



COPPERSTRING 2.0

CopperString 2.0

Site description and climate

Volume 1 Chapter 3



Table of contents

Table of contents	i
3. Site description and climate	1
3.1 Introduction	1
3.1.1 Project overview.....	1
3.1.2 Purpose of chapter.....	1
3.1.3 Defined terms.....	1
3.2 Methodology	3
3.3 Existing environment.....	3
3.3.1 Tenure and land use	3
3.3.2 Topography, geology and soils	4
3.3.3 Watercourses	27
3.3.4 Contaminated land.....	27
3.3.5 Landscape types.....	53
3.3.6 Vegetation canopy heights	59
3.3.7 Planning schemes, regional plans and state policies	61
3.3.8 Climate.....	65

Table index

Table 3-1 Transmission line easement description.....	3
Table 3-2 Dominant land units within bioregions of the study area	25
Table 3-3 General landscape types across the study area	53
Table 3-4 Relevant planning scheme provisions	61
Table 3-5 Meteorological monitoring stations	65

Figure index

Figure 3-1 Project overview.....	2
Figure 3-2 Bioregions	5
Figure 3-3 Topography	8
Figure 3-4 Geology.....	17
Figure 3-5 Dominant soil types.....	26
Figure 3-6 Environmentally sensitive areas	29
Figure 3-7 Percentage canopy height data analysis	60
Figure 3-8 Local government areas	63
Figure 3-9 Climatic zones and meteorological monitoring stations.....	68
Figure 3-10 Annual average temperature statistics (Source: BOM, 2020)	69

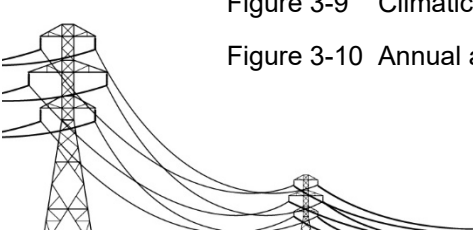
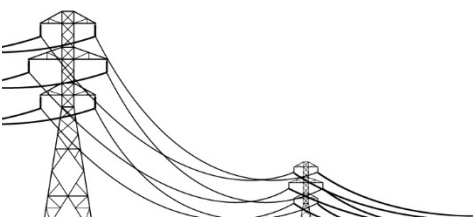


Figure 3-11 Annual average relative humidity statistics (Source: BOM, 2019)	70
Figure 3-12 Annual average rainfall statistics (Source: BOM, 2020)	71
Figure 3-13 Annual rainfall in Richmond, Townsville and Mount Isa	71
Figure 3-14 Annual average 3.00 pm wind speed vs direction (Calm 1%) – Townsville Aero (Source: BOM, 2020)	72
Figure 3-15 Average seasonal wind speed vs direction at Townsville Aero (Source: BOM, 2020)	73
Figure 3-16 Annual average 3.00 pm wind speed vs direction (Calm 4%) - Charters Towers Airport (Source: BOM, 2020).	74
Figure 3-17 Average seasonal wind speed vs direction at Charters Towers Airport (Source: BOM, 2019)	74
Figure 3-18 Annual average 3.00 pm wind speed vs direction (Calm 4%) - Richmond Post Office (Source: BOM, 2019)	75
Figure 3-19 Average seasonal wind speed vs direction at Richmond Post Office (Source: BOM, 2019)	75
Figure 3-20 Annual average 3.00 pm wind speed vs direction (Calm <0.5%) - Cloncurry Airport (Source: BOM, 2019).	76
Figure 3-21 Average seasonal wind speed vs direction at Cloncurry Airport (Source: BOM, 2019)	76
Figure 3-22 Average annual thunder days (Source: BOM, 2020)	78
Figure 3-23 Average annual total lightning flash density (Source: BOM, 2020)	78
Figure 3-24 Average annual ground lightning flash density (Source: BOM, 2020)	79
Figure 3-25 Average warm season ground lightning flash density (Source: BOM, 2020)	80
Figure 3-26 Average cool season ground lightning flash density (Source: BOM, 2020)	80
Figure 3-27 Cyclonic wind hazard zones	82
Figure 3-28 Bushfire prone areas	84
Figure 3-29 Sites of earthquake activity 2000 – 2020	110



3. Site description and climate

3.1 Introduction

3.1.1 Project overview

The Project involves the construction and operation of approximately 1,060 km of extra high voltage overhead electricity transmission line that will extend from Mount Isa to the Powerlink transmission network, via a new connection point near Woodstock, south of Townsville.

The Project involves construction of seven new substations at Woodstock, Hughenden, Dajarra Road (Cloncurry), Mount Isa, Selwyn, Cannington Mine and Phosphate Hill Mine.

The CopperString transmission network is divided into the following eight sections as shown in Figure 3-1:

1. Woodstock Substation
2. Renewable Energy Hub
3. CopperString Core
4. Mount Isa Augmentation
5. Southern Connection
6. Cannington Connection
7. Phosphate Hill Connection
8. Kennedy Connection (option).

3.1.2 Purpose of chapter

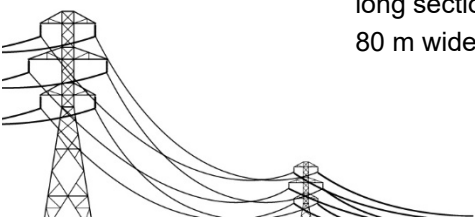
This section of the EIS describes the site conditions of the Project footprint, including current land uses, climate, topography, and environmental significance. The purpose of the site description and climate chapter is to provide information about the Project footprint that can be expanded on in the other EIS chapters and supporting technical reports, and to identify site-specific risks that need to be considered within the pre-construction, construction, operations and potential decommissioning stages of the Project's lifetime.

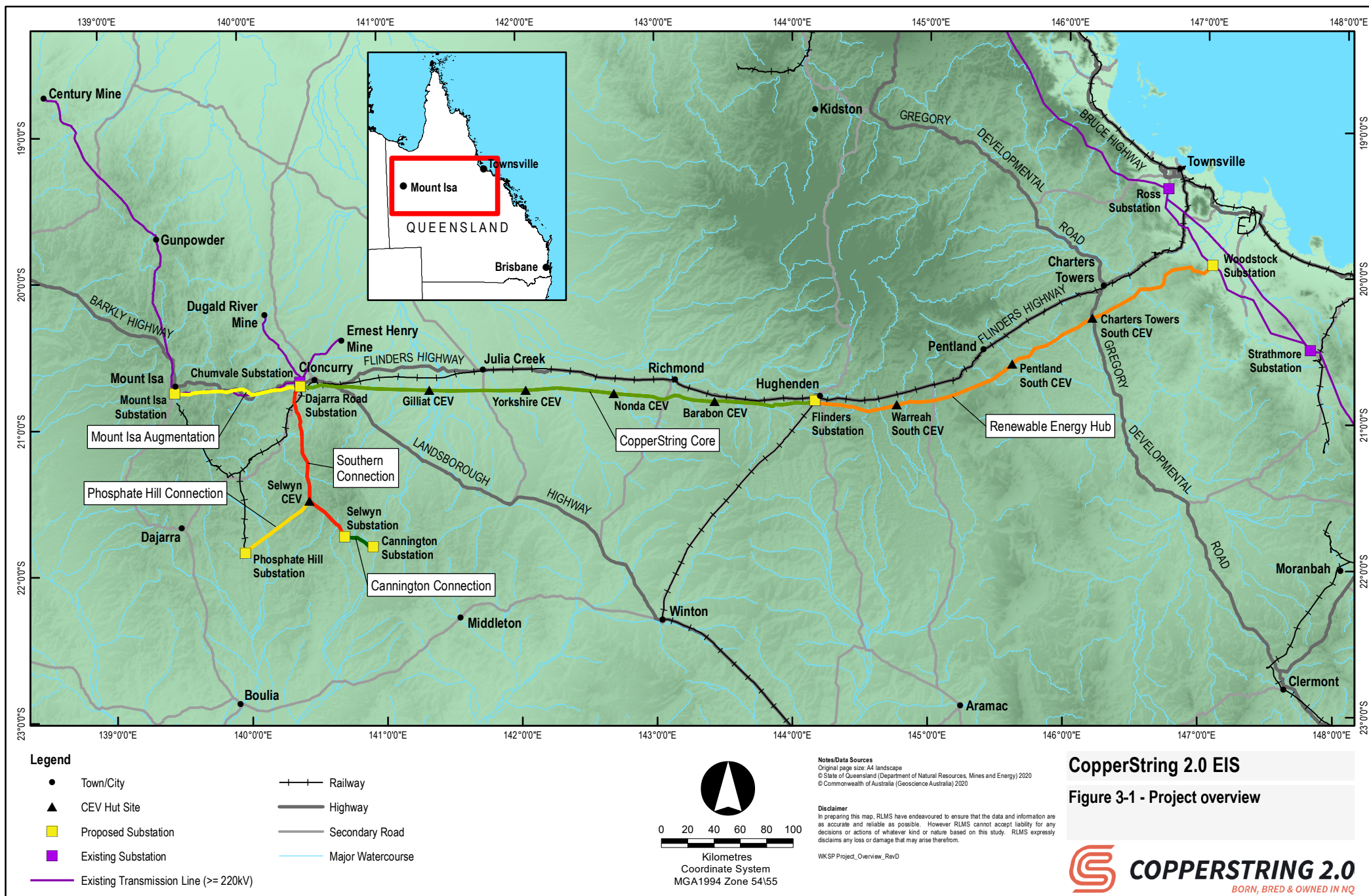
Impact assessments and proposed mitigation measures are not included in this chapter, rather they are included in other applicable chapters of the EIS.

