leucopogon grandiflorus*		NT		No survey records. Previously recorded approximately 5 km downstream of the dam wall site in RE 11.10.7. Potential to occur in RE 11.10.7 near the dam wall site.	Medium
Possible	*Notelaea pungens*		NT		No survey records. Previously recorded approximately 6 km downstream of the dam wall site in RE 11.10.13/11.10.7. Potential to occur in RE 11.10.7 near the dam wall site.	Medium
Possible	*Prostanthera* sp.		V	V	No survey records. Potential to occur in RE 11.3.1.	Medium
Possible	*Solanum stenopterum*		V		No survey records.	Medium
Possible	*Sannantha brachypoda*		NT		No survey records. Closest records are to the north of the dam study area from Precipice National Park (Biodiversity occurrence data, 2010).	Medium
Possible	*Wahlenbergia islensis*	Australian Bluebell	NT		No survey records.	Medium
Unlikely	*Acacia tenuinervis*	Scrub Wattle	NT		No survey records. Suitable habitat does not occur within the impact area.	High
Unlikely	*Callitris baileyi*		NT		No survey records. Suitable habitat does not occur within the impact area.	High
Unlikely	*Commersonia argentea*			V	No survey records. Suitable habitat does not occur within the impact area.	Medium
Unlikely	*Dichanthium queenslandicum*	King Blue-grass		V	No survey records. Suitable habitat (grassland REs) does not occur within the impact area.	Medium
Unlikely	*Digitaria porrecta*	Finger Panic Grass	NT	E	No survey records. Not known from the area. Suitable habitat (grassland REs) does not occur within the water storage.	High
Unlikely	*Senna acclinis*	Rainforest Cassia	NT		No survey records. No dry rainforests occur in the water storage.	Medium

Likelihood of Occurrence	Species Name	Common Name	Status		Likelihood of Occurrence Explanatory Notes	Index of Confidence
			NC Act	EPBC Act		
Unlikely	*Zieria verrucosa*		V	V	No survey records. Suitable habitat does not occur within the impact area.	Medium
Absent	*Cadellia pentastylis*	Ooline	V	V	Detailed searches located several specimens outside of the FSL to the north of Taroom. Thorough searches within the water storage did not locate any specimens or suitable habitat.	High
Absent	*Eucalyptus beaniana*	An Ironbark	V	V	No survey records. Potential habitat occurs in the impact area (RE 11.3.1, 11.9.1 and 11.9.5) however range does not extend to the study area.	High

E= Endangered; V= Vulnerable; NT= Near Threatened.

H = High index of confidence; M = Medium index of confidence; L = Low index of confidence.

Species identified by DERM as threatened priority taxa (EPA, 2008d) were not recorded within the dam and surrounds.

10.1.3.7. Species of cultural significance

Several of the flora species recorded during the field survey have been historically used as food or for materials and are listed in Table 10-7.

Table 10-7 Plants of cultural significance recorded in the dam study area

Species Name	Common Name	Family
Alectryon diversifolius	Scrub Boonaree	SAPINDACEAE
Brachychiton populneus	Kurrajong	STERCULIACEAE
Brachychiton rupestris	Narrow-leaved Bottle Tree	STERCULIACEAE
Capparis canescens		CAPPARACEAE
Capparis lasiantha		CAPPARACEAE
Capparis mitchellii		CAPPARACEAE
Carissa ovata	Currant Bush	APOCYNACEAE
Citriobatus spinescens		PITTOSPORACEAE
Cymbidium canaliculatum		ORCHIDACEAE
Cymbopogon bombycinus	Silky Oilgrass	POACEAE
Grevillea robusta	Silky Oak	PROTEACEAE
Lomandra longifolia	Spinyhead Matrush	LOMANDRACEAE
Murdannia graminea	Grass Lily	COMMELINACEAE
Myoporum deserti	Turkey Bush	MYOPORACEAE
Owenia venosa	Emu Apple	MELIACEAE
Petalostigma pubescens	Quinine Tree	PICRODENDRACEAE
Pittosporum rhombifolium		PITTOSPORACEAE
Pittosporum spinescens	Large-fruited orange thorn	PITTOSPORACEAE
Portulaca oleracea	Pigweed	PORTULACACEAE
Pouteria cotinifolia		SAPOTACEAE
Psydrax odorata		RUBIACEAE
Rumex brownii	Swamp dock	POLYGONACEAE
Tetragonia tetragoinioides	New Zealand spinach	AIZOACEAE
Typha orientalis		TYPHACEAE

10.1.3.8. Weeds

A review of species lists and consultation with local government pest protection officers identified that 89 exotic species potentially occur in the dam study area of which seven are regarded as Class 2 pests and one is regarded as a Class 3 pest under the LP Act.

Ninety-four exotic species were encountered during the field surveys but only five are listed under the LP Act. Declared species are shown in Table 10-8. None of these are Weeds of National Significance.

Table 10-8 Species declared under the LP Act recorded in the dam study area

Species	Common Name	Status	Dam study area sites	Water storage sites
Baccharis halimifolia	Groundsel Bush	Class 2	Fensham and Wilson (1997)	
Opuntia aurantiaca	Tiger Pear	Class 2	W88	
Opuntia stricta var. stricta	Prickly Pear	Class 2	MD100	W18, W7
Opuntia tomentosa	Velvety Tree Pear	Class 2	MD23, MD96, MD21, W99, MD85, W19, MD100	W64, W53, W88, MD67, W79
Macfadyena unguis-cati	Cats Claw	Class 3	Fensham and Wilson (1997)	

Opuntia species were frequently encountered in plots; however, it was not recorded as a dominant species in any site.

Abundant throughout the study area is the exotic Buffel Grass. Although important economically, the species has the potential to degrade patches of Brigalow through an increase in fire frequency (Buttler and Fairfax, 2003). No notable occurrence of any other economically important exotic species was recorded.

The study area is a declared management area for Parthenium (*Parthenium hysterophorus*) (a declared Class 2 plant under the LP Act and a Weed of National Significance). No Parthenium was recorded during field work.

10.1.3.9. Vegetation condition

Generally, the vegetation within the study area has been significantly modified through agricultural activities. Hyder (1997) reported that the vegetation was already highly fragmented, but since that time additional broad scale vegetation clearing has occurred. The highly fragmented landscape is clearly evident in vegetation mapping (Figure 10-6).

Although the State of the Rivers report (Telfer, 1995) rated the riparian vegetation upstream of the proposed dam wall as in 'moderate' condition; Cockatoo, Cabbage Tree and Downfall Creeks as in 'poor' condition; and Spring and Bentley Creeks as in 'very poor' condition, the current study found that much of this vegetation is regarded as remnant and is relatively weed free. Areas downstream of the proposed dam wall are in excellent condition, based on the assessment in the State of the River report.

The vegetation mapping completed for this study identified that large areas of vegetation are non-remnant (Table 10-9).

Table 10-9 Extent of remnant and non-remnant vegetation in the water storage

Remnant Status	Water storage (ha)
Remnant REs	3553.6
Non-remnant REs	341.6
Cropping	296
Water	375.8
Non-remnant	9256.8
TOTAL	**13823.8**

Despite being mappable as remnant vegetation on the basis of height and cover thresholds there are some areas of remnant vegetation which are in better condition than others. Some patches have been subject to intense edge effects including invasion by exotics such as Buffel Grass (*Pennisetum ciliare*) which have degraded their ecological condition. Generally, the smaller patches with greater edge to area ratios were more affected by such impacts.

To assist in gauging the quality of remaining patches a simple four point scale has been applied that assigns a condition ranking based on patch size and remnant status as stated in Section 10.1.2. Good quality vegetation (ranked 1) is distributed throughout the dam study area, although is concentrated along the Dawson River. Areas of vegetation condition rank 3 (non-remnant vegetation in patches greater than 2 ha) are also common throughout the dam study area. The ranking level of vegetation is presented in the secondary and tertiary site data in Appendix 10-B.

10.1.3.10. Cultivation

The cleared areas within the dam study area are heavily utilised for cattle grazing, typically with a range of improved pasture species and legume species. A cultivation area irrigated by centre point is evident on the aerial photography as seven centre pivot irrigators. The area is designated as cropping in the Chenoweth RE mapping and totals an area of 296 ha within the water storage. Cleared, non-remnant vegetation utilised for grazing and cropping totals 9256.8 ha within the water storage.

10.1.3.11. Timber resources

The volume of potential timber resource within each RE is shown in Table 10-10. As noted in Section 10.1.2.10, species were regarded as suitable timber resources if identified as such in Lazarides & Hince (1993). The main species identified in this assessment as being a timber resource include *Eucalyptus crebra, E. populnea, E. camaldulensis, E. cambageana, E. tereticornis, E. coolabah, E. fibrosa subsp. nubila, E. moluccana, Angophora floribunda, Dodonaea viscosa, Geijera salicifolia, G. parviflora, Alphitonia excelsa, Brachychiton populneus, Acacia excelsa, A. harpophylla, A. pendula, Alectryon diversifolius, A. oleifolius, Allocasuarina luehmannii, Alstonia constricta, Apophyllum anomalum, Casuarina cristata, Callitris glaucophylla, Carissa ovata, C. clarksoniana, C. tessellaris, Elaeodendron australe, Lysiphyllum carronii, Psydrax johnsonii* and *Eremophila mitchellii*. Although considered as suitable timber resources in Lazarides & Hince (1993), with the exception of the eucalypts and corymbias, most species listed above would only be suitable for fence posts or minor wood work applications. As indicated in Table 10-10, most resources are associated with regional ecosystems located in alluvial environments.

Table 10-10 Timber volume estimates for the dam and surrounds

Regional Ecosystems	Water storage volume (m^3)	Dam Construction Footprint Volume (m^3)
11.3.1	12093.8	0
11.3.2	31613.5	0
11.3.3	38804.9	355.6
11.3.4	29480.0	4953.4
11.3.19	400.1	0
11.3.25	165832.1	1248.8
11.3.22	1844.5	0
11.9.1	3650.7	166.8

Regional Ecosystems	Water storage volume (m^3)	Dam Construction Footprint Volume (m^3)
11.9.5	866.2	0
11.9.5a	340.4	0
11.9.7	1762.2	0
11.9.10	2126.9	0
11.10.7	548.1	386.3
11.10.7a	112.2	2776.4
11.10.9	2638.2	2776.4
Non-remnant	15961.5	0
TOTAL	**307074.8**	**10314.7**

10.1.4. Pipeline

10.1.4.1. Literature review

DERM Regional Ecosystems

The current vegetation patterns on the pipeline were identified with reference to the remnant (DERM, 2009b) and pre-clearing RE mapping (EPA, 2005c) presented at a scale of 1:100,000. Table 10-11 lists the REs within the pipeline corridor.

In addition to REs identified in Table 10-11, the Least Concern REs 11.4.4, 11.4.12, 11.5.20, heterogeneous 11.5.1/11.9.2/11.7.5, 11.9.12 and 11.9.4b, and the Endangered RE 11.3.24 (*Themeda avenacea* grassland on alluvial plains, basalt derived soils) were also identified in the pre-clearing RE mapping for the area. These areas have relevance for potential habitat for threatened species and were targeted during the field survey.

Table 10-11 Regional Ecosystems within the pipeline corridor (DERM, 2009b)

Regional Ecosystem	VM Act Status	Biodiversity Status	Short Description (EPA, 2007)
11.3.1	Endangered	Endangered	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains
11.3.2	Of concern	Of concern	*Eucalyptus populnea* woodland on alluvial plains
11.3.3	Of concern	Of concern	*Eucalyptus coolabah* woodland on alluvial plains
11.3.4	Of concern	Of concern	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains
11.3.14	Least Concern	No concern at present	*Eucalyptus spp., Angophora spp., Callitris spp.* woodland on alluvial plains.
11.3.21	Endangered	Endangered	*Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains. Cracking clay soils
11.3.25	Least Concern	Of concern	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines
11.3.26	Least Concern	No concern at present	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains.

Regional Ecosystem	VM Act Status	Biodiversity Status	Short Description (EPA, 2007)
11.5.1	Least Concern	No concern at present	*Eucalyptus crebra*, *Callitris glaucophylla*, *Angophora leiocarpa*, *Allocasuarina luehmannii* woodland on Cainozoic sand plains/remnant surfaces
11.5.1a	Least Concern	No concern at present	*Eucalyptus populnea* woodland with *Allocasuarina luehmannii* low tree layer.
11.5.4	Least Concern	No concern at present	*Eucalyptus crebra*, *Callitris glaucophylla*, *C. endlicheri*, *E. chloroclada*, *Angophora leiocarpa* on Cainozoic sand plains/remnant surfaces. Deep sands
11.5.21	Least Concern	No concern at present	*Corymbia bloxsomei* ± *Callitris glaucophylla* ± *Eucalyptus crebra* ± *Angophora leiocarpa* woodland on Cainozoic sand plains/remnant surfaces
11.7.2	Least Concern	No concern at present	*Acacia* spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone
11.7.4	Least Concern	No concern at present	*Eucalyptus decorticans* and/or *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp., *Lysicarpus angustifolius* on Cainozoic lateritic duricrust
11.7.5	Least Concern	No concern at present	*Eucalyptus decorticans* and/or *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp., *Lysicarpus angustifolius* on Cainozoic lateritic duricrust
11.7.6	Least Concern	No concern at present	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks
11.7.7	Least Concern	No concern at present	*Eucalyptus fibrosa* subsp. *nubila* ± *Corymbia* spp. ± *Eucalyptus* spp. on Cainozoic lateritic duricrust
11.9.2	Least Concern	No concern at present	*Eucalyptus melanophloia* ± *E. orgadophila* woodland on fine-grained sedimentary rocks
11.9.5	Endangered	Endangered	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks
11.9.5a	Endangered	Endangered	*Acacia harpophylla* predominates and forms a fairly continuous canopy (10-18m high). Other tree species such as *Eucalyptus populnea, Casuarina cristata, Cadellia pentastylis and Brachychiton spp.* may also be present in some areas and form part of the canopy or emerge above it. Scattered *Eucalyptus orgadophila* may occur, especially on upper slopes and crests. A dense tall shrub layer dominated by a range of species is usually present, while a more open low shrub layer often occurs. Common species in these layers include *Croton insularis, Denhamia oleaster, Apophyllum anomalum, Croton phebalioides, Alectryon diversifolius and Carissa ovata.* The ground layer is sparse, most frequently composed of *Ancistrachne uncinulata and Eragrostis megalosperma* and varies with the density of the shrub layers. Occurs on undulating plains and rises formed mainly on shales. The soils are predominantly cracking clay soils, which are strongly alkaline at or near the surface and acidic beneath, or dark brown and grey-brown gradational soils, with a coarse-textured surface grading into an alkaline, clayey subsoil.
11.9.6	Endangered	Endangered	*Acacia melvillei* ± *A. harpophylla* open forest on fine-grained sedimentary rocks
11.9.7	Of concern	Of concern	*Eucalyptus populnea*, *Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks
11.9.10	Of concern	Endangered	*Acacia harpophylla*, *Eucalyptus populnea* open forest on fine-grained sedimentary rocks
11.10.7	Least Concern	No concern at present	*Eucalyptus crebra* woodland on coarse-grained sedimentary rocks

EPBC Act listed communities

The Terms of Reference (ToR) and the EPBC Act Online Protected Matters database (DEWHA, 2010a) identified seven ecological communities regarded as threatened under the EPBC Act that may potentially occur within the study area:

- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin;
- Brigalow (*Acacia harpophylla* dominant and co-dominant);
- the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin (GAB discharge spring wetlands);
- semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions;
- Weeping Myall woodlands; and
- White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland.

Species of conservation significance

Higher precision records from Corveg (EPA, 2000), Wildnet (EPA, 2008c; EPA, 2010) and Herbrecs (EPA, 2005a; DERM, 2009a) provided the basis for determining the species likely to be encountered in the pipeline corridor. Providing a guide only was data from the EPBC Protected Matters Database (DEWHA, 2004; DEWHA, 2010a). Table 10-12 summarises threatened species identified in the database searches along with the habitat requirements of each species.