3.1.3 Defined terms

The following key terms are used throughout this chapter:

- 'The Project' – means the CopperString 2.0 EIS Project
- 'CuString' – means CuString Pty Ltd, the proponent
- 'Corridor selection' – means the baseline investigation corridor of the transmission line (a nominal 1,060 km long corridor). The corridor selection is 120 m wide from Woodstock to Dajarra Road, and 60 m wide from Dajarra Road to Mount Isa, Dajarra Road to Selwyn, and Selwyn to Phosphate Hill and Cannington. The 4 km long section of the corridor selection from Dajarra Road Substation to Chumvale Substation is 60 m wide and a 3 km long section from Dajarra Road Substation to the Dugald River 220 kV overhead line is 80 m wide.





3.2 Methodology

The following technical reports produced for the CopperString 1.0 EIS were reviewed to assess their currency for the Project:

- Copperstring Project Environmental Impact Statement Topography, Geology, Geomorphology and Soils Assessment, Queensland (Coffey, 2010).
- Climate, Natural Hazards and Climate Change Assessment CopperString Project (URS, 2010).
- CopperString Draft Environmental Impact Statement, RLMS November 2010.

Following these reviews, desktop studies were conducted on areas traversed by the corridor selection to obtain updated data. Desktop assessments included reviews of data from the following:

- Queensland land use mapping
- Queensland Government building (townships and homesteads), stock routes, electrical (power station, substation, transmission line), transportation (road and rail), water, gas datasets to identify and highlight any changes from the previous EIS (existing infrastructure).
- DES Contaminated Land Register (CLR) and Environmental Management Register (EMR)
- Department of Defence unexploded ordnance (UXO) mapping
- Queensland imagery
- Land tenure and native title
- State development areas
- Drainage basin and water resource plan
- Local governments, state government to determine key land use issues
- Land use and tenure impact mitigation strategies

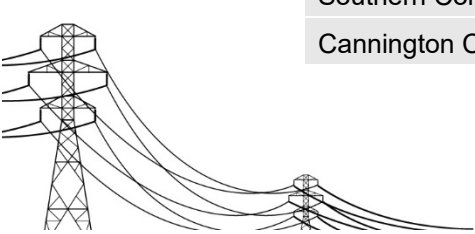
3.3 Existing environment

3.3.1 Tenure and land use

The Project will be constructed within easements, which are summarised in Table 3-1.

Table 3-1 Transmission line easement description

Transmission Line Section	Approximate Distance (km)	Voltage (kV)	Easement width (m)
Renewable Energy Hub	342	330	120
CopperString Core	395	330	120
Dajarra Road Connection for Ernest Henry and Chumvale Substation	4	220	60
Dajarra Road Connection for Dugald River	3	220	80
Mount Isa Augmentation	99	220	60
Southern Connection	129	220	60
Cannington Connection	24	220	60



Transmission Line Section	Approximate Distance (km)	Voltage (kV)	Easement width (m)
Phosphate Hill Connection	63	220	60

The corridor selection is expected to directly impact 130 land parcels, with additional land parcels impacted by the construction of access tracks. The predominant land uses on the impacted land parcels is rural grazing and cattle breeding. Most land traversed by the corridor selection is leasehold followed by freehold.

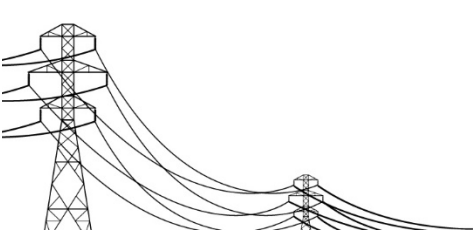
Prior to construction of the Project, the easements will require acquisition by CuString Pty Ltd. A list of all impacted land parcels is included in Volume 3 Appendix F Real property descriptions of impacted land parcels.

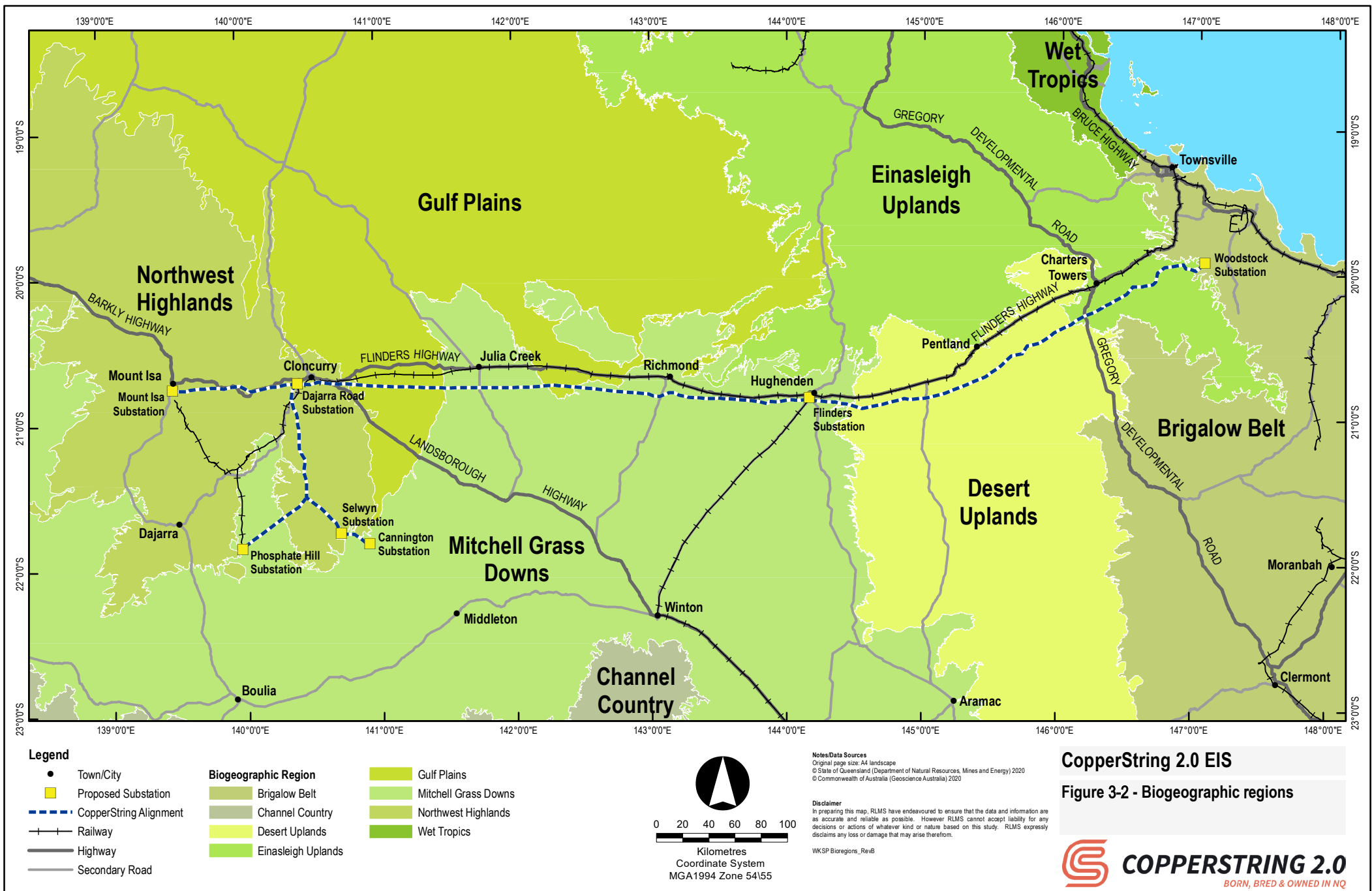
Indigenous land use agreements, native title claims, and biodiversity offset strategies are included in Volume 2 Chapter 5 Land.

3.3.2 Topography, geology and soils

Topography

The Project is situated within six different bioregions (Figure 3-2), that are characterised by broad, landscape-scale natural features and environmental processes that influence the functions of ecosystems. Bioregions capture large-scale geophysical patterns across the land. The bioregions are summarised below. Further detail regarding topography in the study area can be found in Volume 2 Chapter 6 Geology and soils.





Brigalow Belt

The corridor selection originates adjacent to the Ayr Ravenswood Road, approximately 43 km south-east of Woodstock, and traverses a small area of the northern Brigalow Belt bioregion. The Brigalow Belt is associated with undulating to rugged ranges and alluvial plains.

The corridor selection commences at an elevation of approximately 80 m Australian Height Datum (AHD) and traverses the Brigalow Belt bioregion, in a south-westerly direction for approximately 10 km and then heads in a west-north-westerly direction, entering the Einasleigh Uplands bioregion, around KP 11WD. As the characteristics of the Brigalow Belt zone along the corridor selection are broadly similar to the Einasleigh Uplands, for the purposes of this study, the Brigalow Belt has been included within the Einasleigh Uplands.

Einasleigh Uplands

The Einasleigh Uplands represents the hilly territory of the Great Dividing Range. Within the corridor selection, the Einasleigh Uplands rise to 420 m AHD, above broad plains, which have an elevation of approximately 250 m AHD. The corridor selection heads in a north-west direction for approximately 11 km before heading south-west between the Leichhardt Range and Kirk River. It crosses the Burdekin River around KP 71WD.

The fluvial environment of the Einasleigh Uplands is dominated by the Burdekin River and its tributaries. The characteristics of the rivers of the uplands are typically incised trenches, containing a channel adjusted to the extreme variability of flows experienced in the region.

Desert Uplands

From KP 124WD to KP 321WD, the corridor selection is situated within the Desert Uplands bioregion, which is characterised by upland landforms, dominated by sandstone ranges and sand plains. The corridor selection enters the Desert Uplands in a south-west direction at an elevation of around 300 m AHD. It traverses Balfe Creek, Campaspe River, Cape River, and Warrigal Creek. It continues across the Uplands and crosses the Great Dividing Range at 480 m AHD between KP 229WD and KP 230WD, then continues west, parallel with the Flinders Highway, crossing Torrens Creek, Bullock Creek, Prairie Creek and Skeleton Creek.

Mitchell Grass Downs

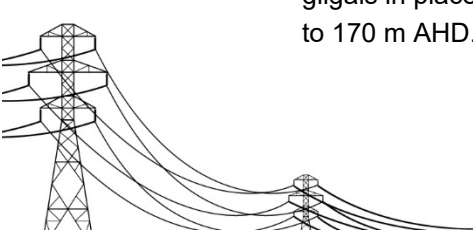
West of Skeleton Creek, the corridor selection enters the Mitchell Grass Downs bioregion, a large bioregion that contains most of the corridor selection. Mitchell Grass Downs consists of largely treeless plains with some occasional ridges, rivers, and gorges.

Around KP 379WD, the corridor selection enters an area of braided channels of Walker Creek and Warianna Creek that form part of the eastern extent of the Flinders River catchment. The corridor selection continues west, generally parallel with the Flinders Highway, crossing the braided channels of Alick Creek, where it briefly enters the Gulf Plains bioregion at KP 525WD, before re-entering the Mitchell Grass Downs at KP 547WD.

The corridor selection then continues west across relatively flat, treeless plains around 140 m AHD and the braided channels of Julia Creek, Eastern Creek and Sadowa Creek, which are all part of the Flinders River catchment.

Gulf Plains

At KP 625WD, the corridor selection again traverses the Gulf Plains bioregion. These plains comprise a broad expanse of flat to gently undulating alluvial clay deposits, which contain gilgais in places. The corridor selection traverses the Gulf Plains at an elevation of 130 m AHD to 170 m AHD.



The plains are characterised by intricate networks of channels, which form large anastomosing rivers. The corridor selection crosses the braided channels of the Gilliat River, McKinlay River, Gidya Creek, Holy Joe Creek, Fullarton River, and Williams River (all part of the Flinders River catchment).

Northwest Highlands

At approximately KP 694WD, the corridor selection enters the Northwest Highlands bioregion. It rises to 220 m AHD as it crosses the Landsborough Highway and continues west across the Cloncurry River. The CopperString Core section terminates at the proposed Dajarra Road Substation, located approximately 3 km south of the Barkly Highway at an elevation of 220 m AHD.

From the Dajarra Road Substation, the Mount Isa Augmentation section of the corridor selection continues west across the sharp topography of the Northwest Highlands, which reflects the faulted, folded nature of the ancient underlying geology. The area is characterised by sharp ridges, elongated plateaux, and steep-sided tors, separated by narrow river valleys and broad, alluvial clay plains.

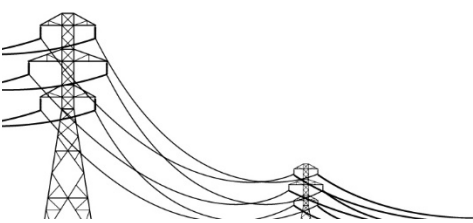
The corridor selection crosses the Corella River around KP 31DM. Just west of the Barkly Highway, the corridor selection enters an area of steep mountains, with elevations of up to 570 m AHD. It crosses Cameron Creek before crossing the Barkly Highway again and continuing west across the Leichhardt River East Branch, north of Lake Mary Kathleen. The corridor selection continues west and terminates west of the Leichhardt River at the proposed Mount Isa Substation.

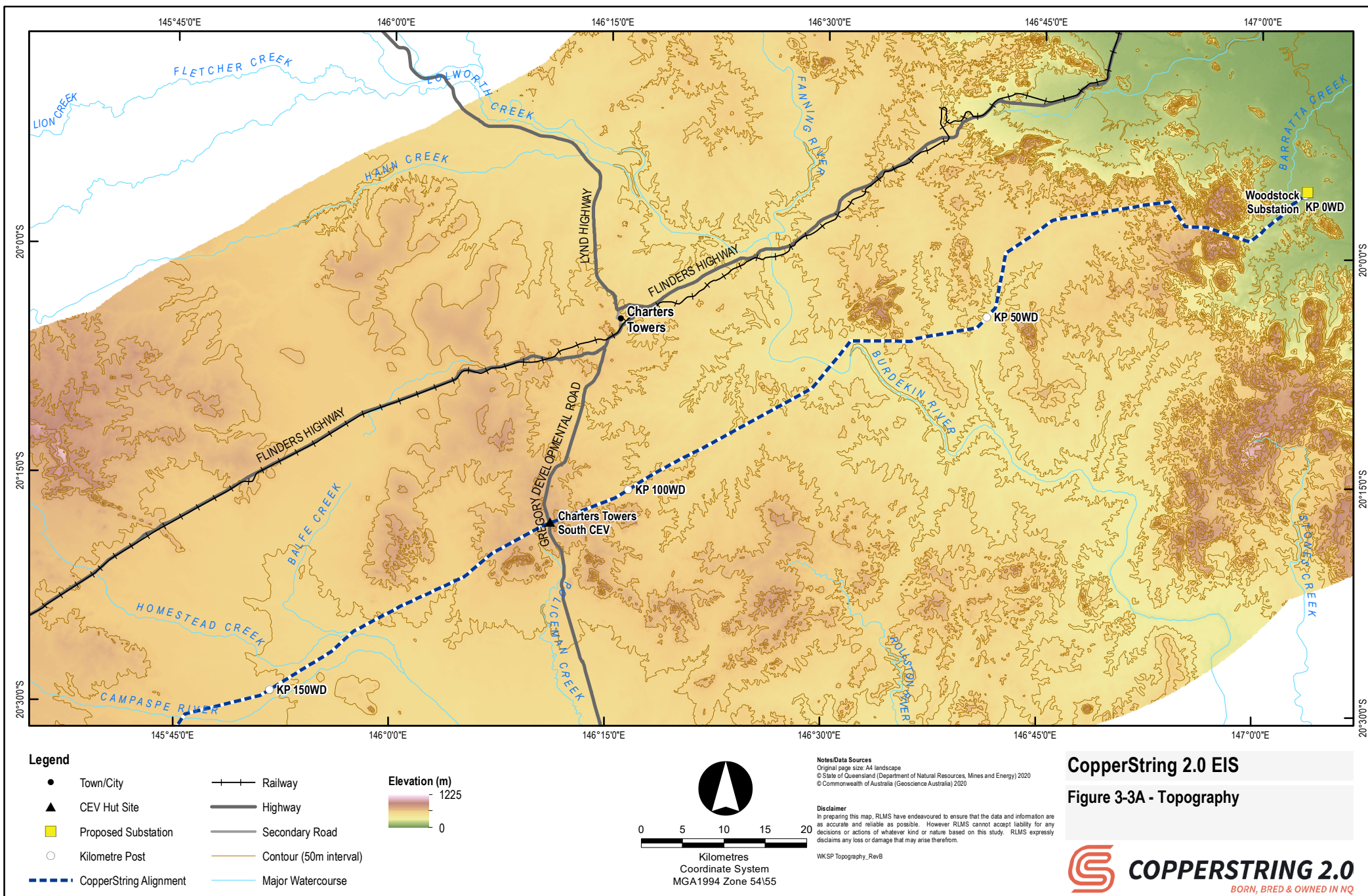
From the Dajarra Road Substation, near Cloncurry, the Southern Connection of the corridor selection traverses the Northwest Highlands in a southerly direction. It crosses Cloncurry Duchess Road just after KP 13DS, then heads south-south-east through the valleys of the steep-sided tors of the highlands. It then continues south and crosses the Cloncurry River at KP 39DS and again at KP 71DS, north of the Selwyn Ranges. Approximately 5 km west of the township of Selwyn, the Southern Connection heads south-east and continues for another approximately 39 km through the Selwyn Ranges before terminating at the Selwyn Substation.