Table 10-12 Threatened species identified in the database search results

Species Name	Common Name	Status		Reference of Record	Habitat Description	Potential Habitat
		NC Act	EPBC Act			
Commersonia argentea			V	EPBC	Recorded from north of Chinchilla on stony ridges in eucalypt forest (Stanley and Ross, 1986). Species overlaps with the following EPBC Act listed threatened ecological communities: o Semi-evergreen vine thickets of Brigalow Belt (North and South) and Nandewar Bioregions; o The community of native species dependent on natural discharge of groundwater from the GAB; o Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin; o Brigalow (*Acacia harpophylla* dominant and co-dominant); and o White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Threatened Species Scientific Committee, 2008kk).	Eucalypt forest potentially supporting stony ridges north of Chinchilla may include REs 11.7.6, 11.5.21, 11.5.20, 11.7.7, 11.7.4, 11.5.1, 11.12.5, 11.12.3, 11.7.5 & 11.5.4
Diuris tricolor (Diuris sheaffiana)	Tricolour Diuris, Tricolour Donkey-Orchid, Spotted-throat Cowslip		V	W, EPBC	Occurs in eucalypt open forest (Stanley and Ross, 1989).	REs 11.8.2a, 11.8.8, 11.9.9a.
Dichanthium queenslandicum	King Blue Grass		V	EPBC	Known in the region from northern Darling Downs district on heavy black soils (Stanley and Ross, 1989).	Grassland REs including 11.9.12
Pterostylis cobarensis	Cobar Greenhood Orchid		V	W	A ground orchid found in dense forest (Stanley and Ross, 1989).	REs 11.3.1, 11.4.3, 11.9.1, 11.9.4, 11.9.5, 11.9.6, 11.8.2a, 11.8.8, 11.9.9a.

Species Name	Common Name	Status		Reference of Record	Habitat Description	Potential Habitat
		NC Act	EPBC Act			
Rutidosis lanata		E		W, H, W	Known from a few places in western Darling Downs district on red soils (Stanley and Ross, 1986).Occurs in Eucalypt and Acacia forests on red sand ridges and clay flats at 280 – 320 m altitude (QPWS, 2001).	RE 11.4.3
Digitaria porrecta	Finger Panic Grass	NT	E	EPBC, W	Occurs in Queensland and New South Wales. Finger panic grass can be found in native grasslands, woodlands or open forest with grassy understorey on richer soils. It is often found along roadsides and traveling stock routes where there is light grazing and occasional fire (DEC (NSW), 2005).	Grassland REs including 11.9.12
Homopholis belsonii		E	V	W, EPBC	Known from near Gurulmundi (Stanley and Ross, 1989). Occurs in elevated gently sloping areas on brown soil in poplar box/*Geijera parviflora* woodland (Queensland Herbarium, AQ 663509)	REs 11.3.1, 11.4.3, 11.9.1, 11.9.5, 11.9.6
Acacia handonis	Percy Grant Wattle	V	V	W	Occurs on low rounded hills with gentle slopes (QPWS, 2001).	REs 11.3.1, 11.4.3, 11.9.1, 11.9.5, 11.9.6 and within Barakula State Forest (DEWHA, 2008)
Acacia curranii	Curly Bark Wattle	V	V	W	Known from three separate areas including Gurulmundi in QLD. Occurs in dry sclerophyll forests and semi-arid woodlands. Distribution overlaps with the following EPBC Act listed communities: o Semi-evergreen vine thickets of Brigalow Belt (North and South) and Nandewar Bioregions; o Brigalow (*Acacia harpophylla* dominant and co-dominant); o White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grasslands; and	Habitat equates with REs 11.3.1, 11.4.3, 11.9.1, 11.9.4, 11.9.5 and 11.9.6

Species Name	Common Name	Status		Reference of Record	Habitat Description	Potential Habitat
		NC Act	EPBC Act			
					o Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions (Threatened Species Scientific Committee, 2008gt).	
Arthraxon hispidus	Hairy Joint Grass	V	V	W, EPBC	Found in the eastern parts of south-eastern Queensland, often in damp shady places (Stanley and Ross, 1989).	RE 11.3.27b
Cadellia pentastylis	Ooline	V	V	W	Occurs in Queensland and New South Wales. It grows in four main habitats. In Queensland it may be found as a tall emergent in semi-evergreen vine thickets, in pure stands or mixed communities on residual sandstone ranges and scarps (associated with Brigalow, *Acacia harpophylla*, and Belah, *Casuarina cristata*), or localised clumps among Brigalow-Belah communities on undulating clay plains and low hills (Leigh and Briggs, 1992).	REs 11.4.9, 11.5.15, 11.7.1, 11.9.4, 11.9.5, 11.9.11, 11.11.14 (NRMW)
Calytrix gurulmundensis	Gurulmundi Fringe Myrtle	V	V	W	Occurs on low laterised, sandstone ridges. The plant can form part of a dense shrub community. It has been recorded growing in Triodia-hummock grassland with scattered shrubs, and tall shrubland with sparse, stunted eucalypts, casuarinas and acacias (QPWS, 2001).	RE 11.7.7 (REDD)
Denhamia parviflora	Small-leaved Denhamia, Thorny Pea	V	V	W	Restricted to semi-evergreen vine thickets, vine scrubs and *Acacia harpophylla*- softwood scrub communities at elevations of 160to 560m. Associated with *Diosporos humilis, Flindersia australis, Geijera parviflora, Owenia venosa and Austromyrtus bidwillii* (QPWS, 2001).	REs 11.3.1, 11.4.3, 11.9.1, 11.9.4, 11.9.5, 11.9.6,
Eucalyptus argophloia	Qld Western White gum	V	V	W (bp)	Occurs on flat to undulating country from 300 to 340m altitude. Prefers deep, dark, heavy clays often with strong Gilgai development. Restricted to a small area north of Chinchilla in South East Queensland (QPWS,	RE 11.4.3b (REDD) and REs 11.3.1, 11.4.3, 11.9.1, 11.9.5, 11.9.6, 11.8.2a, 11.8.8, 11.9.9a

Species Name	Common Name	Status		Reference of Record	Habitat Description	Potential Habitat
		NC Act	EPBC Act			
					2001).	
Floydia praealta	Ball Nut	V	V	W	Restricted to east Australia from Clarence River NE NSW to near Gympie in southeast QLD. Occurs in riverine and lowland subtropical rainforest (QPWS, 2001).	
Homoranthus decumbens		V	V	W	Restricted to central (Blackdown Tableland) and southeast Queensland (north of Chinchilla). Found in tall shrubland or heath and has been recorded associated with *Goodenia racemosa, Petrophile sp, Xanthorrhoea spp and Banksia oblongifolia* (QPWS, 2001).	
Philotheca sporadica		V	V	W	This species is found on residual hills which are remnants of laterised Cretaceous sandstones. Soils are shallow uniform sandy loams to clay loams or shallow texture contrast soils with loamy surfaces and medium clay subsoils. Ironstone gravel is usually present. The soils on which this species grows are of extremely low fertility and poor physical condition (Dawson 1972). Vegetation consists primarily of low open forest of *Acacia burrowii, Eucalyptus exserta, E. crebra, E. fibrosa ssp. Nubila and Callitris glaucophylla* (DEWHA, 2008b).	REs 11.3.1, 11.4.3, 11.9.1, 11.9.5, 11.9.6, 11.8.2a, 11.8.8, 11.9.9a
Rhaponticum australe	Austral Cornflower	V	V	EPBC	Grows in woodland and grassland on heavy black or redbrown clay or clay loam. Often found on road sides and verges. Associated with species including *Eucalyptus crebra, E. orgadophila, E. populnea, E. tereticornis, E. melanophloia, Angophora subvelutina, A. floribunda, Cirsium vulgare, Dichanthium sericeum and Themeda triandra* (QPWS, 2001).	
Thesium australe	Toadflax	V	V	W, H	Occurs in Queensland, New South Wales and Tasmania. Found in grassland or grassy woodland, often found associated with Themeda australis (DEC (NSW), 2005).	REs 11.3.2, 11.3.21, 11.8.2, 11.8.5, 11.8.8 (NRMW)

Species Name	Common Name	Status		Reference of Record	Habitat Description	Potential Habitat
		NC Act	EPBC Act			
Eucalyptus pachycalyx subsp. waajensis		E		W	Restricted to southeast Queensland between Miles, Taroom and Eidsvold. Occurs on hillsides and ridge tops on shallow sandy soils. Grows in woodland communities associated with *Eucalyptus tenuipes, E. sideroxylon, E. corynodes, Corymbia watsoniana and C. petalophylla* (QPWS, 2001).	
Micromyrtus carinata	Gurulmundi Heath Myrtle	E		W	Occurs only in the Gurulmundi area (Hando, 1997).	
Micromyrtus patula	Waaje Micromyrtus	E		W	Known from only one patch growing on the rocky area near the Yellow Calytrix at Waaje (Hando, 1997).	
Solanum papaverifolium		E		W	Found in heavy black soils, often a weed of cultivation (Stanley and Ross, 1989).	Approximate location mapped in non-remnant vegetation
Acacia barakulensis		V		W	Found only in Waaje Wildflower area. Occurs in sandy soil with small Melaleuca spp. and bloodwood at Waaje Wildflower area in Barakula State Forest (Hando and Hando, 1997).	Within Barakula State Forest (Hando and Hando, 1997)
Cyperus clarus		V		W	Found in heavy soils (Stanley and Ross, 1989).	
Eucalyptus sideroxylon subsp.. (Waaje N.B.Byrnes 3955)		V		W	Occurs in Waaje Wildflower area in Barakula State Forest (Hando, 1997).	Within Barakula State Forest
Gonocarpus urceolatus		V		W	A small herb recorded near Chinchilla (Hando, 1997).	Approximate location mapped in polygons of REs 11.5.1, 11.5.1/11.7.7
Homoranthus papillatus	Mouse bush	V		W	Prefers sandy soils.	

Species Name	Common Name	Status		Reference of Record	Habitat Description	Potential Habitat
		NC Act	EPBC Act			
Myriophyllum variifolium		V		W	A water milfoil found in stagnant waters (Australian National Botanic Gardens, 2008).	
Picris barbarorum		V		W, H	Occurs on riverbanks and floodplains (Australian National Botanic Gardens, 2008).	Approximate location mapped in RE 11.3.2
Acacia tenuinervis	Scrub Wattle	NT		W	Occurs mainly on red earths with pure stands occurring on ridges. It also occurs in eucalypt scrub and forest and has been recorded with *Eucalyptus panda, E. crebra* and *E. populnea*. In the Chinchilla area it is common on roadsides. It has also been recorded in vegetation containing Acacia harpophylla (QPWS, 2001)	Approximate location mapped in polygons of RE 11.5.1/11.7.7
Apatophyllum teretifolium		NT		W	Grows on coarse sandy soils. Found in association with ironbarks (including *Eucalyptus virens*), narrow-leaved white mahogany, budgeroo, white cypress pine, black cypress pine, *Corymbia hendersonii*, brown bloodwood, *C. citriodora, Leucopogon grandiflorus* and rush leaf wattle (Santos, 2007).	
Bertya pedicellata		NT		W	Occurs in open and closed forests on rocky hills with shallow, skeletal or sandy soils (QPWS, 2001).	REs 11.5.15, 11.7.4, 11.8.4, 11.8.5, 11.10.3 (NRMW)
Eleocharis blakeana		NT		W	Occurs on plains and low undulating country on poorly drained, clayey soils. It grows in ephemerally wet habitats in melon hole country in *Acacia harpophylla* and *Casuarina cristata* communities. It has also been recorded in road side channels and in paddocks (QPWS, 2001).	RE 11.4.3
Eucalyptus curtisii	Plunkett mallee	NT		W, H	Occurs in mixed eucalypt forest where it prefers more open areas. Soils on which it occurs include sandy podosols with impeded drainage, shallow sandy soils, clay loams and stony clays with a surface layer of loose stones (QPWS, 2001).	Approximate location mapped in RE 11.7.6

Species Name	Common Name	Status		Reference of Record	Habitat Description	Potential Habitat
		NC Act	EPBC Act			
Fimbristylis vagans		NT		W	A sedge of wet sandy soil (Australian National Botanic Gardens, 2008).	RE 11.3.27d (REDD)
Melaleuca groveana		NT		W	Grows on ridges, high mountain slopes and summits. Generally occurs in heaths and eucalypt woodlands and forests with heath understoreys (QPWS, 2001).	

E= Endangered; V= Vulnerable; NT= Near Threatened

Reference abbreviations: W = Wildnet; H = Herbrecs database (EPA, 2005a; DERM, 2009a); Corveg = EPA (2000); EPBC = EPBC Protected Matters Search (the search polygon was defined by the following lines with a 300m buffer: -25.49083, 150.1327; -25.46672, 150.0341 and -26.81, 150.75; -25.26, 151.37); NMRW = NMRW (2008) Essential Habitat Mapping; and REDD = Regional Ecosystem Description Database (EPA, 2007).

10.1.4.2. Observed Regional Ecosystems

- Remnant Regional Ecosystems

A total of 25 REs were identified within the pipeline corridor. These are summarised in Table 10-13. Mapping of REs along the pipeline is included in Appendix 10-A. This mapping is at a scale of 1:10,000 presented at a scale of 1:40,000. One RE was mapped at a scale of 1:10,000 that was not previously mapped by the EPA (2005b); RE 11.4.3 - *Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains.

RE 11.9.2, previously mapped at a scale of 1:100,000 (EPA, 2005b) was not recorded at the finer scale of mapping. Semi-evergreen vine thicket (RE 11.9.4a) was not observed on the preferred route.

The bioregional extent and representation of significant REs in the pipeline corridor are listed in Appendix 10-C.

Table 10-13 Regional ecosystems within the pipeline corridor

Regional Ecosystems	Proportion (%) of REs in mixed polygons	VM Status	Biodiversity Status
11.3.1	100	Endangered	Endangered
11.3.2	100	Of concern	Of concern
11.3.14/11.5.21	50/50	Least concern	No concern at present
11.3.21	100	Endangered	Endangered
11.3.25	100	Least concern	Of concern
11.3.25/11.3.4	80/20	Of concern (sub)	Of concern
11.3.25/11.3.4	50/50	Of concern (sub)	Of concern
11.3.4	100	Of concern	Of concern
11.4.3	100	Endangered	Endangered
11.5.1	100	Least concern	No concern at present
11.5.1/11.7.7/11.7.5/11.7.2	85/5/5/5	Least concern	No concern at present
11.5.1a/11.5.1	50/50	Least concern	No concern at present
11.5.21	100	Least concern	No concern at present
11.5.21/11.5.4	60/40	Least concern	No concern at present
11.5.21/11.7.4/11.5.4	40/40/20	Least concern	No concern at present
11.5.4	100	Least concern	No concern at present
11.7.6	100	Least concern	No concern at present
11.7.4/11.7.7/11.7.5/11.7.2	80/10/5/5	Least concern	No concern at present
11.7.7/11.5.1	80/20	Least concern	No concern at present
11.7.7/11.7.2/11.5.1a/11.5.1	85/5/5/5	Least concern	No concern at present
11.9.5	100	Endangered	Endangered
11.9.6	100	Endangered	Endangered
11.9.7	100	Of concern	Of concern
11.9.7/11.9.10	50/50	Of concern	Endangered (sub)
11.9.10	100	Of concern	Endangered

Regional Ecosystems	Proportion (%) of REs in mixed polygons	VM Status	Biodiversity Status
11.10.7	100	Least concern	No concern at present
11.10.9/11.3.3	70/30	Of concern (sub)	No concern at present

- Non remnant vegetation

Non remnant vegetation is described in Appendix 10-B and shown on the RE mapping in Appendix 10-A. Irrespective of vegetation condition, some areas of non-remnant vegetation have biodiversity value. This is particularly the case for narrow strips of vegetation frequently associated with roadways. Narrow strips can still retain important values (as evident in the 12 m narrow patch of remnant RE 11.4.3 that supports the only recorded *Rutidosis lantana* population along the pipeline corridor) and they are often the only vegetation remaining in the broader landscape. The vegetation mapping completed for this study, supplemented by DERM RE and Regrowth Vegetation mapping, identified that 54% of vegetation within the pipeline corridor is non-remnant (Table 10-14).