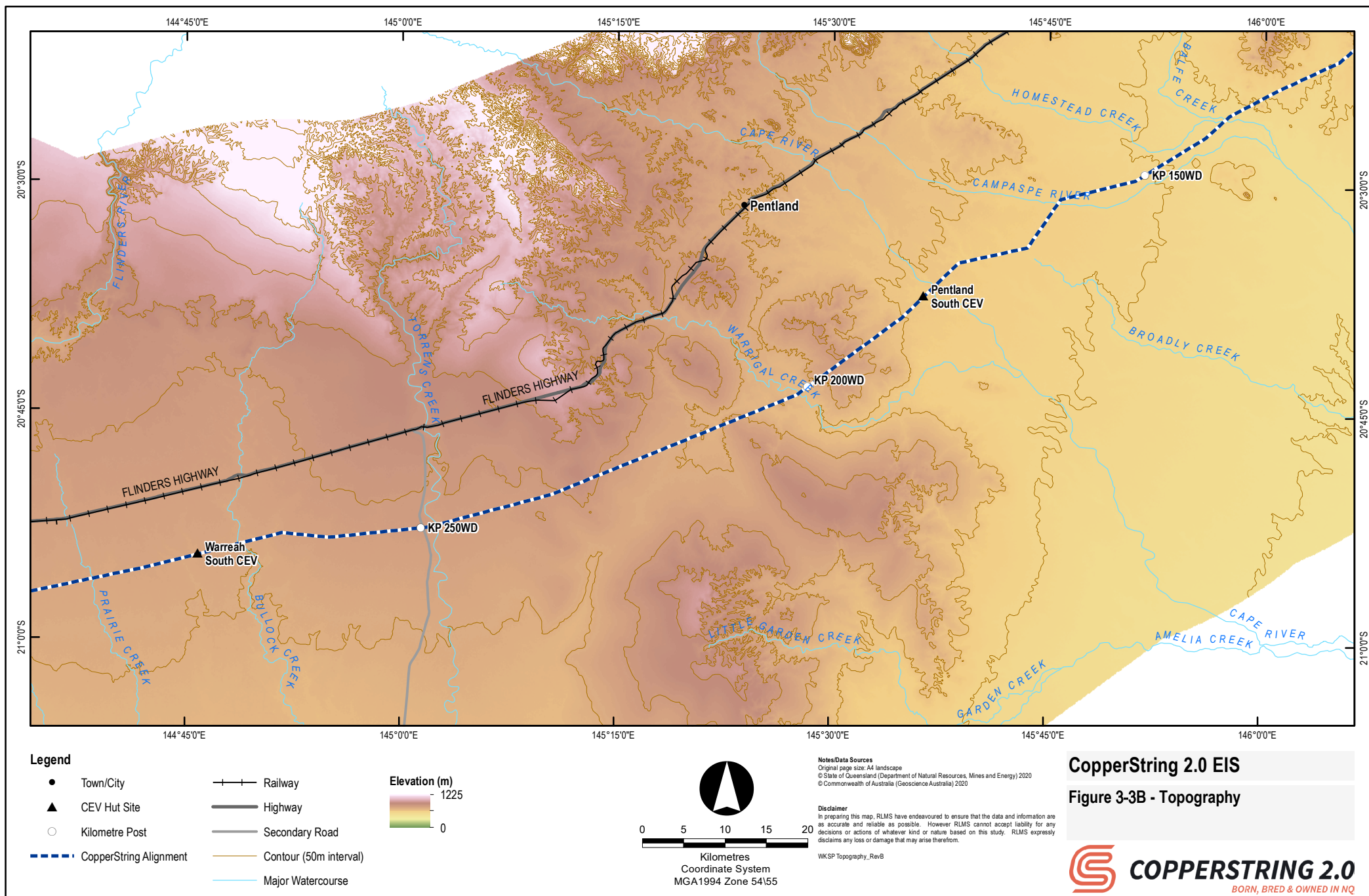
The Cannington Connection originates at the Selwyn Substation and heads west for approximately 10 km, then south-west for another 12 km before terminating at the Cannington Substation. The Cannington Connection is located within the Mitchell Grass Downs bioregion.

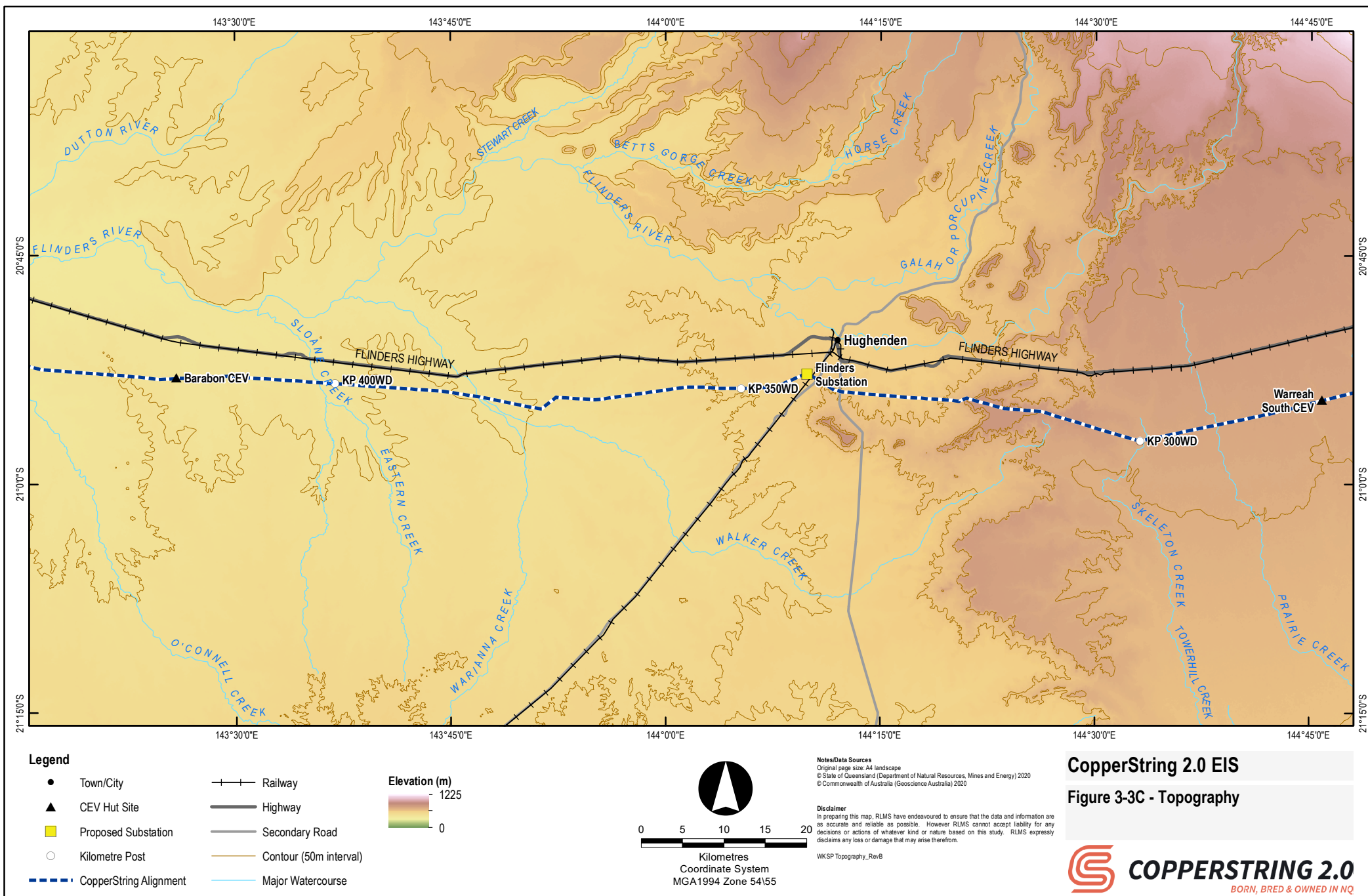
The Phosphate Hill Connection originates at approximately KP90DS on the Southern Connection and extends south-west through a flatter section of the Northwest Highlands, then enters the Mitchell Grass Downs bioregion at KP 25SP before crossing the Burke River and terminating at the Phosphate Hill Mine.

The topography of the corridor selection is illustrated in Figure 3-3.



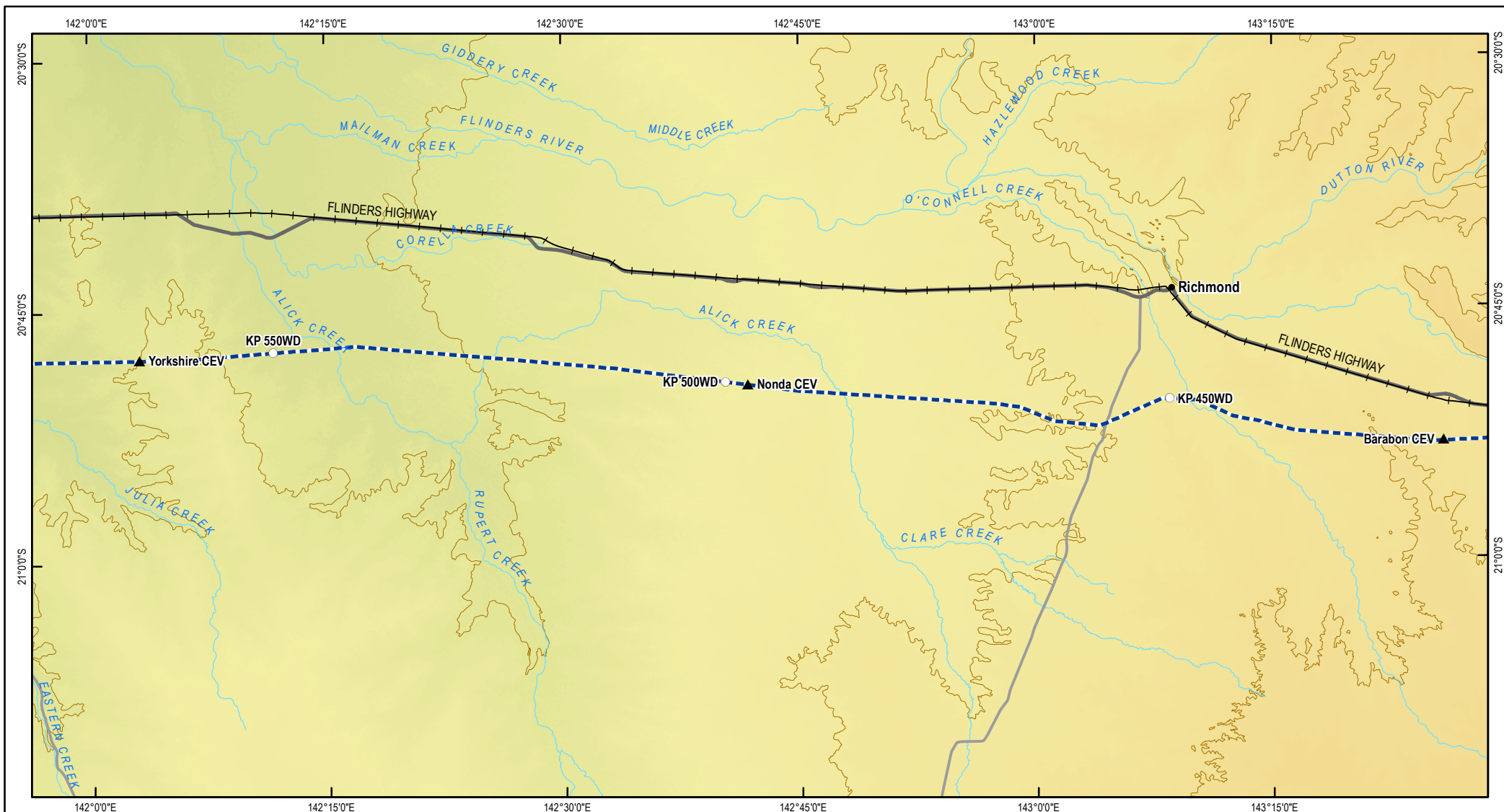






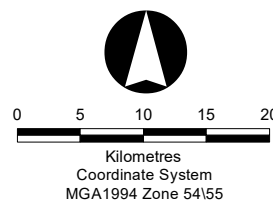
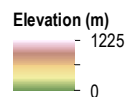
CopperString 2.0 EIS

Figure 3-3C - Topography



Legend

- Town/City
- ▲ CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Contour (50m interval)
- Major Watercourse



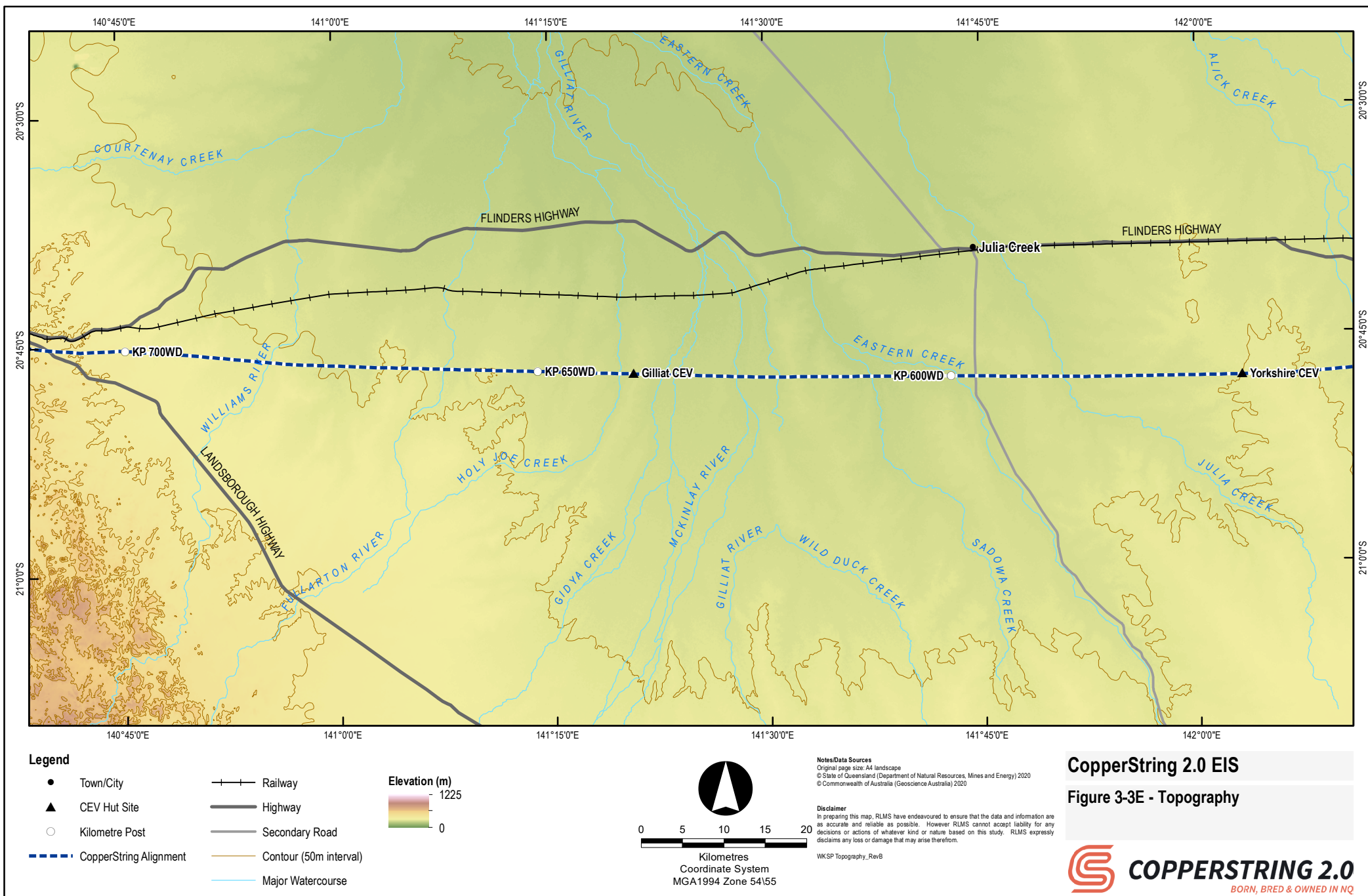
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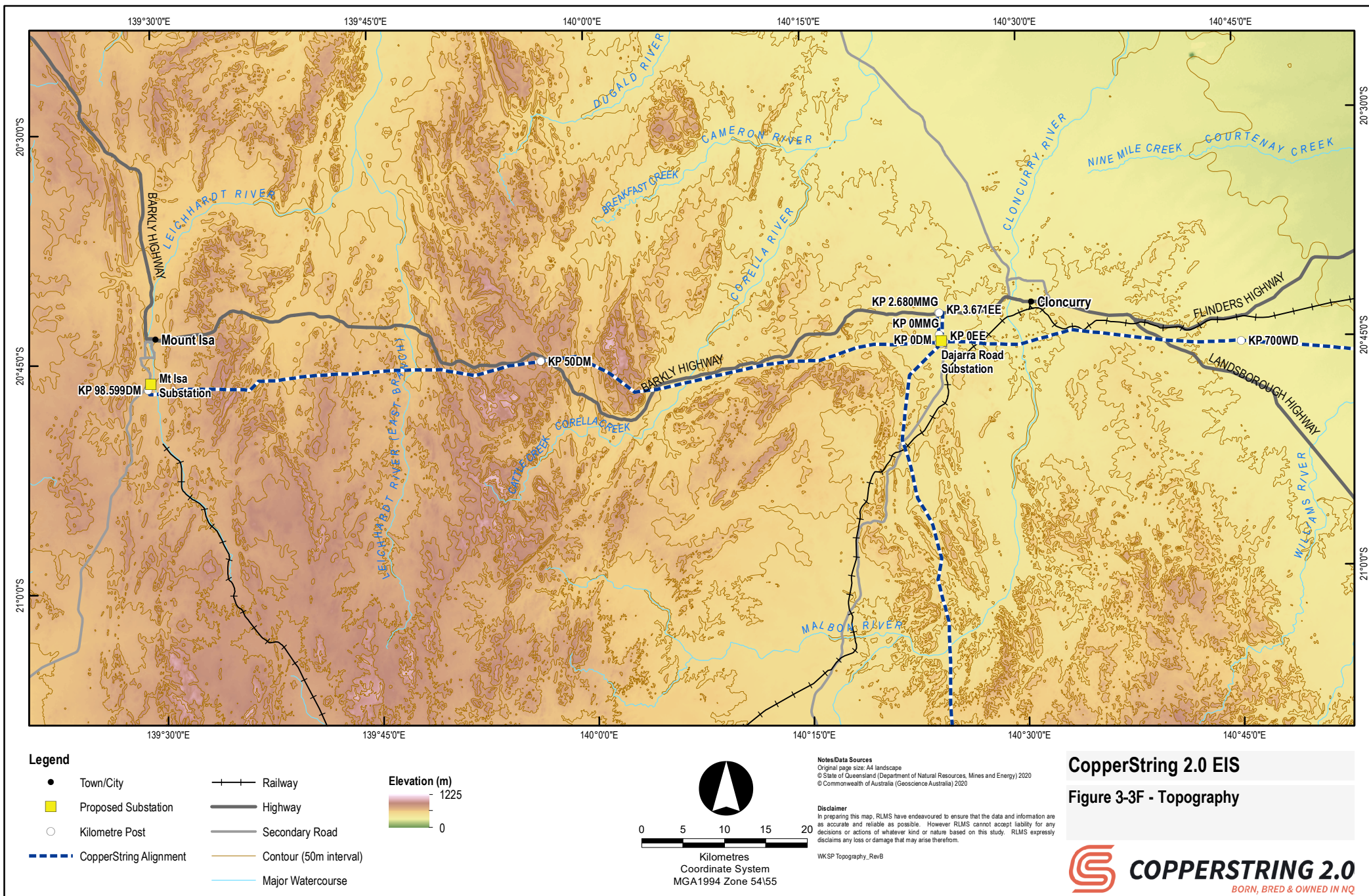
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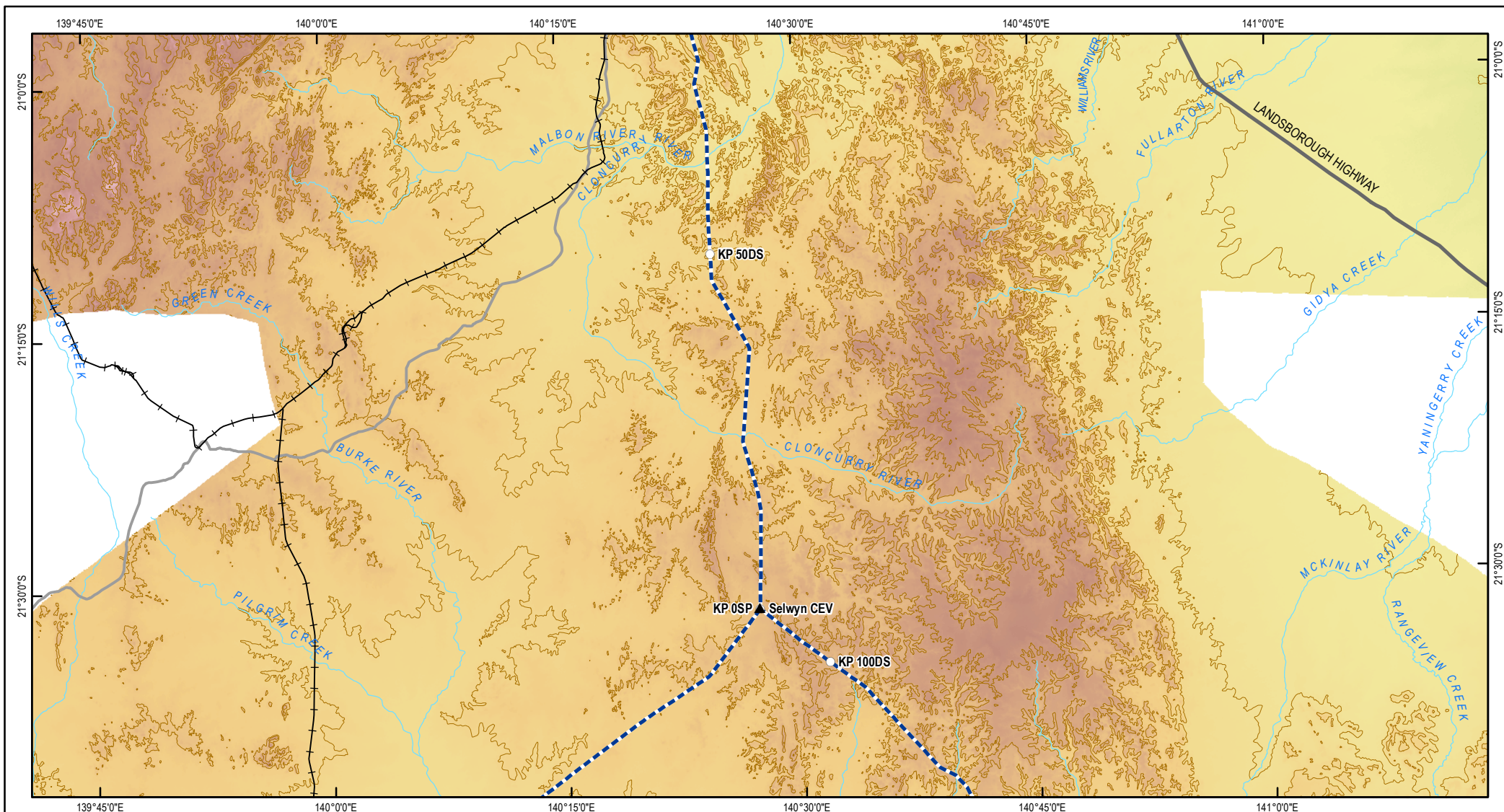
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Figure 3-3D - Topography