Table 10-14 Extent of remnant and non-remnant vegetation within the pipeline corridor

Remnant Status	Pipeline corridor (ha)
Remnant REs	123.6
Non-remnant REs	146.5
% Non-remnant	54%

10.1.4.3. EPBC Act listed communities

The following vegetation communities found within the pipeline corridor are listed as threatened under the EPBC Act:

- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin; and
- Brigalow (*Acacia harpophylla* dominant and co-dominant).

Although the ToR made specific reference to the White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland it was not found in the pipeline corridor nor were the GAB spring wetlands, Weeping Myall woodlands or semi-evergreen vine thickets (SEVT).

Brigalow occurs throughout the pipeline corridor. Natural grasslands occur as a narrow linear patch of RE 11.3.21 within the roadside of the Warrego Highway at Macalister. SEVT occurs as a fragmented patch adjacent to the roadside of Nathan Road but not within the pipeline corridor.

10.1.4.4. Floristics

One hundred and sixty seven species were recorded from survey sites within the pipeline corridor.

10.1.4.5. Species of conservation significance

Literature review identified the potential for 37 threatened flora species to occur in the vicinity of the pipeline corridor. Baseline surveys identified four species listed under the NC Regulations within the pipeline corridor including *Acacia tenuinervis, Cryptandra ciliata, Livistona nitida* and *Rutidosis lantana*. The locations of these species as mapped during the field survey and previously by the EPA (2005a) are illustrated in Figure 10-10. The likelihood of occurrence of threatened flora species in the pipeline corridor is presented in Table 10-15.

Table 10-15 Likelihood of occurrence of threatened flora in the pipeline corridor

Likelihood of Occurrence	Species Name	Common Name	Status		Likelihood of Occurrence Explanatory Notes	Index of Confidence
			NC Act	EPBC Act		
Known	*Acacia tenuinervis*	Scrub Wattle	NT		Recorded within REs 11.10.7/11.9.5 at one location along pipeline corridor between dam wall site and Wandoan and has historically been recorded in RE 11.5.1/11.7.7. Likely to occur throughout the pipeline corridor in eucalypt scrub and forest on red earths including REs 11.5.1, 11.5.4, 11.5.21, 11.9.7, 11.9.10, 11.9.5, 11.9.6, 11.10.7.	High
Known	*Cryptandra ciliata*		NT		Recorded at two locations along pipeline corridor between Wandoan and Chinchilla within communities with a heath understorey dominated by *Corymbia bloxsomei* (RE 11.5.21).	High
Known	*Rutidosis lanata*		E		Recorded within RE 11.4.3 at one location along pipeline corridor between Wandoan and Chinchilla.	High
Known	*Livistona nitida*		NT		Recorded at one location along pipeline corridor in a non-remnant patch with *Eucalyptus populnea*.	High
Likely	*Acacia curranii*	Curly Bark Wattle	V	V	No survey records but potential habitat occurs within pipeline corridor.	Medium
Likely	*Bertya pedicellata*		NT		Essential habitat includes RE 11.7.4 which is mapped within the pipeline corridor.	Medium
Likely	*Gonocarpus urceolatus*		V		Survey records are located within the vicinity of the pipeline corridor.	High
Possible	*Apatophyllum teretifolium*		NT		Marginal habitat occurs within the pipeline corridor.	Medium
Possible	*Calytrix gurulmundensis*	Gurulmundi Fringe Myrtle	V	V	No survey records. Potential to occur in eucalypt associations to the north of Miles.	Medium
Possible	*Commersonia argentea*			V	No survey records. Potential to occur in eucalypt associations to the north of Miles.	Medium
Possible	*Cyperus clarus*		V		As the pipeline route avoids remnant and disturbed grasslands it is unlikely that this species would be	Medium

Likelihood of Occurrence	Species Name	Common Name	Status		Likelihood of Occurrence Explanatory Notes	Index of Confidence
			NC Act	EPBC Act		
					encountered.	
Possible	*Denhamia parviflora*	Small-leaved Denhamia, Thorny Pea	V	V	Although the pipeline avoids softwood scrub communities some vine forest species occur in association with Brigalow communities.	Medium
Possible	*Digitaria porrecta*	Finger Panic Grass	NT	E	Mapped within grassland ecosystems including RE 11.9.12 which occurs within the pipeline corridor.	Medium
Possible	*Diuris tricolor (Diuris sheaffiana)*	Tricolour Diuris, Tricolour Donkey-Orchid, Spotted-throat Cowslip	C	V	No survey records. Potential to occur in eucalypt associations to the north of Miles.	Medium
Possible	*Eleocharis blakeana*		NT		Some potential to occur in areas 11.4.3.	Medium
Possible	*Eucalyptus curtisii*	Plunkett Mallee	NT		No survey records. Potential to occur in eucalypt associations to the north of Miles.	High
Possible	*Eucalyptus pachycalyx subsp. waajensis*		E		No survey records. Potential to occur in eucalypt associations to the north of Miles.	Medium
Possible	*Homopholis belsonii*		E	V	No survey records. Potential to occur In road reserves under Brigalow. The proposed pipeline alignment largely avoids all Brigalow associations.	Medium
Possible	*Homoranthus papillatus*	Mouse Bush	V		No survey records. Potential to occur in eucalypt associations to the north of Miles.	Medium
Possible	*Micromyrtus carinata*	Gurulmundi Heath Myrtle	E		No survey records. Potential to occur in eucalypt associations to the north of Miles.	Medium
Possible	*Micromyrtus patula*	Waaje Micromyrtus	E		No survey records. Potential to occur in eucalypt associations to the north of Miles.	Medium
Possible	*Philotheca sporadica*		V	V	No survey records. Potential to occur in eucalypt associations to the north of Miles.	Medium

Likelihood of Occurrence	Species Name	Common Name	Status		Likelihood of Occurrence Explanatory Notes	Index of Confidence
			NC Act	EPBC Act		
Possible	*Pterostylis cobarensis*	Cobar Greenhood Orchid	C	V	No survey records. Potential to occur in eucalypt associations to the north of Miles.	Medium
Possible	*Solanum papaverifolium*		E		Database record mapped in non-remnant vegetation. Potential to occur in non remnant vegetation within pipeline corridor.	Medium
Unlikely	*Acacia barakulensis*		V		No survey records. The restricted distribution of this species limits the likelihood that it would be encountered within the pipeline corridor.	Medium
Unlikely	*Acacia handonis*	Percy Grant Wattle	V	V	Known only from Barakula State Forest.	Medium
Unlikely	*Arthraxon hispidus*	Hairy Joint Grass	V	V	No survey records. Suitable habitat absent from pipeline corridor.	Medium
Unlikely	*Cadellia pentastylis*	Ooline	V	V	Suitable habitat does not occur within the pipeline corridor.	Medium
Unlikely	*Dichanthium queenslandicum*	King Blue Grass		V	As the alignment avoids remnant and disturbed grasslands it is unlikely that this species would be encountered.	Medium
Unlikely	*Eucalyptus argophloia*	Qld Western White Gum	V	V	No survey records. Has a restricted distribution in a small to the north of Chinchilla.	Medium
Unlikely	*Fimbristylis vagans*		NT		No survey records. Suitable habitat absent from pipeline corridor.	Medium
Unlikely	*Floydia praealta*	Ball Nut	V	V	No survey records. Suitable habitat absent from pipeline corridor.	Medium
Unlikely	*Homoranthus decumbens*		V	V	Specific habitat requirements do not occur in the study area.	Medium
Unlikely	*Melaleuca groveana*		NT		No survey records. Potential to occur in eucalypt associations to the north of Miles although preferred habitat including exposed areas at high elevations, on rocky outcrops and cliffs is not present.	Medium
Unlikely	*Myriophyllum variifolium*		V		No survey records. Suitable habitat absent from pipeline corridor.	Medium

Likelihood of Occurrence	Species Name	Common Name	Status		Likelihood of Occurrence Explanatory Notes	Index of Confidence
			NC Act	EPBC Act		
Unlikely	*Picris barbarorum*		V		Recorded in grasslands located outside of, but in proximity to, the pipeline alignment. As the alignment avoids remnant and disturbed grasslands it is unlikely that this species would be encountered.	High
Unlikely	*Rhaponticum australe*	Austral Cornflower	V	V	As the alignment avoids remnant and disturbed grasslands it is unlikely that this species would be encountered.	Medium
Unlikely	*Thesium australe*	Toadflax	V	V	Recorded in grasslands located outside of, but in proximity to, the pipeline alignment. As the alignment avoids remnant and disturbed grasslands it is unlikely that this species would be encountered.	High
Unlikely	*Eucalyptus sideroxylon subsp.. (Waaje N.B.Byrnes 3955)*		V		No survey records. Has a restricted distribution within Barakula State Forest.	Medium

E= Endangered; V= Vulnerable; NT= Near Threatened.

Species identified as possible or likely to occur in the pipeline corridor were actively searched out during field surveys. Although none were recorded in survey plots or areas searched by foot, this does not discount their potential presence as indicated by the REs and/or habitat requirements.

Three species regarded as non-EVR priority taxa by the EPA's flora expert panel (EPA, 2008d) were identified within the pipeline corridor. These are *Acacia melvillei, Acacia omalophylla* and *Corymbia bloxsomei.*

10.1.4.6. Species of cultural significance

Based on Chenoweth's experience the species listed in Table 10-16 may have been historically used as food or for materials and were recorded within the pipeline corridor.

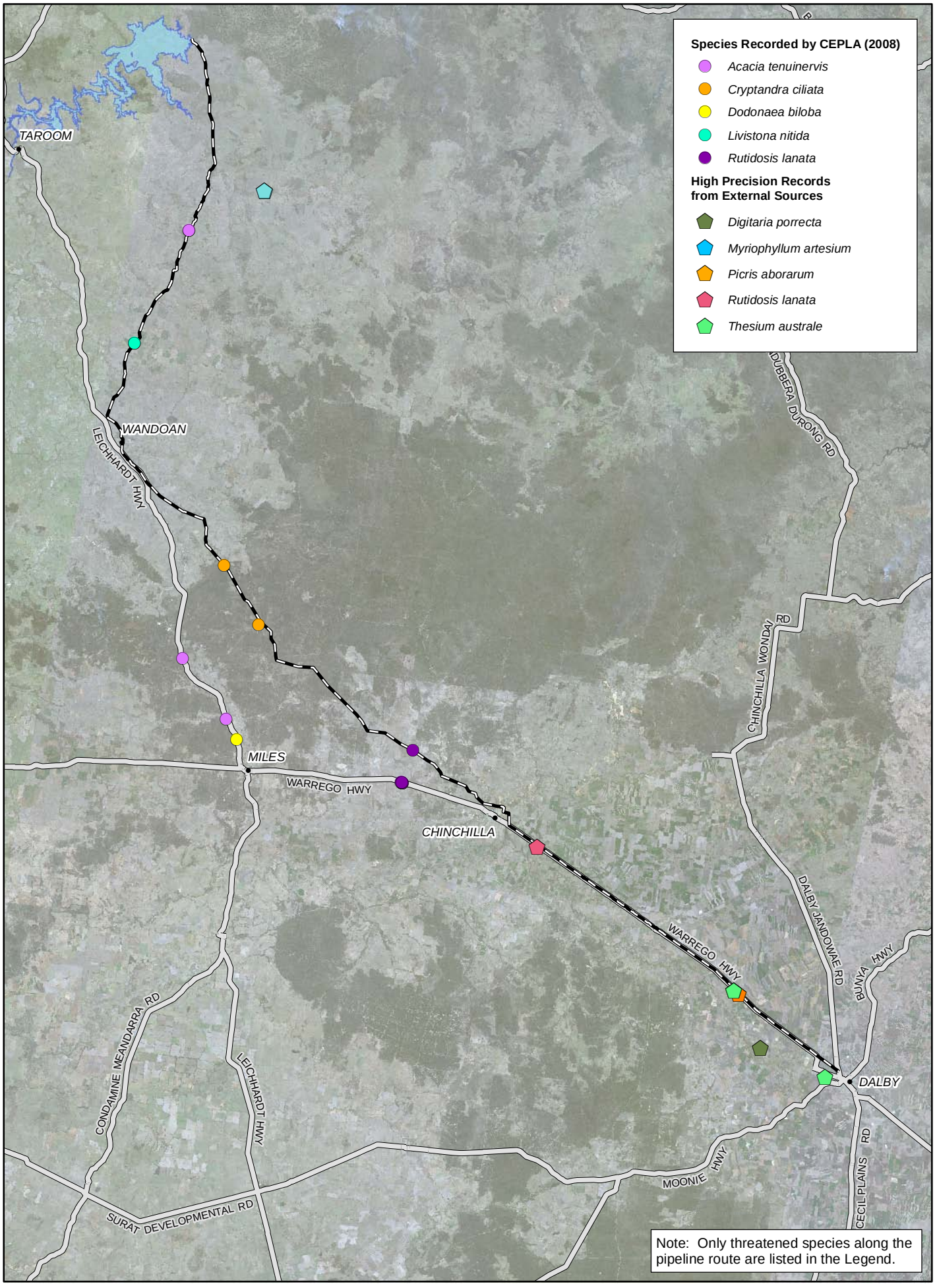
Table 10-16 Species of cultural significance within the pipeline corridor

Species Name	Common name	Family
Acacia harpophylla	Brigalow	Mimosaceae
Acacia oswaldii		Mimosaceae
Acacia salicina	Sally Wattle	Mimosaceae
Alectryon diversifolius	Scrub Boonaree	Sapindaceae
Alphitonia excelsa	Red Ash	Casuarinaceae
Alstonia constricta	Quinine Bush	Apocynaceae
Brachychiton populneus	Kurrajong	Sterculiaceae
Brachychiton rupestris	Bottle Tree	Sterculiaceae
Brunoniella australis	Blue Trumpet	Acanthaceae
Carissa ovata	Currant Bush	Apocynaceae
Citrus glauca	Limebush	Rutaceae
Clematicissus opaca	Slender Grape	Vitaceae
Eremophila debilis	Winter Apple	Myoporaceae
Eremophila mitchellii	False Sandalwood	Myoporaceae
Grevillea striata	Beefwood	Proteaceae
Lomandra longifolia	Spinyhead Matrush	Lomandraceae
Marsilea drummondii	Nardoo	Marsileaceae
Pittosporum phylliraeoides	Weeping Pittosporum	Pittosporaceae
Portulaca oleracea	Pigweed	Portulacaceae
Psydrax odorata		Rubiaceae
Santalum lanceolatum	Sandelwood	Santalaceae
Tetragonia tetragonioides	New Zealand Spinach	Aizoaceae

10.1.4.7. Species of recreational significance

Much of the area around Miles is renowned for its wildflowers which are celebrated in September each year at the Miles Wildlflower Festival. The Leichhardt Highway north from Miles through to the Gurulmundi Road turnoff (Murilla Shire Council, 2004) has been identified as a Wildflower circuit in the Miles Self Drive Tours publication. Along the pipeline from north of Miles to near the Gurulmundi turnoff are a number of Queensland Department of Main Roads Significant Environmental Areas, most likely for the purpose of delineating this important wildflower area. These areas are located along the highway near Miles and are not located within the pipeline corridor.

Although some of the species and ecosystems may not necessarily be significant from a legislative perspective, they are nonetheless important from an aesthetic sense and consequently possibly important to the local economy, and have significant biodiversity value.



LEGEND

- Towns
- Pipeline Route
- State Controlled Roads
- Full Supply Level (183.5m AHD)

Projection: GDA94 Zone 56

Figure 10-10

0 5 10 20
Kilometres

N

Scale 1:900,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Location of threatened flora species in the pipeline corridor

10.1.4.8. Weeds

Databases also provided the opportunity to identify exotic species likely to occur in the pipeline corridor. A review of species lists and consultation with Local Government pest protection officers identified that four declared weeds potentially occur in the pipeline corridor, all of which are listed as Class 2 pests under the LP Act. These were encountered during the field surveys (Table 10-17). None of these are Weeds of National Significance.

Table 10-17 Declared weeds recorded within the pipeline corridor

Species	Common Name	LP Act Status	Sites
Lycium ferocissimum	African Boxthorn	Class 2	PW45
Bryophyllum delagoense	Mother of Millions	Class 2	PW24
Opuntia stricta var. *stricta*	Prickly Pear	Class 2	
Opuntia tomentosa	Velvety Tree Pear	Class 2	DF T12, PW29, PW24

Opuntia species was frequently encountered in survey plots; however, it was not recorded as a dominant species in any site. Mother of Millions frequently appeared to have been subject to recent herbicide treatment, however, it is also possible that the condition of the plants could be attributed to the presence of the South African Citrus Mite in the area (pers. comm. Clark, 2008). Significantly, no Parthenium was recorded at any of the sites inspected.

10.1.4.9. Vegetation condition

With the exception of a virtually continuous (approximately 33 km) tract of vegetation located approximately 32 km to the southeast of Wandoan and 30 km to the northwest of Chinchilla, much of the vegetation on the pipeline is highly modified. Scattered patches of vegetation are present incorporating remnant trees and areas of regrowth. Some of these patches are regarded as remnant REs given canopy structure. In total, 54% of the vegetation mapped is non-remnant vegetation.

The same 4 point scale as applied to the dam study area was utilised for the pipeline corridor. Good quality vegetation (ranked 1) is common between the dam FSL and Wandoan. Areas of vegetation condition rank 3 (non-remnant vegetation in patches greater than 2 ha) are also common along this portion of the pipeline corridor. Crop land (not rated on the 4 point scale) is common between Dalby and Chinchilla. The ranking level of vegetation is presented in the secondary and tertiary site data in Appendix 10-B.

10.1.4.10. Cultivation

Areas supporting horticultural crops in proximity to the pipeline are illustrated in Appendix 10-A. These largely occur on more fertile ground between Chinchilla and Dalby. During the time of the field survey most cropping land was dedicated to cotton production.

10.1.4.11. Timber resources

The volume of potential timber resource within each RE is shown in Table 10-18. The main species identified in this assessment include *Eucalyptus crebra, E. populnea, E. camaldulensis, E. cambageana, E. tereticornis, E. coolabah, E. fibrosa subsp. nubila, E. moluccana, Angophora floribunda, Dodonaea viscosa, Geijera salicifolia, G. parviflora, Alphitonia excelsa, Brachychiton populneus, Acacia excelsa, A. harpophylla, A. pendula, Alectryon diversifolius, A. oleifolius, Allocasuarina luehmannii, Alstonia constricta, Apophyllum anomalum, Casuarina cristata, Callitris endlicheri, Callitris glaucophylla, Carissa ovata, C. clarksoniana, C. tessellaris, Elaeodendron australe, Lysiphyllum carronii, Psydrax johnsonii* and *Eremophila mitchellii*. Although considered as suitable timber resources in Lazarides & Hince (1993), with the exception of the Eucalypts and Corymbias, most species listed above would only be suitable for fence posts or minor wood work applications. Most of the timber resources occur to the north of Miles to the edge of the Great Dividing Range.

Table 10-18 Timber volume estimates for the pipeline corridor

Regional Ecosystem	Volume (m^3)
11.3.1	74.2
11.3.2	788.3
11.3.3	3.4
11.3.4	158.0
11.3.14	130.9
11.3.21	N/A - grassland
11.3.25	363.7
11.4.3	0.6
11.5.1	1058.9
11.5.1a	4.2
11.5.4	2271.1
11.5.21	306.6
11.7.2	60.5
11.7.4	1117
11.7.5	12.7
11.7.6	137.9
11.7.7	705.5
11.9.4a	0.6
11.9.5	88.6
11.9.6	93.1
11.9.7	352.4
11.9.10	21.4
11.10.7	88.8
11.10.9	11.2
Non-remnant	4458.2
TOTAL	**12307.8**

10.1.5. Associated infrastructure

10.1.5.1. Remnant Regional Ecosystems

A number of road upgrades are proposed in association with the dam. Road upgrades will take place on Bend Road, Brodies Road, Bundulla Road, Southern Recreation Area Access Road, Glebe Weir Road, and Cracow Road (Chapter 2). These are largely located within the dam study area but where they are not, the DERM RE mapping was used. Eleven REs were recorded at a scale of 1:10,000 or 1:100,000 within the road upgrades for Glebe Weir Road and Cracow Road (Table 10-19). The others (Bend Road, Brodies Road, Bundulla Road and Southern Recreation Area Access Road) will not impact on any REs.

The potential clay borrow areas are located within the water storage (Section 10.1.3). The recreation areas are located within the dam study area and will be sited on existing cleared areas.

The bioregional extent and representation of significant REs in the road upgrades are listed in Appendix 10-C.

Table 10-19 Remnant regional ecosystems mapped at a scale of 1:10,000 within road upgrades

Regional Ecosystem	VMA Status	Biodiversity Status	Short Description (EPA, 2007)	Source
11.3.2	Of concern	Of concern	*Eucalyptus populnea* woodland on alluvial plains	CEPLA, DERM
11.3.3	Of Concern	Of concern	*Eucalyptus coolabah* woodland on alluvial plains	CEPLA
11.3.4	Of concern	Of concern	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains	CEPLA
11.3.25	Least Concern	Of concern	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	CEPLA, DERM
11.3.39	Least Concern	No concern at present	*Eucalyptus melanophloia* ± *E. chloroclada* open-woodland on undulating plains and valleys with sandy soils	CEPLA, DERM
11.9.5	Endangered	Endangered	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	*CEPLA*
11.9.5a	Endangered	Endangered	*Acacia harpophylla* predominates and forms a fairly continuous canopy (10-18m high).	*CEPLA*
11.9.7	Of Concern	Of concern	*Eucalyptus populnea*, *Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	*CEPLA, DERM*
11.9.10	Of Concern	Endangered	*Acacia harpophylla*, *Eucalyptus populnea* open forest on fine-grained sedimentary rocks	*CEPLA, DERM*
11.10.7	Least Concern	No concern at present	*Eucalyptus crebra* woodland on coarse-grained sedimentary rocks	*CEPLA*
11.10.7a	Least Concern	No concern at present	*Eucalyptus crebra* ± *Callitris glaucophylla* ± *Angophora leiocarpa* ± *Eucalyptus* spp woodland.	*CEPLA*

Regional Ecosystem	VMA Status	Biodiversity Status	Short Description (EPA, 2007)	Source
11.10.9	Least Concern	No concern at present	*Callitris glaucophylla* woodland on coarse-grained sedimentary rocks	*CEPLA, DERM*
11.10.11	Least Concern	No concern at present	*Eucalyptus populnea, E. melanophloia +/- Callitris glaucophylla woodland on coarse-grained sedimentary rocks*	*DERM*

CEPLA = Chenoweth RE mapping (2008)

DERM = Department of Environment and Resource Management RE mapping (2010)

10.1.5.2. EPBC Act listed communities

Brigalow (*Acacia harpophylla* dominant and co-dominant) associated with REs 11.9.5, 11.9.5a and 11.9.10 and is recorded within the road upgrade areas (Figure 10-7). There are no GAB discharge spring wetlands located within the road upgrade areas.

10.1.5.3. Species of conservation significance

No threatened flora species have been recorded within the road upgrade areas. As the vegetation types are largely the same as those mapped within the dam impact area, the likelihood of occurrence of threatened flora species for dam impact area also applies to associated infrastructure (Table 10-6).

10.1.5.4. Species of cultural significance

As the vegetation types are largely the same as those mapped within the dam impact area, the occurrence of species of cultural significance for the dam study area also applies to associated infrastructure (Table 10-7).

10.1.5.5. Weeds

As the road upgrade areas are largely located within the dam study area, the declared weeds recorded in the dam study area also applies to the associated infrastructure (Table 10-8).

10.1.5.6. Timber resources

The volume of potential timber resource within each RE impacted by the road upgrades is shown in Table 10-20.

Table 10-20 Timber volume estimates for the road upgrades

Regional Ecosystems	Volume (m^3)
11.3.2	212.6
11.3.3	4.8
11.3.4	801.8
11.3.22	0.9
11.3.25	145.9
11.3.39	92.1

Regional Ecosystems	Volume (m^3)
11.9.5	19.2
11.9.5a	9.0
11.9.7	38.5
11.9.10	20.4
11.10.7	37.4
11.10.7a	15.8
11.10.9	573.2
11.10.11	39.7
Non-remnant	706.6
TOTAL	**2717.9**

10.2. Potential impacts and mitigation measures

This section addresses section addresses Section 3.3.2.2 of the ToR, describing the potential impacts of construction and operation of the Project, including the dam, pipeline and associated infrastructure, and measures to mitigate these impacts on terrestrial flora. Where measures to mitigate impacts are insufficient, offsets have been proposed.

10.2.1. Dam and surrounds

The aspects of the dam construction and operation that have the potential to impact on terrestrial flora and habitat include:

- Clearing of vegetation for the dam wall and related infrastructure including spillway, saddle dam, intake and outlet works, fishway and turtle way and diversion works;
- clearing of vegetation within the water storage;
- groundwater fluctuations (drawdown during dam wall construction, and increased pressure from inundation of the FSL);
- operation of the dam including permanent inundation of the FSL, allowance of flood and environmental flows, maintenance work (i.e. slashing of grassed areas) and recreational use; and
- water level fluctuations within the water storage, including temporary inundation of the flood margin.

The loss of vegetation from both clearing and permanent inundation has been assessed collectively under construction impacts.

10.2.1.1. Loss of vegetation

- Construction

Construction of the dam will require the clearing and/or inundation of both remnant and non-remnant vegetation within the dam construction footprint and water storage. The extent and class of REs impacted are listed in Table 10-21 and illustrated in Figure 10-5.

Habitat within the landscape of the dam study area is highly fragmented from historic vegetation clearing for grazing and agricultural uses. Fragmentation results in a loss of connectivity impacting on floristic dispersal through the landscape. Fragmentation impacts will occur as a result of clearing the dam construction footprint. When construction is complete much of the site will be rehabilitated with native vegetation to recreate the original community. Some residual impact will be evident because of the presence of the dam wall and associated infrastructure.

With respect to the loss of the east west corridor within the water storage, the vegetation clearing strategy will aim to minimise the impacts of fragmentation along the Dawson River to some extent by not clearing riparian vegetation within 1.5 m vertical below FSL. While it is assumed this vegetation will eventually die when the dam reaches FSL for an extended period, if the dam does not fill in the short term, it provides an opportunity for the revegetation strategy to create effective habitat. The only way to effectively mitigate this impact will be to re-establish the riparian corridor. This will be achieved by rehabilitation and management of non-remnant habitat on land parcels surrounding the water storage. The rehabilitation work will enhance connectivity between areas of remaining vegetation, aid natural regeneration (i.e. filling gaps), and improve habitat quality through weed and feral animal control, fire management and exclusion of cattle grazing in critical areas.

The dam construction footprint and water storage will not impact on the larger and higher value habitat patches at Nathan Gorge (Precipice National Park), Spring Creek and Taroom Town Common.

The Project will result in the loss of approximately 3655 ha of remnant vegetation (assuming islands lost as a result of fragmentation) and 342 ha of non-remnant vegetation. Of the remnant total area, 128.2 ha is classed as Endangered REs, 1777.9 ha Of Concern REs and 1727.7 ha Least Concern REs under the VM Act. With the retention of remnant vegetation on islands created by inundation, the total area of remnant vegetation impacted will decrease to 3582 ha. The Brigalow (*Acacia harpophylla* dominant and co-dominant) listed threatened ecological community was also impacted.

These are addressed in Section 10.2.1.2.

Table 10-21 Areas of Regional Ecosystems impacted by the dam

Regional Ecosystem	Short Descriptions	VM Status	Biodiversity Status	Water storage (ha)	Dam Construction Footprint (ha)	Total
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	Endangered	Endangered	61.9	0	61.9
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Of concern	Of concern	473.6	0	473.6
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	Of concern	Of concern	1029.1	6.64	1035.7
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains	Of concern	Of concern	141.8	23.48	165.3
11.3.19	*Callitris glaucophylla*, *Corymbia* spp. and/or *Eucalyptus melanophloia* open-forest to woodland on Cainozoic alluvial plains	Least concern	No concern at present	4.9	0	4.9
11.3.22	Springs. Associated with recent alluvia, but also including those	Of concern	Endangered	17.4	0	17.4

Regional Ecosystem	Short Descriptions	VM Status	Biodiversity Status	Water storage (ha)	Dam Construction Footprint (ha)	Total
	on fine-grained sedimentary rocks (shale), basalt, ancient alluvia and metamorphic rocks.					
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Least concern	Of concern	1587	0.62	1587.6
11.3.27	Freshwater wetlands	Least concern	Of concern	5.5	0	5.5
11.9.1	*Acacia harpophylla-Eucalyptus cambageana* open forest to woodland on fine-grained sedimentary rocks	Endangered	Endangered	34.7	2.18	36.9
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	Endangered	Endangered	24.7	0	24.7
11.9.5a	*Acacia harpophylla* predominates and forms a fairly continuous canopy (10-18m high). Other tree species such as *Eucalyptus populnea, Casuarina cristata, Cadellia pentastylis and Brachychiton spp.* may also be present in some areas and form part of the canopy or emerge above it	Endangered	Endangered	4.5	0	4.5
11.9.7	*Eucalyptus populnea*, *Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	Of concern	Of concern	32.9	0	32.9
11.9.10	*Acacia harpophylla*, *Eucalyptus populnea* open forest on fine-grained sedimentary rocks	Of concern	Endangered	58.5	0	58.5
11.10.7	*Eucalyptus crebra* woodland on coarse-grained sedimentary rocks	Least concern	No concern at present	22.1	12.92	35.
11.10.7a	*Eucalyptus crebra* ± *Callitris glaucophylla* ± *Angophora leiocarpa* ± *Eucalyptus* spp Woodland. *Eucalyptus crebra* predominates and forms a distinct but discontinuous canopy (16-20 m high). In places, *Angophora leiocarpa* forms part of the canopy. The low tree layer (12-16 m high) is dominated by *Callitris glaucophylla*. Scattered tall and low shrubs may be present. The ground layer is open to dense, and dominated by perennial grasses, usually *Aristida* spp. or *Themeda triandra*.	Least concern	No concern at present	3.6	11.65	15.3
11.10.9	*Callitris glaucophylla* woodland on coarse-grained sedimentary rocks	Least concern	No concern at present	51.7	43.87	95.6
Total Remnant REs (with islands)				3553.6	101.37	3655

Regional Ecosystem	Short Descriptions	VM Status	Biodiversity Status	Water storage (ha)	Dam Construction Footprint (ha)	Total
Total Remnant REs (without islands)				3451.6	101.37	3553
Total Non-Remnant REs				341.6	341.6	341.6
TOTAL				**3895.2**	**442.97**	**3996.57**
Total Endangered REs (VM Status)				126	2.18	128.2
Total Of Concern REs (VM Status)				1769	30.12	1799.1
Total Least Concern REs (VM Status)				1658.6	69.07	1727.7
Total remnant Brigalow community (REs 11.3.1, 11.9.1, 11.9.5 & 11.9.5a)				125.7	2.2	127.9
Total regrowth Brigalow community REs (11.3.1, 11.9.1, 11.9.5 & 11.9.5a)				72.7		72.7

* The total area of REs within the water storage has been calculated, however a number of islands will remain totalling 100.3 ha of remnant vegetation.

The Project involves both permanent inundation to FSL (water storage) and temporary inundation (flood margin). All tree and shrub vegetation within the water storage will be cleared, except in the riparian zone of the Dawson River and tributaries which will be cleared to within 1.5 m of the FSL and clearly marked to this line. However, it is assumed that this vegetation left in place will eventually die due to inundation, although it may take some time to die, depending on the rate of filling of the dam. In addition, several islands will be created by the water storage. The islands will not be cleared and will be re-vegetated if necessary and designated for nature conservation. However, there is approximately 102 ha of remnant vegetation that will be maintained on the islands.

Section 2.4.1.4 provides procedures for vegetation clearing and fauna relocation. Vegetation clearing will be staged, commencing with the area required for construction works. The remainder will be cleared progressively until the water storage is ready to fill.

Millable timber, or timber suited to artisans will be sold (via DERM Forest Products) and as much of the remaining suitable material as practicable will be mulched for use in construction site rehabilitation, landscaping of recreational facilities or made available for potential use in regional rehabilitation schemes.