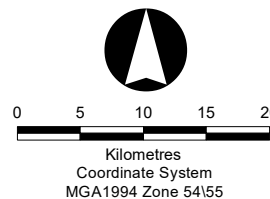
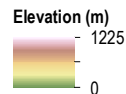






Legend

- ▲ CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Contour (50m interval)
- Major Watercourse



Notes/Data Sources

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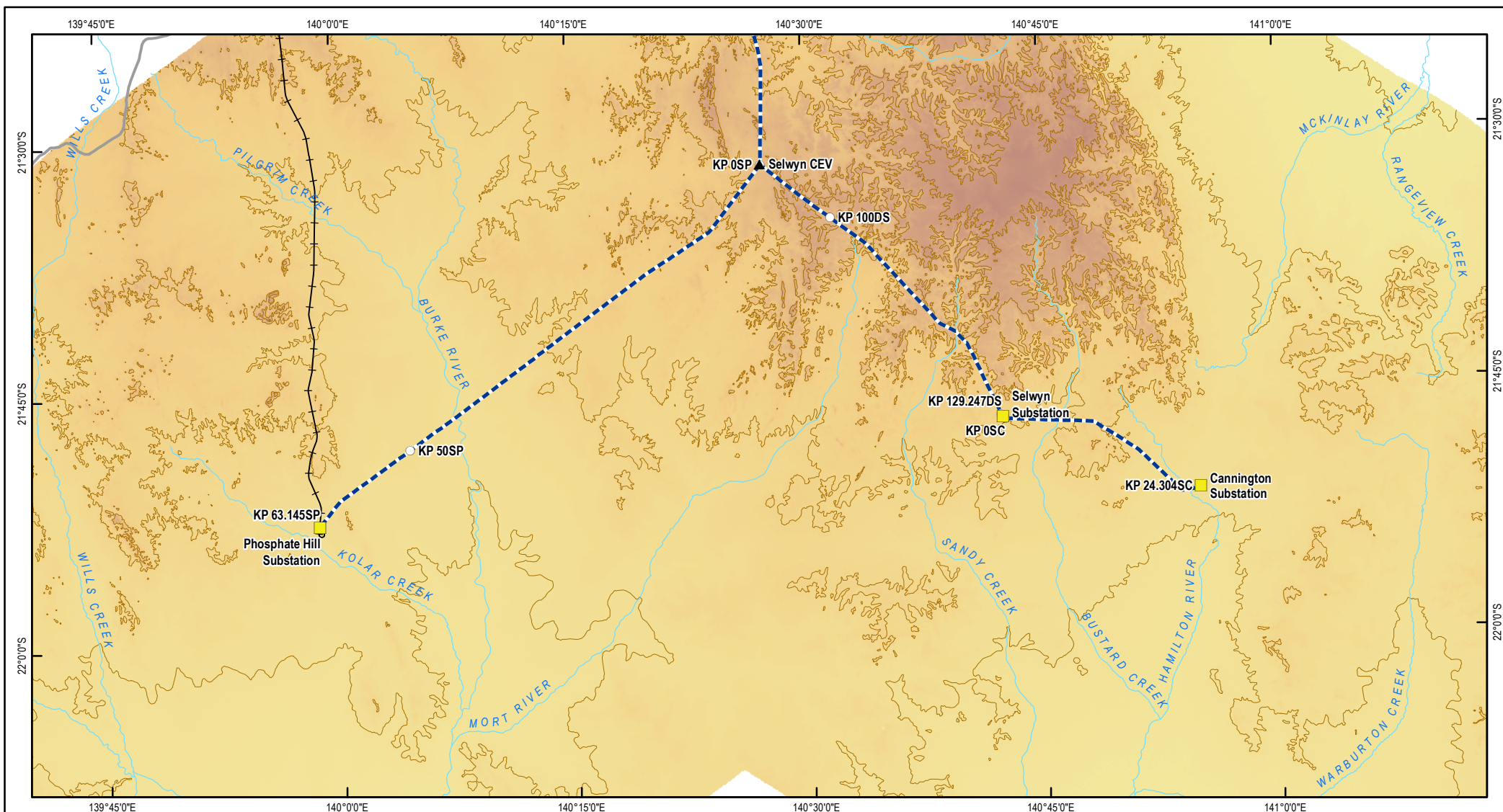
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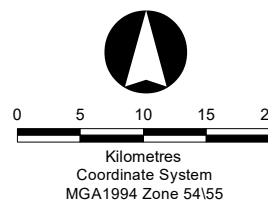
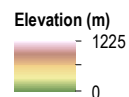
CopperString 2.0 EIS

Figure 3-3G - Topography



Legend

- ▲ CEV Hut Site
- Proposed Substation
- Kilometre Post
- CopperString Alignment
- +— Railway
- Secondary Road
- Contour (50m interval)
- Major Watercourse



Notes/Data Sources
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Figure 3-3H - Topography

Geology

Geology across the corridor selection area is highly complex. The following sections summarise the surface geology of the corridor selection. The simplified geology of the corridor selection is shown in Figure 3-4. More detailed information about geology, including geological cross-sections that are representative of the landscape can be found in Volume 2 Chapter 6 Geology and soils.