Approval for clearing native vegetation is required under the VM Act, NC Act and possibly the EPBC Act. Clearing associated with the Project will be for a relevant purpose under section 22a of the VM Act, that is a declared significant project under the *State Development and Public Works Organisation Act 1971* (SDPWO Act). The clearing application for the Project will address the performance requirements in Part S of the Regional Vegetation Management Code (RVMC) for Brigalow Belt and New England Tablelands Bioregions. Elements of the proposed clearing will be subject to the provisions of the *Queensland Government Environmental Offset Policy* (QGEOP) (EPA, 2008) and the specific-issue *Policy for Vegetation Management Offsets* (DERM, 2009) including provision for limiting clearing and minimising impacts on watercourses, connectivity, soil erosion, salinity, endangered and of concern REs, essential habitat and threshold REs. The Project design and vegetation clearing strategy seeks to minimise vegetation loss as far as practicable. The unavoidable loss of vegetation will be offset as part of the Project's Environmental Offset Strategy (Section 10.4).

GAB springs

There are a number of GAB spring communities in the dam study area classified as recharge springs. These are not listed under the EPBC Act, however, a number of them correspond to RE 11.3.22, which has a VM Status of Of Concern and an Endangered Biodiversity status.

There are 83 mapped springs within the immediate vicinity of the Water Storage and 28 of these within 2 spring complexes (Boggomoss and Dawson River) will be flooded at FSL (Figure 10-11). This represents 10.5% of springs in the Springsure group and 1.3% and active springs nationally.

During dam construction 21springs will be affected by temporary (approximately 50 days) groundwater level drawdown as a result of dewatering for construction purposes (Figure 10-11). Springs potentially affected by drawdown will be monitored and if necessary irrigated to keep moisture levels adequate. Monitoring will include abiotic (moisture and water level) and biotic factors (water stress of plants).

Table 10-22 GAB springs affected by temporary drawdown during dam construction

Impact Area	RE	Object ID	Total
Surrounding dam construction footprint	11.3.22	34,35,36,45-51,69	11
	11.3.4 or Non-Remnant	B13, B12, B11, B17, B16, B14, B10, B9, B8, B7	10
			21

- Operation

The loss of vegetation from inundation to FSL has been discussed collectively with the construction impacts in Section 10.2.1.1. Operation of the dam also involves occasional inundation of the flood margin. Given the temporary and infrequent nature of these flood events (Chapter 14), impacts on terrestrial flora are not considered to be significant and vegetation will not be cleared in this area. While vegetation may suffer damage from temporary flooding these communities are considered to have high recovery potential.

Operation of the dam will also alter the flow regime downstream which has the potential to affect the riparian environment. Adoption of low flow release strategies will increase low flows relative to current levels and move towards the natural situation. This will maintain water levels downstream which in turn are expected to maintain riparian vegetation. Long-term monitoring of downstream riparian habitat however will be undertaken for the Boggomoss Snail to confirm these predictions. Should decreases in riparian health be observed then remedial measures will be developed, possibly including alterations to the operational flow regime (Section 11.2.1.1).

Based on the outputs of the groundwater modelling (Chapter 15), 41 springs outside the FSL (Figure 10-12) will be subject to increased groundwater pressure in the Precipice and Hutton sandstones resulting in increased groundwater flow rates by 94% for springs fed from the Precipice sandstone (20) and >100% for springs fed from the Hutton sandstone. This is likely to cause an increase in the size of wetland areas and it is highly likely that new springs will be created outside the FSL. This is not listed as a threat in the Recovery Plan (Fensham *et al*., 2010) though enhancing flows and increasing weltand area is a plan objective. Whether this increase will match the area lost via inundation cannot be estimated with certainty.

Long term monitoring of the biological condition of the springs will assist with understanding the impacts of the increased flow on terrestrial flora and fauna.

Table 10-23 GAB springs affected by increased groundwater pressure and flow

Impact Area	RE	Object ID	Total
Nathan Gorge	11.10.14	1,5, 6, 7, 8,9, 10, 15, 16, 17, 18, 20, 22, 23,24, 26, 27, 28, 34, 35, 38, 39, 40, 41, 45, 46, 47, 48, 49, 50, 51, 52, 55, 56, 57, 58, 60, 62, 67, 68, 69	41
	11.10.14 or 11.3.22	B7, B8, B9, B10, B11, B12, B13, B14, B15, B16, B17	11

Increases in groundwater pressure in the Precipice and Hutton sandstones when the dam is at FSL may also have some impact on the existing eucalypt forests and woodlands that are scattered around the water storage as indicated in Figure 10-12. There is a modelled increase in potentiometric surface of 10-15 m around the water storage when the storage is full. It is unknown if this is likely to temporarily intercept surrounding forest and woodland communities root zones however REs associated with land zone 3 are resilient and adapted to temporary flooding and are unlikely to be impacted. The same is true of *Eucalyptus populnea, Brigalow* dominated woodlands and associated regrowth that dominate the vegetation communities surrounding the water storage.

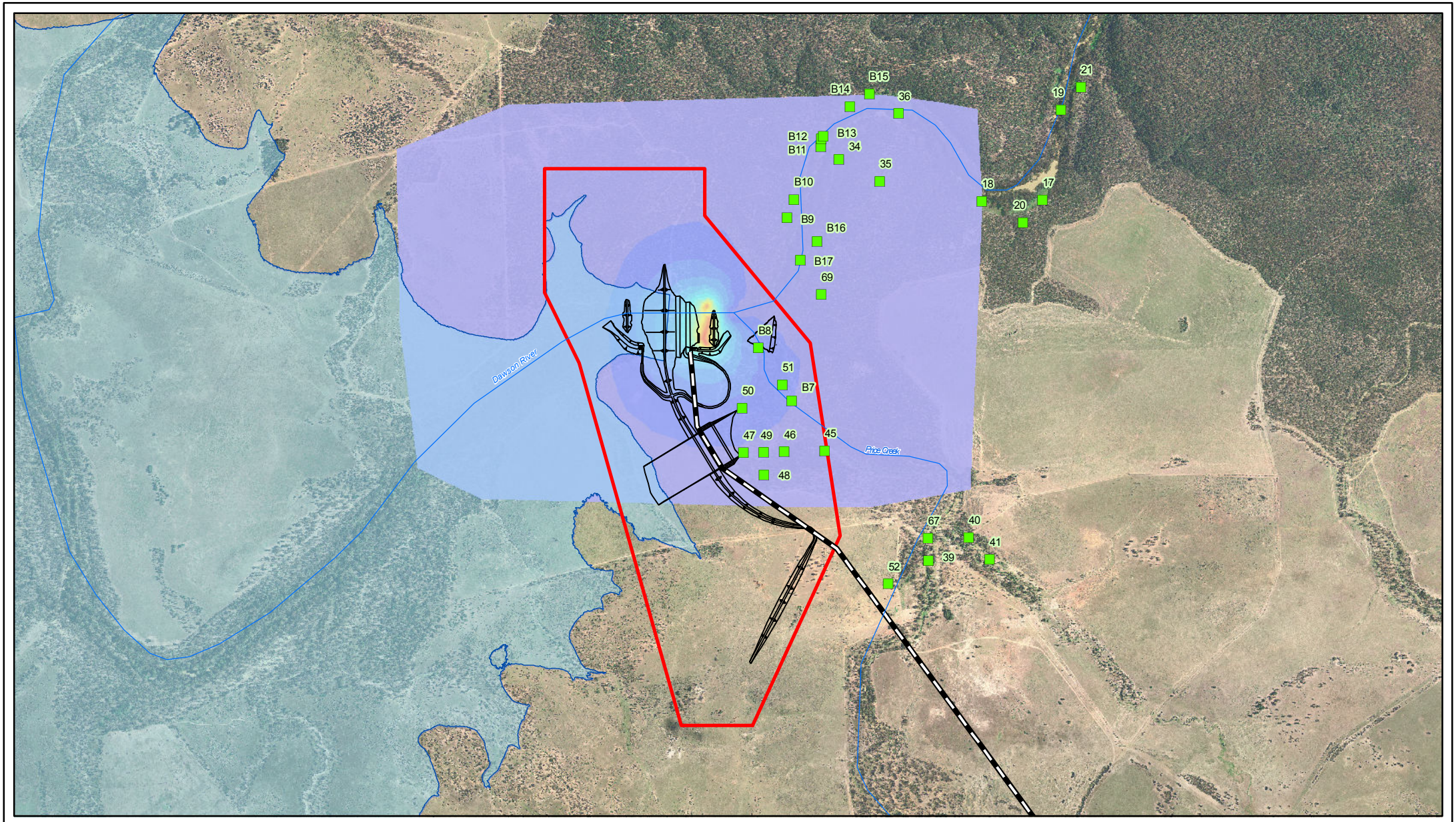
10.2.1.2. Impacts on EPBC listed communities

The Brigalow (*Acacia harpophylla* dominant and co-dominant) EPBC listed threatened ecological community is impacted as a result of dam construction, inundation and operation.

The assessment of the significance of impacts from the construction and operation of the dam on this community follows the Significant Impact Guidelines (version 1.1) prepared by the DEWHA (2009). These guidelines assist with determination of whether an action will have a significant impact on a matter of national environmental significance (MNES). The guidelines provide a specific set of significant impact criteria for each MNES against which the proposed action can be assessed and this is undertaken in Chapter 28.

- Brigalow ecological community

The extent of the Brigalow ecological community (comprising REs 11.3.1, 11.9.1, 11.9.5 and 11.9.5a) within the water storage is mapped in Figure 10-13. The construction and operation of the dam will result in the loss of 127.9 ha of remnant and 72.7 ha of regrowth Brigalow EC within the water storage. This will be managed by the vegetation clearing strategy; residual impacts will be offset by the offsets strategy (Section 10.4). Impacts of the Project on Brigalow are discussed in regards to the EPBC Act Significant Impact Criteria in Section 28.4.2.2.



LEGEND

- GAB Spring Sites
- Proposed Pipeline
- Watercourses
- Proposed Dam Arrangement
- Dam Construction Footprint
- Full Supply Level (183.5m AHD)

Drawdown (m)

19 - 20	14 - 15	9 - 10	4 - 5
18 - 19	13 - 14	8 - 9	3 - 4
17 - 18	12 - 13	7 - 8	2 - 3
16 - 17	11 - 12	6 - 7	1 - 2
15 - 16	10 - 11	5 - 6	0 - 1

Projection: GDA94 Zone 56

Figure 10-11

0 125 250 500
Metres

N

Scale 1:25,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

GAB spring communities impacted by drawdown during construction of the dam wall

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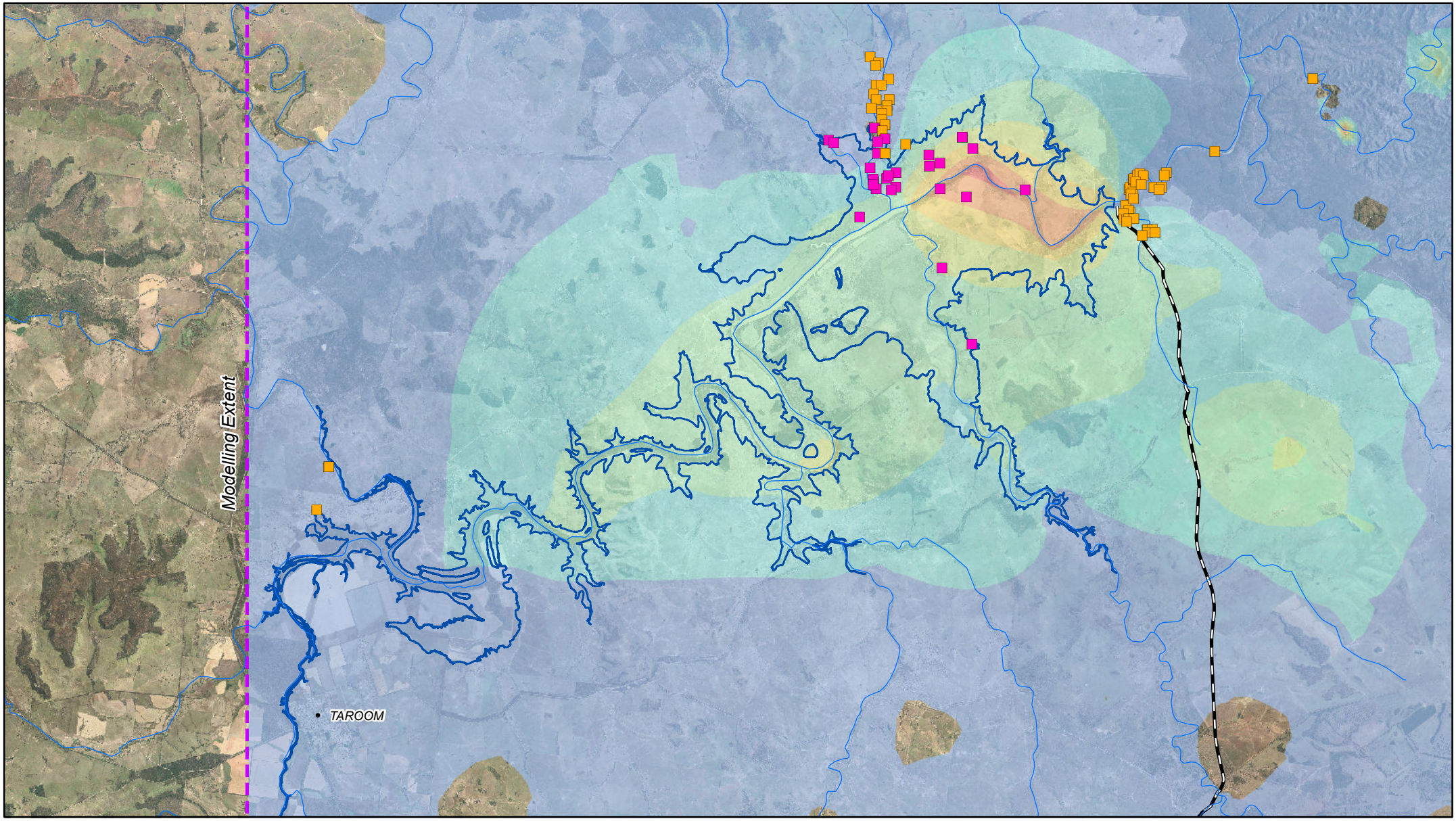

LEGEND

- Town
- Proposed Pipeline
- Watercourse
- Full Supply Level (183.5m AHD)
- Modelling Extent

GAB Spring Sites

- Inside FSL
- Outside FSL

Increase in Potentiometric Surface (m)

- 30 - 35
- 25 - 30
- 20 - 25
- 15 - 20
- 10 - 15
- 5 - 10
- 0 - 5
- < 0

Projection: GDA94 Zone 56

Figure 10-12

0 1 2 4
Kilometres

N

Scale 1:200,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

GAB spring communities impacted by increased groundwater pressure in the Precipice Sandstone

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10.2.1.3. Impacts on species of conservation significance

Species known to occur in the dam impact area or with a high likelihood of occurrence have been included in the assessment of impacts (Table 10-24). The locations of threatened flora species in the dam study area are shown in Figure 10-9. Those impacted by the dam construction footprint are shown in Figure 10-13.

Table 10-24 Potential impacts on threatened flora in the dam impact area

Species Name	Status[1]	Presence	Potential Impact
Cryptandra ciliata	NT (NC)	Known (H)	**Figure 10-9** highlights that the population along the Dawson River will be impacted by the dam construction footprint. However, the populations around Spring Creek will be maintained. Clearing and/or flooding within the inundation will result in the loss of 130.6 ha of RE 11.10.9, 11.10.7 and heterogenous polygon REs 11.3.3/11.3.4/11.9.1/11.3.11 which provide potential habitat for this species.
Livistona nitida Carnarvon Palm	NT (NC)	Known (H)	Populations of this species will be impacted by the dam construction footprint and by the water storage along Spring Creek. However, this species is abundant downstream of the dam wall to Theodore, therefore impacts are unlikely to be significant.
Rutidosis crispata	V (NC)	Known (H)	A portion of the plants in two populations will be inundated at FSL, however, the majority of the populations will be maintained outside the FSL (**Figure 10-9**). Clearing and/or flooding within the water storage will result in the loss of 73.8 ha of REs 11.10.7 and 11.10.9 which provide potential habitat for this species.
Arthraxon hispidus Hairy-joint Grass	V (NC) V (EPBC)	Likely	Clearing and/or flooding within the water storage will result in the loss of 17.4 ha of RE 11.3.22 which provides potential habitat for this species. Potential habitat for *A. hispidus* will be improved by the protection, management and restoration of spring wetlands in the surrounding area, by reducing threats such as overgrazing and competition from pastures and weeds (TSSC, 2008ig).
Thelypteris confluens	V (NC)	Likely	Clearing and/or flooding within the water storage will result in the loss of 17.4 ha of RE 11.3.22 which provides potential habitat for this species. Potential habitat for *T. confluens* will be improved by the protection, management and restoration of spring wetlands in the surrounding area, by reducing threats such as overgrazing and competition from pastures and weeds.

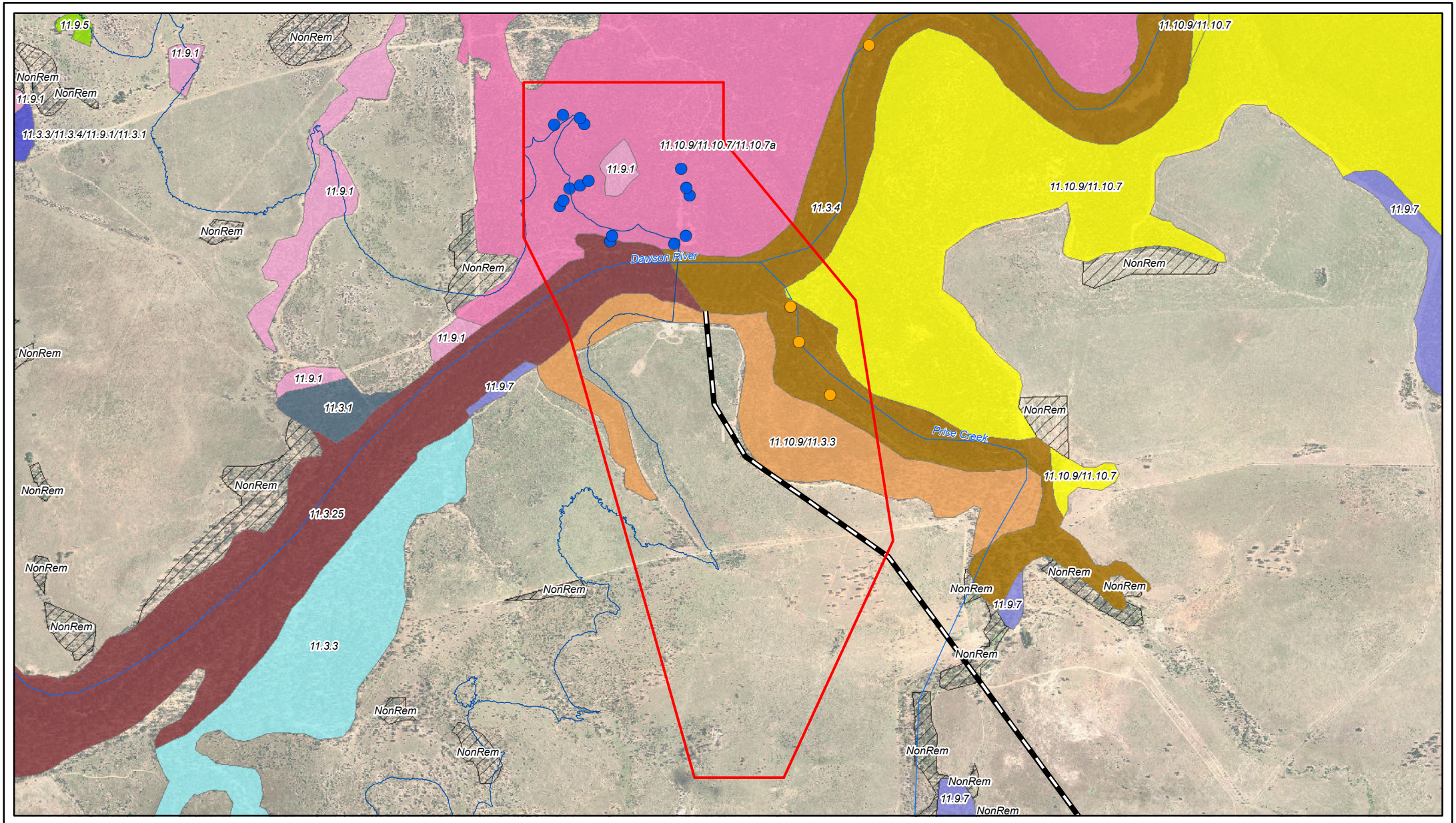
1 Status: EPBC = *Environment Protection and Biodiversity Conservation Act 1999*
NC = *Nature Conservation (Wildlife) Regulation 2006*
E = Endangered; V = Vulnerable; NT – Near Threatened

To minimise impacts on species known to occur in the dam impact area, mitigation will involve a qualified botanist collecting seeds and propagating plants for use in rehabilitation of other areas.

To minimise impacts on threatened flora species, a qualified botanist will undertake pre-construction surveys of known and potential habitat to assess the size/condition/structure of known populations or confirm the presence of likely species. These will occur sufficiently in advance of construction so that potential management measures can feasibly be implemented.

For known populations and/or any confirmed populations, management measures will be implemented as follows:

1. review the design to see if the extent of impact can be reduced (for example by changing the location of an aspect of the dam infrastructure);
2. determine if the age and condition of individuals present will allow successful translocation;
3. determine if seed collection and nursery propagation is feasible;
4. if 2 and/or 3 are possible, design rehabilitation plans to incorporate the species; and
5. if 2 and/or 3 are not possible, incorporate suitable habitats for the species within the offset package.



LEGEND

- Pipeline Route
- State Controlled Roads
- Watercourses
- Full Supply Level (183.5m AHD)
- Dam Construction Footprint

Species Recorded by CEPLA (2008)

- *Cryptandra ciliata*
- *Livistona nitida*

Regional Ecosystems (CEPLA, 2008)

- 11.10.9/11.10.7
- 11.10.9/11.10.7/11.10.7a
- 11.10.9/11.3.3
- 11.3.1
- 11.3.25
- 11.3.3
- 11.3.3/11.3.4/11.9.1/11.3.1
- 11.3.4
- 11.9.1
- 11.9.5
- 11.9.7
- NonRem

Projection: GDA94 Zone 56

Figure 10-13

0 100 200 400
Metres

N

Scale 1:20,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Location of threatened flora in the dam construction footprint

I:\QENV2\Projects\QE40192\400 - Nathan - Spatial\ArcMXD\Figures\100_Terrestrial_Flora\Figure_10-13_Regional_Ecosystems_Threatened_Sp_DamConstruction.mxd Produced: 13/01/2012

10.2.1.4. Weeds and pests

Construction

There is potential for the spread of weeds into cleared and disturbed areas from construction of the dam and vegetation clearing activities. Four declared weed species were recorded during the terrestrial flora survey (Table 10-8).

To minimise the potential for the spread and introduction of weeds from the outset of construction, a weed management plan will be developed for construction and operation of the Project. Specific management measures for construction will include:

- review Biosecurity Queensland's Annual Pest Distribution Survey and Predictive Pest Maps to assist in the risk assessment of invasive plant and pest animals that are likely to occur in the Project area, and support the development of threat abatement plants if required;
- use of wash-down facilities for vehicles and equipment entering and leaving the construction site and those areas proposed for vegetation clearance;
- all machinery, equipment and vehicles shall be certified as "clean" prior to entering the construction site;
- avoid the removal of vegetation, which is not salvaged for timber resource, from the vegetation clearance areas;
- declared weeds not to be used as mulch for landscape will be disposed of at a landfill that accepts green waste or pit burnt and buried to prevent reseeding;
- soil and landscaping material brought onto the site must be from a source that is clean and weed free;
- weed inspection of the dam construction footprint to identify existing weed infestations;
- weed control of new and existing weed infestations identified;
- weed monitoring of dam construction footprint to identify new infestations and control any weeds identified; and
- management methods for declared weeds must be consistent with recommendations in Pest Fact sheets produced by Queensland Primary Industries and Fisheries.

Operation

There is also potential for an increase in weeds and pest animals from the presence of the water storage. In particular weeds may proliferate around the banks of the water storage and pigs may be attracted to the permanent water supply, ultimately resulting in damage to fringing vegetation as a result of the intrusive foraging behaviour of this species. A weed management plan will be developed for operation of the dam and will accord with existing SunWater plans. Specific management measures for operation will include:

- review of Biosecurity Queensland's Annual Pest Distribution Survey and Predictive Pest Maps to assist in the risk assessment of invasive plant and pest animals that are likely to occur in the Project area, and support the development of threat abatement plants if required.

- weed inspection across the Project area, targeting offsets and water storage edges, to identify the density and distribution of weed infestations;
- weed control of new and existing weed infestations identified. Control methods may include physical (e.g. machinery or hand-pulling), chemical (e.g. herbicides) or cultural (e.g. replanting of native species). Specific control methods for all identified weeds in the Project area will be identified in the weed management plan;
- routine weed monitoring (weed density and distribution) of weeded areas to determine effectiveness of treatments and identify areas requiring additional applications;
- management methods for declared weeds must be consistent with recommendations in Pest Fact sheets; and
- weed management will be undertaken by a suitably qualified officer and will focus on controlling and reducing weed species diversity and density.

10.2.1.5. Construction dust

Dust generation from construction, excavation and blasting activities associated with construction of the dam, including the on-site concrete batching plants, may affect plant growth within close proximity of the works. Reactive dusts, such as cement dust, which contain soluble materials that alter substrate, soil pH or the nutrient or ionic balances in plants, may have adverse effects on plant growth at rates of deposition greater than about 500 mg/m^2/day (Doley, 2003). The load of cement dust on leaves that may be associated with reduced plant growth is generally in excess of 2 g/m^2 (Doley 2003). Dusts that are chemically inert, or which do not markedly alter substrate pH, are generally effective if the dust load is greater than 5 g/m^2 (Doley, 2003) as it may possibly have an effect on photosynthesis and therefore growth. Dust control measures will be implemented as part of the Construction Environmental Management Plan for the Project and recommended mitigation measures are provided in Chapter 17. Furthermore, the concrete batching plants will have strict air emission controls to minimise cement dust in accordance with the Environmentally Relevant Activity (ERA) under the Queensland *Environmental Protection Act 1994* approval which will be required for operation of the plant. With the appropriate mitigation measures in place dust impacts on plant growth and habitat are not anticipated.

10.2.2. Pipeline

10.2.2.1. Loss of vegetation

□ Design

The pipeline has sought to minimise the impact on remnant vegetation and habitat through route selection. Recommendations from the field surveys were implemented to avoid areas of remnant vegetation and habitat where possible. Route refinement will continue with this aim.

□ Construction

Construction of the pipeline will require clearing within a 30 m wide easement including access tracks. This is the maximum easement width required for construction but depending on terrain and adjacent land use it may be possible to reduce this to 15 m where there is space available for machinery access (i.e. adjacent to roads or at creek crossings), where significant REs and threatened ecological communities occur. The extent of remnant REs within the pipeline corridor is illustrated in Appendix 10-A.

The areas of REs impacted by the maximum 30 m pipeline easement are provided in Table 10-25. This would result in the clearing of approximately 123.6 ha of remnant vegetation, comprising (based on VM status) approximately 1.8 ha of Endangered REs, 16.6 ha of Of Concern REs and 105.1 ha of Least Concern REs. The pipeline also crosses several rivers/creeks and 1.9 ha of this remnant vegetation comprises watercourse.

Although a 30 m wide easement is required for construction, only a 15 m wide easement is required for maintenance. The remaining 15 m width will be rehabilitated post-construction to re-establish the pre-construction environment. Rehabilitation will progressively occur after completion of the pipeline construction and will include reinstatement and grading of topsoil, spreading of cleared vegetation (in the form of mulch and woody debris) salvaged from the construction easement, and revegetation (seed mixtures and/or seedlings).

Vegetation offsets will be provided to compensate the residual loss of remnant vegetation (Section 10.4).

Table 10-25 Areas of regional ecosystems impacted by the pipeline easement

Regional Ecosystems	Proportion (%) of REs	VM Status	Biodiversity Status	Pipeline 30 m Easement (ha)
CEPLA RE mapping				
11.3.1	100	Endangered	Endangered	0.64
11.3.2	100	Of concern	Of concern	7.45
11.3.21	100	Endangered	Endangered	0.07
11.3.25	100	Least concern	Of concern	1.94
11.3.4	100	Of concern	Of concern	0.04
11.9.6	100	Endangered	Endangered	0.73
11.9.7	100	Of concern	Of concern	5.78
11.9.7/11.9.10	50/50	Of concern	Endangered sub-dominant	1.18
11.9.10	100	Of concern	Endangered	1.90
11.10.7	100	Least concern	No concern at present	0.82
11.10.9/11.3.3	50/50	Of concern	Of concern	0.42
Sub-total Remnant REs				*21.0*
Sub-total Non-Remnant REs				*130.5*
DERM RE mapping				
11.3.14		Least concern	No concern at present	1.2
11.3.14/11.5.21	50/50	Least concern	No concern at present	2.2
11.5.1		Least concern	No concern at present	0.03
11.5.1/11.7.4/11.3.4	50/40/10	Of concern subdom	Of concern subdom	3.0
11.5.1/11.7.7/11.7.5/11.7.2	85/5/5/5	Least concern	No concern at present	17.7
11.5.1a/11.5.1	50/50	Least concern	No concern at present	0.2

Regional Ecosystems	Proportion (%) of REs	VM Status	Biodiversity Status	Pipeline 30 m Easement (ha)
11.5.21/11.7.4/11.5.4	40/40/20	Least concern	No concern at present	56.7
11.7.4/11.7.7/11.7.5/11.7.2	80/10/5/5	Least concern	No concern at present	16.2
11.7.7/11.5.1	80/20	Least concern	No concern at present	5.0
11.7.7/11.7.2/11.5.1a/11.5.1	85/5/5/5	Least concern	No concern at present	0.1
11.9.5/11.9.5/11.9.6	60/25/15	Endangered	Endangered	0.4
Sub-total Remnant REs				*102.6*
Sub-total Non-Remnant REs (Regrowth Vegetation)				*16.0*
Sub-total Non-remnant				*131.6*
Totals				
Total Remnant REs				**123.6**
Total Non-Remnant REs				**146.5**
Total Endangered REs (VM Status)				**1.8**
Total Of Concern REs (VM Status)				**16.6**
Total Least Concern REs (VM Status)				**105.1**

- GAB springs

There are a number of GAB springs in the vicinity of the pipeline near the dam wall but they are not regarded as a threatened ecological community. The pipeline corridor travels to the south of these springs and therefore they will not impact upon them.

- Operation

A 15 m wide permanent easement will be maintained for pipeline maintenance. This will require pruning of trees and large shrubs, and/or slashing of regrowth vegetation. This is unlikely to have any significant impact on the vegetation communities. No other operational impacts related to clearing are anticipated.

10.2.2.2. Impacts on EPBC listed communities

Construction of the pipeline has the potential to impact on two threatened ecological communities, Brigalow and Natural Grasslands. SEVT has been avoided in selection of the pipeline alignment. The areas of Brigalow and Natural Grasslands impacted by the maximum 30 m wide easement are provided in Table 10-26.

Table 10-26 Area of EPBC listed communities impacted by the pipeline easement

EPBC Act Threatened Ecological Community	Condition	Pipeline 30 m Easement (ha)
Brigalow (*Acacia harpophylla* dominant and co-dominant) (Including REs 11.3.1, 11.9.5, 11.9.5a, 11.9.6)	Remnant	1.7
Natural Grasslands (RE 11.3.21)	Remnant	0.07

- Brigalow (*Acacia harpophylla* dominant and co-dominant)

The construction of the pipeline will result in the loss of 1.7 ha of remnant Brigalow. The impacts of the pipeline on the Brigalow ecological community in regards to the EPBC Act significant impact criteria are assessed in Chapter 28. Loss and fragmentation of the Brigalow ecological community will be minimised by:

- avoiding, or at least traversing the edges of patches of Brigalow in the final pipeline alignment;
- reducing the width of the construction easement to 15 m where topography and access allow; and
- rehabilitation of the pipeline construction easement post-construction to reinstate the Brigalow community.