Einasleigh Uplands

Resistant basement rocks, comprising of granite and a mix of volcanic rocks including tuff and 'welded' air-fall pyroclastic types as well as lavas, dominate the Einasleigh Uplands region. To the south-east of Charters Towers alluvial and colluvial plains associated with large river systems prevail.

Desert Uplands

The majority of this bioregion passes over the broad colluvial and alluvial plains associated with the Cape and Campaspe Rivers. Here, the underlying Tertiary age Campaspe Formation comprises muddy sandstone. This area has been subject to intense tropical weathering.

Geological maps indicate that the higher topography in this region is made up of a highly varied range of rocks.

Mitchell Grass Downs

The Mitchell Grass Downs bioregion is a flat landscape that comprises river-borne and wind-blown (alluvial and aeolian) soils that overlie almost horizontal sequences of relatively young sandstone, muddy sandstone and limestone rock types. These sedimentary sequences are gently up-warped rocks that formed within a vast marine basin.

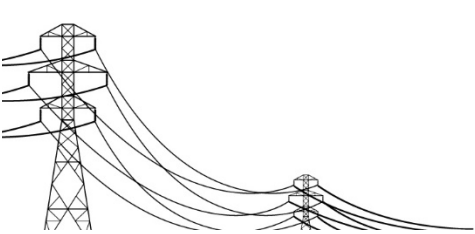
The strata are locally incised by rivers, exposing tropical weathering characteristics. This region represents a relatively tectonically stable zone of sedimentary accumulation and basin formation.

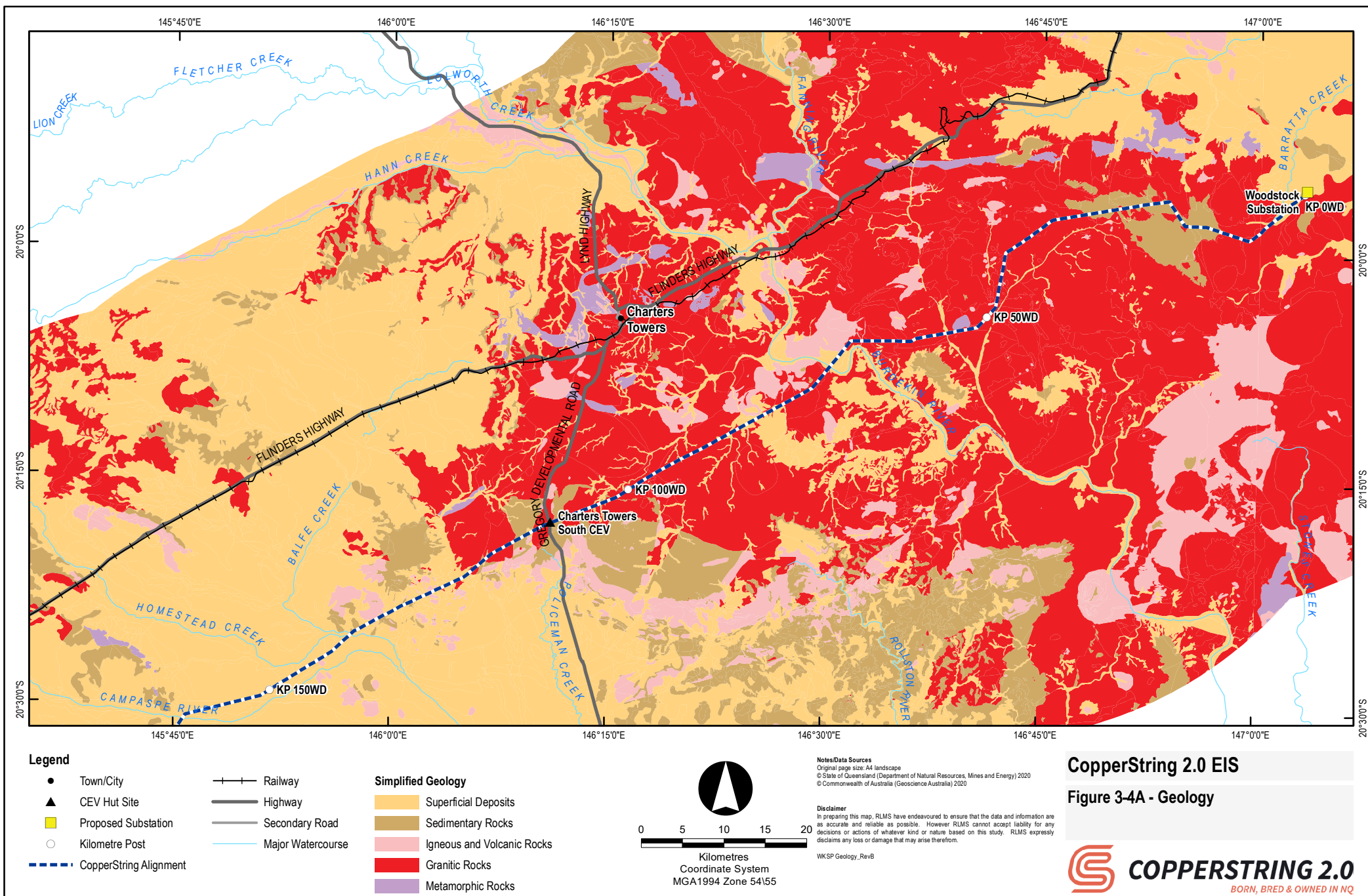
Gulf Plain

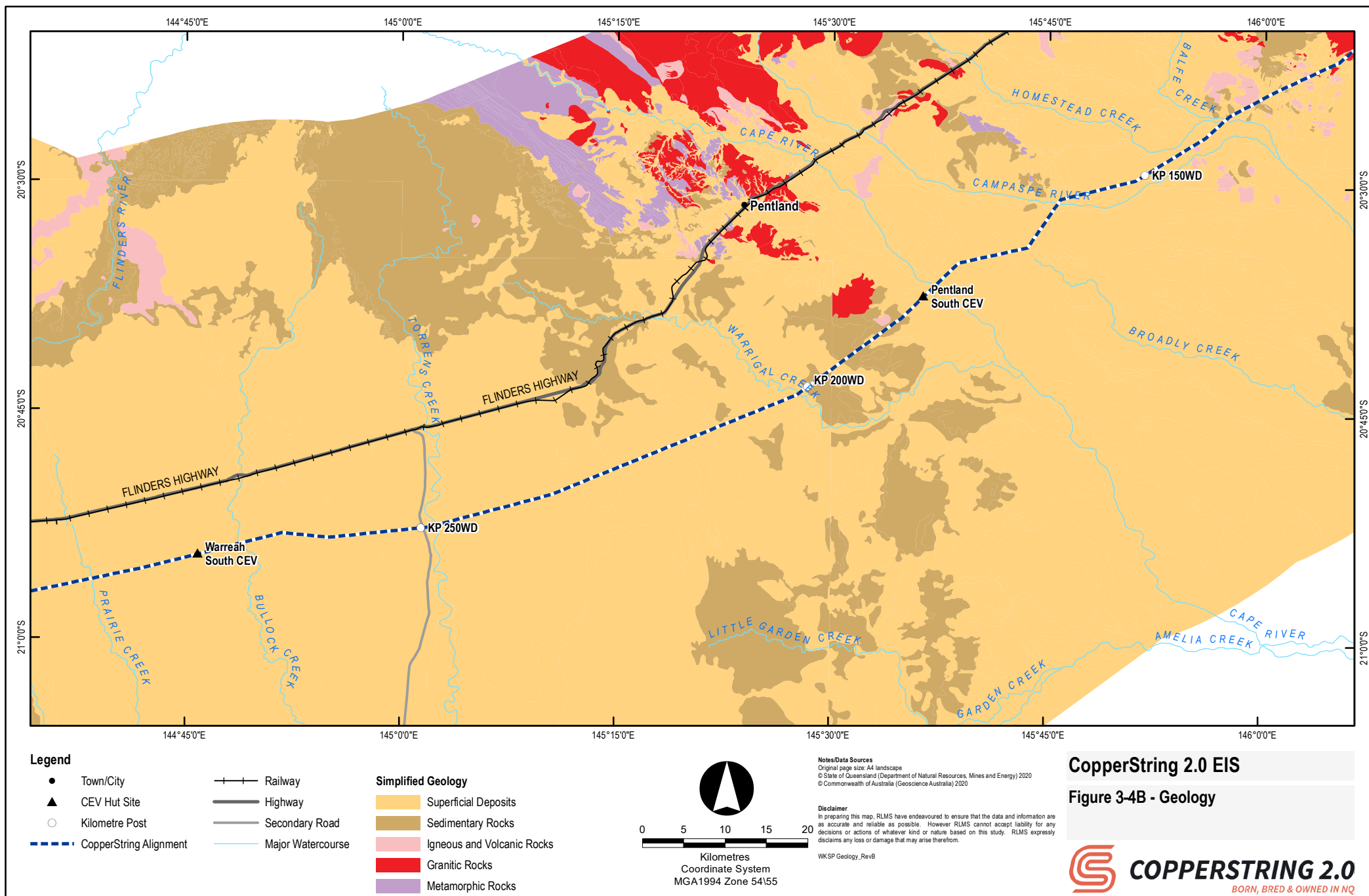
The Gulf Plains bioregion has similar geology to the Mitchell Grass Downs bioregion, with a flat landscape overlying sequences of sedimentary rock types. Typically, there is a thickening of the overlying sedimentary deposits to the west (between Julia Creek and Cloncurry). The corridor selection traverses areas of volcanic and metamorphic stratified rock units associated with Toolebuc Formation.