The offsets package will compensate the residual loss of Brigalow within the pipeline easement (Section 10.4).

- Natural grasslands

The Natural grasslands EC is located within the roadside of the Warrego Highway at Macalister, as shown in Appendix 10A-48. The pipeline route runs adjacent to the roadside in cleared private property and has been aligned to avoid most of EC (RE 11.3.21). However, 0.07 ha of the Natural grasslands is still impacted, based on the maximum 30 m wide construction easement. In reality the impact can be minimised by reducing the easement width to 15 m. The area to be avoided will be clearly marked so no construction vehicles enter.

- Semi-evergreen vine thickets (SEVT)

SEVT is located as a fragmented patch on private property adjacent to the roadside of Nathan Road north of the proposed dam wall. No SEVT is located within the 30 m wide impact corridor. Along this section construction will be restricted to the roadside to avoid impacts on SEVT.

10.2.2.3. Impacts on species of conservation significance

- Construction

The extent of impact is uncertain at this stage as several threatened flora species are considered likely to occur though they were not identified during the field survey. Potential habitat within the pipeline easement will require targeted assessment prior to construction so this information can be incorporated into refinement of the final pipeline route. The potential impacts on likely threatened flora species are discussed in Table 10-27.

Table 10-27 Potential impacts on threatened flora by the pipeline

Species	Status	Occurrence	Potential Impact
Acacia tenuinervis Scrub Wattle	NT (NC)	Known	Clearing for the pipeline easement will result in the loss of several individuals within REs 11.10.7/11.9.5 between the dam and Wandoan and 63.7 ha of potential habitat for this species throughout the pipeline corridor (eucalypt scrub and forest on red earths comprising REs 11.5.1, 11.5.4, 11.5.21, 11.9.7, 11.9.10, 11.9.5, 11.9.6, 11.10.7). With the implementation of mitigation measures outlined below impacts are unlikely to be significant.
Cryptandra ciliata	NT (NC)	Known	Clearing for the pipeline easement will result in the loss of several individuals within RE 11.5.21 and 23.8 ha of habitat for this species associated with RE 11.5.21. With the implementation of mitigation measures outlined below impacts are unlikely to be significant.
Livistona nitida Carnarvon Palm	NT (NC)	Known	A single specimen of this species was recorded along the pipeline corridor. This species is a dense occurrence on Palm Tree Creek, Spring Creek, Price Creek, Nathan Gorge and the Dawson River (downstream to Theodore). Therefore the loss of this individual will not have a significant impact on this species.
Rutidosis lanata	E (NC)	Known	*Rutidosis lanata* was recorded within RE 11.4.3 at one location along pipeline corridor between Wandoan and Chinchilla. Two large populations of this species were found outside the water storage which will not be impacted. Clearing for the pipeline easement will result in the loss of 0.8 ha of potential habitat associated with REs 11.4.3 and 11.10.7. The loss of this small area of potential habitat is unlikely to be significant for this species.
Acacia curranii Curly Bark Wattle	V (NC) V (EPBC)	Likely	Clearing for the pipeline easement will result in the loss of 1.7 ha of potential habitat associated with REs 11.3.1, 11.4.3, 11.9.4a, 11.9.5 and 11.9.6. The loss of this small area of potential habitat is unlikely to be significant for this species.
Bertya pedicellata	NT (NC)	Likely	Clearing for the pipeline easement will result in the loss of 36.8 ha of potential habitat associated with RE 11.7.4. With the implementation of mitigation measures outlined below impacts on this species (if present) are unlikely to be significant.
Gonocarpus urceolatus	V (NC)	Likely	Clearing for the pipeline easement will result in the loss of 24.4 ha of potential habitat associated with REs 11.5.1 and 11.7.7. With the implementation of mitigation measures outlined below impacts on this species (if present) are unlikely to be significant.

To minimise impacts on threatened flora species within the pipeline easement, a qualified botanist will undertake pre-construction surveys to assess the size/condition/structure of populations and potential habitat to confirm the presence of likely species. These will occur sufficiently in advance of construction so that potential management measures can feasibly be implemented. For known populations and any confirmed populations, management measures will be implemented as follows:

1. realign the final pipeline route to avoid the species / populations where practicable;
2. reduce the width of the construction easement to 15 m to minimise impacts on the species / population where practicable;
3. determine if the age and condition of individuals present will allow successful translocation;

4. determine if seed collection and nursery propagation is feasible;

5. if 2 and/or 3 are possible, design translocation or propagation plans to incorporate the species in the rehabilitation of the pipeline easement post-construction; and

6. if 2 and/or 3 are not possible, incorporate suitable habitats for the species within the offset package.

- Operation

Maintenance of the permanent pipeline easement will require pruning of trees and/or slashing of regrowth vegetation. This is unlikely to have any significant impact on the threatened species. No other operational impacts are anticipated. Locations of threatened species beside the easement will be mapped so that maintenance activities do not interfere with them.

10.2.2.4. Weeds

- Construction

Without appropriate management strategies, the construction of the pipeline has the potential to disperse weeds into areas of remnant vegetation not currently weed infested from the movement of soil and seed by construction vehicles and machinery. In particular, clearing of the pipeline easement has the potential to spread weeds into disturbed areas along the extent of the easement.

To minimise the potential for the spread of weeds, a Weed Management Plan will be developed for construction and operation of the pipeline. This will mirror that for the dam and surrounds (Section 10.2.1.4).

- Operation

There is potential for proliferation of weeds from recently disturbed areas along the pipeline easement. A Weed Management Plan will be developed for maintenance of the pipeline in accordance with SunWater standard operating procedures as defined by their EMS.

10.2.2.5. Construction dust

Dust control measures will be implemented as part of the Construction Environmental Management Plan for the Project.

10.2.3. Associated infrastructure

▪

10.2.3.1. Loss of vegetation

The construction of new or upgraded roads will result in the loss of 25.8 ha of remnant vegetation of which approximately 10.5 ha is listed as Endangered or Endangered sub-dominant, 8.7 ha is listed as Of Concern or Of concern sub-dominant and 6.6 ha is listed as Least Concern under VM Status. Potentially 10.4 ha also meets the criteria for the EPBC listed Brigalow ecological community, due to the dominance or co-dominance of Brigalow. The impact of the road upgrades on remnant vegetation is summarised in Table 10-28. Loss of significant REs and threatened ecological communities will be offset as part of the offsets strategy (Section 10.4).

Table 10-28 Area of vegetation impacted by the associated infrastructure (road upgrades)

Regional Ecosystem	VM Status	Biodiversity Status	Area ha
CEPLA RE mapping			
11.10.7	Least concern	No concern at present	1.0
11.10.9/11.10.7/11.10.7a	Least concern	No concern at present	2.0
11.3.2	Of concern	Of Concern	3.0
11.3.2/11.9.5a	Endangered sub-dominant	Of Concern/ Endangered	0.07
11.3.2/11.9.7	Of concern	Of Concern	0.1
11.3.3/11.3.2/11.3.25	Of concern	Of Concern	0.3
11.3.4	Of concern	Of Concern	3.8
11.3.4/11.3.27b	Of concern	Of Concern	0.08
11.9.10	Of concern	Endangered	0.4
11.9.5	Endangered	Endangered	0.04
11.9.5a/11.9.7/11.3.2	Endangered - dominant	Endangered/ Of concern	0.2
11.9.7	Of concern	Of Concern	0.2
DERM RE mapping			
11.10.11	Least concern	No concern at present	0.6
11.10.9	Least concern	No concern at present	0.6
11.10.9/11.9.5	Endangered sub-dominant	No concern at present/ Endangered	10.2
11.3.25	Least concern	Of Concern	1.1
11.3.25/11.3.2	Of concern sub-dominant	Of Concern	0.3
11.3.39	Least concern	No concern at present	1.4
11.9.7/11.9.10	Of concern sub-dominant	Of Concern/ Endangered	0.6
Total Remnant REs			**25.8**
Total Non-Remnant			**31.8**
Total Of Concern REs (VM Status)			8.7
Total Endangered REs (VM Status)			10.5
Total Least Concern REs (VM Status)			6.6

The majority of road works will be within existing easements and clearing will be restricted to roadside verges. The extension of Glebe Weir Road will require some clearing of remnant open forest and woodlands, and will be offset by provision of vegetation offsets.

Potential sources of construction resources for the dam, pipeline and roads have been identified. Permits for resource extraction will be sought by the allocation holder. Utilisation of existing sources of resources (i.e. rock quarries) will minimise impacts on vegetation and flora.

The clay borrow areas will be located within the water storage, and therefore there will be no additional impacts on vegetation and flora than those described in Section 10.2.1.1.

The construction camp for the dam will be located on cleared grazing land to avoid impacts on remnant vegetation. Further, the temporary haul roads for construction of the dam will either be within the construction or water storage footprint or will largely follow existing roads and tracks.

The recreation area will complement the existing environment and construction of the boat ramp, picnic facilities, and toilet facilities with solar power, non-potable water supply and general landscaping will be conducted in a manner which minimises impact on remnant vegetation.

10.2.3.2. Impacts on EPBC listed communities

Construction of the road upgrades will also impact on the EPBC listed Brigalow ecological community. The construction of the road upgrades will result in the loss of 10.6 ha of remnant Brigalow (REs 11.9.5, 11.9.5a and 11.9.10). The impacts in regards to the EPBC Act significant impact criteria are assessed in Chapter 28. The loss and fragmentation of the Brigalow ecological community will be minimised by avoiding, or at least traversing the edges of patches of Brigalow in the new road alignments. The offsets package will compensate the residual loss of Brigalow by the road upgrades (Section 10.4).

10.2.3.3. Impacts on species of conservation significance

No threatened flora species have been recorded within the road upgrade areas. As the vegetation types are largely the same as those mapped within the dam impact area, the likelihood of occurrence of threatened flora species for dam impact area also applies to associated infrastructure (Table 10-6).

Potential habitat for threatened flora species likely to occur within the road upgrades will require targeted survey pre-construction to confirm the presence of species of conservation significance. If any are confirmed as present, the procedure outlined in Section 10.2.2.3 will be followed.

10.3. Impact assessment and residual risks

The methodology used for risk assessment and management is discussed in Section 1.8.

This section assesses the risks relevant to terrestrial flora and summarises the mitigation measures proposed to minimise those risks. Where significant residual risks remain after mitigation, offsets are described where practicable.

SunWater has developed an offsets package in recognition of Queensland and Australian Government offset policies and of the residual impacts after avoidance and mitigation identified in the EIS. Vegetation offsets as required under the VM Act will be provided for impacts on remnant vegetation and essential habitat which remain after mitigation (Section 10.4). In the case of residual impacts on NC Act and EPBC Act listed threatened flora species and ecological communities, biodiversity offsets will be provided where this is not specifically covered in the vegetation offsets.

The risk assessment is of the Project as described in Chapter 2, in which SunWater has already incorporated a range of risk reduction and mitigation measures. Table 10-29 and Table 10-30 present the assessment of residual risks after mitigation for the dam and pipeline, respectively.

Based on this assessment, the significance of the mitigation measures and offsets package in managing the risk to significant REs, threatened flora species and threatened ecological communities are highlighted. Mitigation measures to reduce the extent of impact on vegetation and flora during construction and operation will be employed including:

- vegetation clearing strategy;
- monitoring and improving management practices associated with GAB springs impacted by increased flows outside the water storage in accordance with actions associated with the Recovery Plan (Fensham, Ponder and Fairfax, 2010);
- provision of temporary watering to springs affected by groundwater drawdown during construction including pre and post construction monitoring of abiotic and biotic factors;
- pre construction assessment of listed species affected by construction footprint, pipeline and associated infrastructure including population assessments, seed collection, propagation and use in rehabilitation for certain species; and
- a medium risk is maintained for least concern REs where clearing is unavoidable as offsets are only planned for least concern REs if they are watercourse REs (11.3.25) or provide habitat for threatened plants.

Where clearing and impacts as a result of the Project are unavoidable, the offsets package will compensate the loss of significant REs (Endangered, Of Concern, Watercourse and Wetlands), habitat for threatened flora and threatened ecological communities.

Table 10-29 Risk assessment – terrestrial flora – dam and surrounds

Hazards	Factors	Impacts	Project Description Controls & Standard Industry Practice	Risk with Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk			Offset required?
				C	L	Current Risk			C	L	Mitigated Risk	
Loss of 128.2ha Endangered REs and 1727.7 ha Of Concern RE's from the dam and surrounds.	Construction of the dam and clearing within the water storage. Inundation at FSL.	Loss of Endangered and Of Concern REs (VM Status).	Vegetation clearing strategy. Islands will not be cleared.	Moderate	Absolute	High	Re-vegetate riparian corridor and islands if necessary.	Slightly	Moderate	Absolute	High	Yes (Section 10.4).
Loss of Least Concern REs from the dam and surrounds.	Construction of the dam and clearing within the water storage. Inundation at FSL.	Loss of Least Concern REs (VM Status).	Vegetation clearing strategy.	Minor	Absolute	Medium	.Re-vegetate riparian corridor.	Slightly	Minor	Absolute	Medium	Partly, in watercourse vegetation and biodiversity offsets (Section 10.4).
Loss of regrowth vegetation from the dam and surrounds.	Construction of the dam and clearing within the water storage. Inundation at FSL.	Regulated regrowth vegetation is protected under the VM Act.	Vegetation clearing strategy.	Minor	Unlikely	Low	Re-vegetate riparian corridor.	Slightly	Minor	Unlikely	Low	
Impacts on GAB springs.	Groundwater drawdown from construction dewatering.	Impacts on 20 GAB springs in Nathan Gorge. Impacts on 37 GAB		Minor	Possible	Medium	Monitoring and if required watering of the GAB springs.	Moderately	Minor	Unlikely	Low	

Hazards	Factors	Impacts	Project Description Controls & Standard Industry Practice	Risk with Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk			Offset required?
				C	L	Current Risk			C	L	Mitigated Risk	
	Increased groundwater flows.	springs outside the FSL.										
Impacts on threatened ecological communities.	Clearing and/or inundation within the water storage.	–Loss of 206 ha of Brigalow	Vegetation clearing strategy.	Moderate	Absolute	High			Moderate	Absolute	High	Yes (Section 10.4).
Impacts on springs	Increased groundwater flows.	Impacts on 21 GAB spring wetlands outside the FSL.		Minor	Likely	Medium	Monitoring and if required develop actions to mitigate any negative effects. . Protect, manage and restore degraded springs.	Moderately	Minor	Possible	Medium	
Impact on threatened flora species	Construction of the dam and clearing within the water storage. Inundation at FSL. Changes to ground water flows.	Loss of populations of known species (*Cryptandra ciliata, Rutidosis crispata* and *Livistona nitida*) and likely species (*Arthraxon hispidus and Thelypteris confluens,*).	Vegetation clearing strategy. Environmental flow regime to maintain downstream flows to riparian habitat.	Moderate	Absolute	High	Pre-construction surveys to confirm extent of populations. Translocation and/or propagation plans to rehabilitate species.	Significantly	Minor	Unlikely	Low	Where species cannot be translocated or propagated, include in offsets package (Section 1.4).

Hazards	Factors	Impacts	Project Description Controls & Standard Industry Practice	Risk with Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk			Offset required?
				C	L	Current Risk			C	L	Mitigated Risk	
Spread of declared weeds from construction of the dam.	Construction of the dam and clearing within the water storage.	Spread of declared weed to the locality.	Weed management plan.	Minor	Unlikely	Low		Significantly	Minor	Unlikely	Low	
Adverse effect on plant growth from dust generated from construction of the dam and concrete batching plant.	Mobile plant and machinery. Earth excavation creates dust.	May inhibit growth of vegetation located near the construction zones.	Watering of roads. Dust covers on trucks to control dust emissions.	Insignificant	Unlikely	Low			Insignificant	Unlikely	Low	

Table 10-30 Risk assessment - terrestrial flora - pipeline

Hazards	Factors	Impacts	Project Description Controls & Standard Industry Practice	Risk with Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk			Offset required?
				C	L	Current Risk			C	L	Mitigated Risk	
Loss of 1.8 ha Endangered REs and 16.6 ha Of Concern REs from the pipeline construction.	Clearing 30 m pipeline construction easement.	Loss of Endangered and Of Concern REs (VM Status).	Vegetation clearing strategy. Pipeline route selection minimised the impact on remnant vegetation through field survey recommendations.	Moderate	Likely	High	Avoid or traverse the edges of patches in the final pipeline alignment. Minimise clearing width in sensitive areas. Rehabilitate construction easement to pre-construction condition.	Significantly	Minor	Possible	Medium	Yes (Section 10.4).
Loss of 105.1 ha Least Concern REs from the pipeline construction.	Clearing 30m pipeline construction easement.	Loss of least concern REs (VM Status).	As above	Minor	Absolute	Medium	As above	Moderately	Minor	Absolute	Medium	Partly, in watercourse vegetation and biodiversity offsets (Section 10.4).
Loss of regrowth vegetation from the pipeline construction.	Clearing 30m pipeline construction easement.	Regulated regrowth vegetation is protected under the VM Act.	As above	Minor	Absolute	Medium	As above	Moderately	Insignificant	Absolute	Low	

Hazards	Factors	Impacts	Project Description Controls & Standard Industry Practice	Risk with Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk			Offset required?
				C	L	Current Risk			C	L	Mitigated Risk	
Impacts on threatened ecological communities.	Clearing 30m pipeline construction easement.	Loss of the 1.7 ha of –Brigalow and 0.07 ha of Natural Grasslands.	As above	Moderate	Likely	High	As above. Minimise clearing width to 15m to avoid impacts on grasslands.	Significantly	Minor	Possible	Medium	Unavoidable impacts on Brigalow will be offset (Section 10.4).
Impact on threatened flora species	Clearing 30m pipeline construction easement.	Loss of individuals of *Livistona nitida*, *Acacia tenuinervis* and *Rutidosis lanata* and population of *Cryptandra ciliata*. Loss of potential habitat for *Acacia curranii, Bertya pedicellata* and *Gonocarpus urceolatus*.	Vegetation clearing strategy.	Moderate	Likely	High	Pre-construction surveys to confirm size and condition of populations. Realign pipeline route to avoid populations of species where possible. Develop translocation and/or propagation plans to rehabilitate species.	Significantly	Minor	Possible	Medium	Where species cannot be translocated or propagated, include in offsets package (Section 1.4).
Spread of declared weeds from construction and pipeline maintenance.	Clearing 30m pipeline construction easement. Maintenance along the pipeline	Project has the potential to introduce new weeds to the locality.	Weed management plan.	Minor	Possible	Medium		Moderately	Minor	Possible	Medium	

Hazards	Factors	Impacts	Project Description Controls & Standard Industry Practice	Risk with Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk			Offset required?
				C	L	Current Risk			C	L	Mitigated Risk	
	easement.											
Adverse effect on plant growth from dust from pipeline construction	Mobile plant and machinery.	May inhibit growth of vegetation located near the construction zones.	Watering of roads.	Insignificant	Unlikely	Low			Insignificant	Unlikely	Low	

10.4. Environmental offsets strategy

The Queensland Government *Environmental Offsets Policy* (QGEOP) (EPA, 2008) states that the Project design considered in an EIS for a significant project should aim to avoid and minimise environmental impacts, before consideration of an environmental offset. This was done in the EIS, for example through project design, vegetation clearing and fauna relocation processes, and environmental management plans.

The QGEOP also states that if there are remaining impacts covered by a specific-issue offsets policy(s), the intention to provide offsets in line with the policy(s) should be signalled. The only existing specific-issue offsets policy of relevance is the *Policy for Vegetation Management Offsets* (PVMO) (Version 3; DERM, 2011) and SunWater intends to satisfy this policy.

The Queensland Biodiversity Offset Policy (version 1) (DERM, 2011) is an offsets policy for State significant biodiversity values but does not apply to State significant projects under the SDPWO Act (Section 5 of the policy). However the Coordinator General may take the policy into account when assessing projects. In reviewing the requirements of the policy SunWater is of the view that the proposed satisfaction of the PVMO and of EPBC requirements will concurrently largely satisfy the requirements of this policy.

The QGEOP further states that for significant projects the Coordinator General may also require offsets for impacts not currently covered by a specific-issue offsets policy.

The Australian Government *Draft Environmental Offsets Policy* (DEWR, 2007) sets out the use of environmental offsets under the EPBC Act. A compliant offset is required to meet the following objectives:

a) environmental offsets should be targeted to protected matter being impacted;

b) a flexible approach should be taken to design and use of environmental offsets to achieve long term and certain conservation outcomes that are cost-effective for proponents;

c) to deliver real conservation outcomes;

d) should be developed as a package of actions that may include both direct and indirect offsets;

e) as a minimum should be commensurate with the magnitude of the impacts of the development and ideally deliver outcomes that are 'like for like';

f) located within the same general area as the development;

g) should be delivered in a timely manner and be long lasting; and

h) should be enforceable, monitored and audited.

The Queensland and Australian government offset policies are cognisant of each other, meaning an offset which satisfies the PVMO may also be suitable to satisfy the Queensland or Australian Government biodiversity offsets policy. As such, co-location of offsets is acceptable where the outcome with respect to each policy is achieved.

In recognition of Queensland and Australian Government offset policies and of the residual impacts after avoidance and mitigation identified in the EIS, SunWater is developing a draft offsets package, termed the 'Environmental Offset Strategy', which is likely to incorporate a significant portion of the land parcels impacted by the dam wall and water

storage. The primary components of the Environmental Offset Strategy, including a discussion on how the offsets have been determined and which impact they specifically relate to, is summarised below. SunWater is using the services of Ecofund to develop the draft strategy. The strategy is being developed based on the assessment of the Project as presented in the EIS. Development of the Project through the detailed design phase will likely reduce the level of impact and therefore the level of offset required. As such, while the need for offsets is recognised and committed to, the residual impacts which require offset cannot be precisely defined till detailed design is undertaken. Similarly the actual location of offsets can only be finalised following landholder negotiation and agreement, which will only be undertaken after the project is approved. As Ecofund has identified a number of potential locations which can satisfy the various offset requirements it cannot be confirmed at this time exactly where those offsets will be. Importantly, Ecofund has however identified that a compliant offset strategy can be developed.

10.4.1. Vegetation offsets

The Project will include clearing of native remnant vegetation for which a permit is required under the Queensland VM Act. Clearing associated with the Project will be for a relevant purpose under section 22a of the VM Act, that is a declared significant project under the *State Development and Public Works Organisation Act 1971* (SDPWO Act).

The clearing application for the Project will address the performance requirements in Part S of the Regional Vegetation Management Code (RVMC) for Brigalow Belt and New England Tablelands Bioregions. Within Part S of the RVMC there are ten specific performance requirements that must be met in order to gain development approval. How the proponent intends to comply with each of the performance requirements is briefly discussed below.

- PR S.1: Limits of clearing – Clearing will be limited to the extent necessary for the Project;
- PR S.2: Wetlands – There are several wetlands in the Project area including freshwater wetlands associated with REs 11.3.22 and 11.10.14. No clearing will take place in wetlands however a number of GAB spring wetlands will be inundated at FSL by the Project and are planned to be offset under the environmental offset strategy (Table 10-5).
- PR S.3: Watercourses – Clearing will be limited in the riparian zones to within 1.5 m below FSL. However, the Project will unavoidably impact on watercourse vegetation for construction of the dam, the water storage and along the pipeline corridor. As a result, vegetation offsets will be provided.
- PR S.4: Connectivity – Fragmentation will result from clearing and/or inundation of the water storage area and pipeline corridor. While Acceptable Solution (AS) S.4.1[1] may apply at times to the pipeline and AS S.4.2[2] to the dam, some areas of fragmented remnant vegetation may require vegetation offsets. Riparian corridor impacts will also be mitigated through rehabilitation around the water storage.
- PR S.5: Soil erosion – Is applicable and will be managed in accordance with the Project EMP.

1 S.4.1 Where clearing is less than c) 25 m wide in the non-coastal subregions of the Brigalow Belt and the New England Tableland Bioregion; or d) is less than 5 hectares in the non-coastal subregions of the Brigalow Belt and the New England Tableland Bioregion.

[2] S.4.2 Clearing does not c) reduce areas of contiguous mapped remnant vegetation to less than 50 hectares in the non-coastal subregions of the Brigalow Belt and the New England Tableland Bioregion; and d) occur in areas of contiguous mapped remnant vegetation that are less than 50 hectares in the non-coastal subregions of the Brigalow Belt and the New England Tableland Bioregion.

- PR S.6: Salinity – Not applicable as clearing will not contribute to water logging or salinisation.
- PR S.7: Conserving remnant endangered and of concern regional ecosystems (REs) – The Project will unavoidably impact remnant endangered and of concern REs and vegetation offsets will be provided.
- PR S.8: Essential Habitat – Areas of essential habitat are mapped as occurring in the Project area for *Rutidosis crispata* and offsets will be provided in accordance with the PVMO.
- PR S.9: Conserving status thresholds – Not applicable as none of the REs listed in Table 5 of the RVMC are mapped in the Project area.
- PR S.10: Acid sulphate soils – Not applicable as the Project area is not within the applicable sub-regions and is above 5 m AHD.

The clearing application will be based on DERM's RE mapping with certified amendments. It is likely that a map amendment request will be made to reflect mapping prepared as a result of vegetation surveys completed for this EIS. Vegetation offsets will incorporate relevant aspects of landform, geology and plant community to ensure the PVMO is met. A management plan will be developed for each offset area to ensure long term success of the offset which will include measures for planting maintenance, weed and pest management and a monitoring program. SunWater has assessed the potential to obtain appropriate offsets from the purchased impacted properties and intends managing parts of the purchased land as part of the Environmental Offsets Strategy.

10.4.2. Biodiversity offsets

Biodiversity offsets which relate to impacts on NC Act or EPBC Act listed threatened species, will be provided should they not be completely compensated for in the vegetation offsets. Readers should be aware that what constitutes eligible offsets under each Act or policy differs so the comments below may relate to one or other or more than one.

This will be achieved by initially targeting those areas nearest to the area of impact which could increase the value of the offsets already offered, for example strategic in-filling (revegetation) of non-remnant areas that would provide linkages between offset or remnant habitats to improve connectivity. In larger areas natural regeneration will be enhanced by strategic plantings. Remnant habitat will be included in the offsets strategy where it is immediately adjacent to offset areas to add value to the total managed estate. The proximity of Precipice National Park and high value vegetation that abuts the park or the adjoining Dawson River and Nathan Gorge, is recognised by SunWater as a strategic opportunity for expansion of the conservation estate. Offsets will be protected from conflicting uses through active weed and feral animal control, fire management, appropriate stocking rates and periodic exclusion of stock.

For the GAB spring wetlands, offsets will focus on implementation of the recovery plan actions irrespective of SunWaters view that the local springs are not included with the definition of the threatened ecological community (EPBC Act). This will include assessment for conservation rankings of the individual springs impacted. Offsets for springs will be focussed on satisfying the State VM Act requirements but also increasing protection and conservation of category 1-3 springs whilst looking to restore and rehabilitate category 4-5 springs within the Dawson River and Boggomoss Spring Complexes.

10.5. Cumulative impacts

While no projects are located directly within the dam study area, a range of resource development and infrastructure projects are currently operating, or are planned within the wider region and along the pipeline route.

A number of water infrastructure, resource development and infrastructure projects are planned within the wider region and along the pipeline. These are listed in Section 28.2.10.1. Major projects in the region include Wandoan Coal Project, Surat Basin Railway Southern Missing Link and Surat Gas Project. Most of the Coal Seam Gas (CSG) projects are located in the Condamine catchment. Each of these projects are likely to have varying impacts on remnant vegetation and habitat, however to meet approval requirements under state and federal legislation will be mitigated and offset to ensure no net loss of vegetation or habitat within the region. Any impacts on threatened species would be required to be mitigated and offset to an acceptable level.

With mitigation and offsets, the development of these projects is not expected to have a cumulative impact upon the terrestrial flora of the Dawson Valley. The offsets strategy will aim to establish offsets immediately following project approval so that the period between impact and usable new habitat is as short as possible. It will aim to link the new riparian corridor with nearby habitat (i.e. Nathan Gorge, Precipice National Park, Spring Creek and Taroom Town Common) to increase connectivity and ensure that during any lag time suitable habitat is available in the surrounding area.

10.6. Summary

This section has assessed the potential impact of the Project on terrestrial flora. This assessment showed that:

- there will be a total loss of 3655 ha of remnant vegetation and approximately 342 ha of non remnant vegetation (assuming islands are lost as a result of fragmentation) within the dam construction footprint and water storage, including 128.2 ha of Endangered REs and 1777.9 ha of Of Concern REs. This impacts on 200 ha of the EPBC listed threatened ecological community Brigalow (*Acacia harpophylla* dominant and co-dominant). This will be minimised to some extent by not clearing vegetation on islands created by the water storage and implementing a vegetation clearing strategy. As it is not possible to fully mitigate this impact, this will be compensated by the offsets package;
- inundation to FSL will result in the loss of 28 GAB spring wetlands. This equates to a reduction of 11% of the GAB springs in the Springsure Supergroup. Offsets will be provided in the offsets package to restore and protect these communities outside the impact area in line with VM Act requirements and in general accordance with the recovery plan actions;
- GAB spring wetlands outside the FSL will also be subject to increased groundwater flow likely to cause wetlands to expand. It is highly likely that new springs will also be created. Springs will be monitored and mitigation measures developed should any negative effects be observed;
- clearing within the dam construction footprint and water storage will impact on populations of three threatened flora species, *Cryptandra ciliata, Rutidosis crispata* and *Livistona nitida*, and potential habitat for *Arthraxon hispidus and Thelypteris confluens*. Impacts will be mitigated by pre-construction surveys to confirm the size and condition of populations, and development of translocation and/or propagation plans to rehabilitate these species in suitable

habitat outside the impact area. The environmental flow regime will maintain downstream riparian habitat for *Livistona nitida*. Any residual impacts will be compensated by the offsets package;

- there will be a maximum loss of 123.6 ha of remnant vegetation and 146.5 ha of non-remnant vegetation within the pipeline corridor. The pipeline route selection has sought to minimise the impact on remnant vegetation through implementation of recommendations from the field surveys and following existing easements. The current pipeline corridor still impacts on 1.8 ha of Endangered REs and 16.6 ha of Of Concern REs, which comprise 1.7 ha of the EPBC listed Brigalow ecological community and 0.07 ha of the EPBC listed Natural Grassland ecological community. Impacts on Endangered and Of Concern REs and threatened ecological communities will be minimised by realigning the final pipeline route to avoid or at least traverse the edges of patches of significant communities, minimise clearing width to as little as 15 m where topography and access allow and rehabilitation of the construction easement to pre-construction condition. Any residual impacts will be compensated by the offsets package;
- clearing within the pipeline easement has the potential to impact on a number of known threatened flora species (*Livistona nitida, Acacia tenuinervis, Rutidosis lanata* and *Cryptandra ciliata*) and likely threatened flora species (*Acacia curranii, Bertya pedicellata* and *Gonocarpus urceolatus*). Impacts will be mitigated by pre-construction surveys to confirm the size and condition of populations, realigning the pipeline to avoid populations or individual species where possible, and development of translocation and/or propagation plans to rehabilitate these species in the construction easement. Where impacts on threatened flora species cannot be completely mitigated, they will be compensated by the offsets package; and
- the spread of weeds will be managed by implementation of a weed management plan during construction and operation.

Feasible mitigation actions are described and these will be reflected in the EMPs (Chapter 29) and as such are also included as Proponent Commitments (Appendix 30-A).

Based on this risk assessment, the impacts relevant to terrestrial flora can be effectively managed to acceptable levels. The loss of vegetation and ecological communities will be compensated by the offsets strategy.