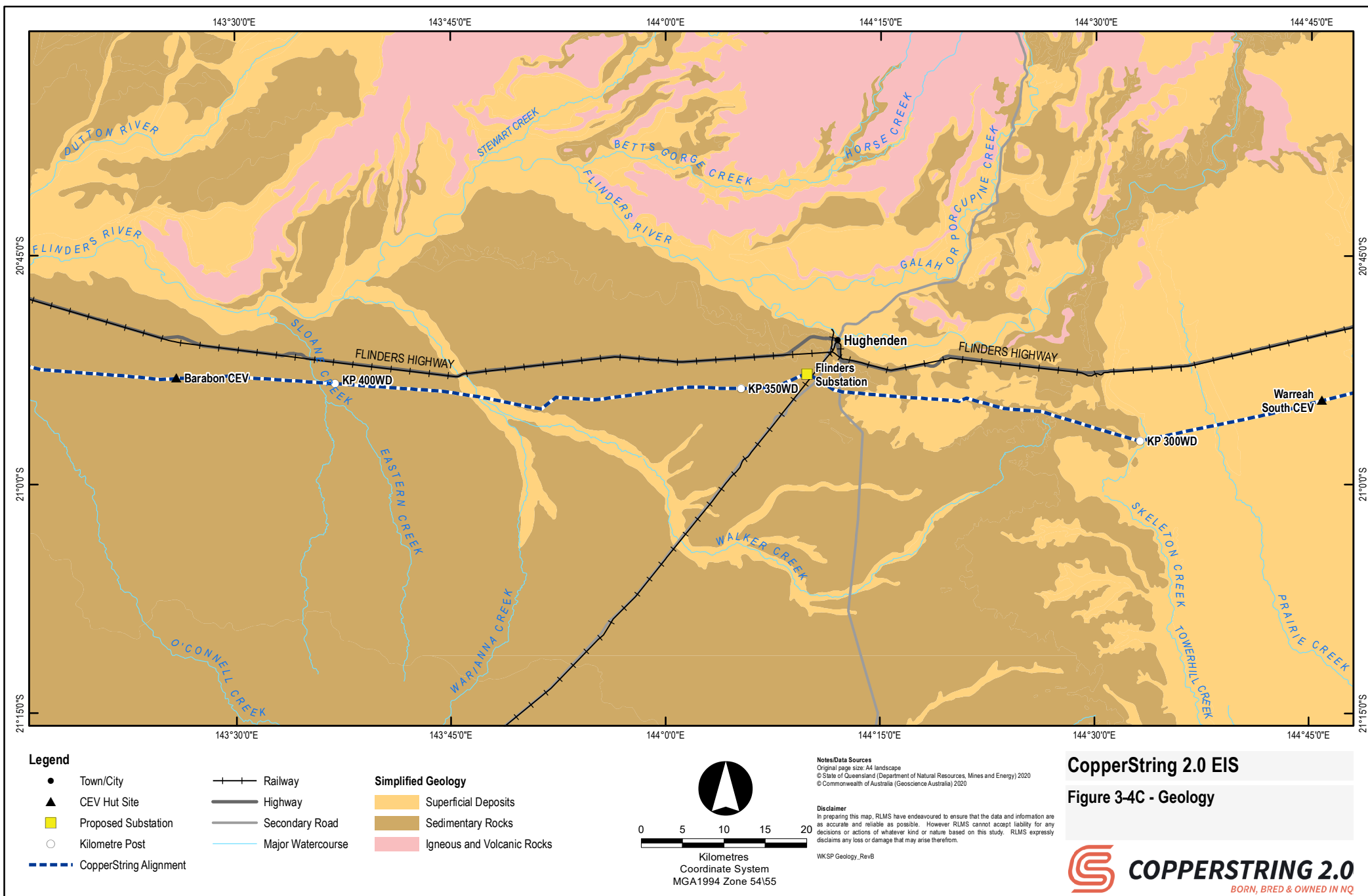
Northwest Highlands

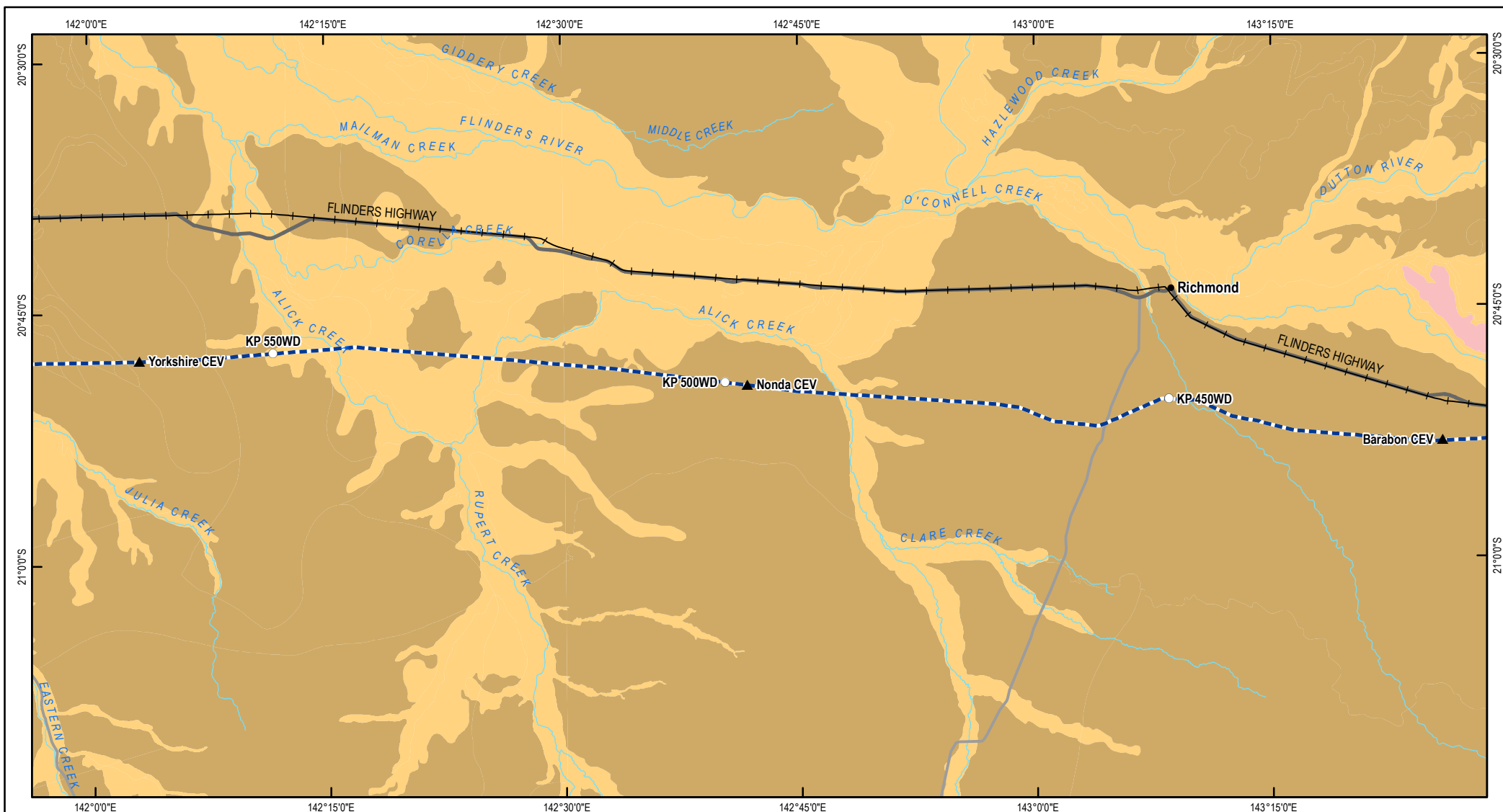
The Northwest Highlands area is known for its complex geology. It comprises an area of relatively low, steep-sided ridges and hills comprising resistant igneous rock types interspersed within metamorphosed (predominantly sandstone and mudstone) sediments. Flat land between the ridges may comprise ancient colluvium, intermixed clay, sand gravel and cobbles, partially reworked by river action.









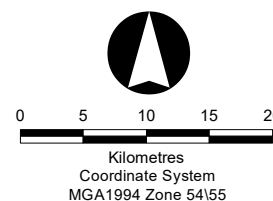


Legend

- Town/City
- ▲ CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Major Watercourse

Simplified Geology

- Yellow: Superficial Deposits
- Brown: Sedimentary Rocks
- Pink: Igneous and Volcanic Rocks



Notes/Data Sources

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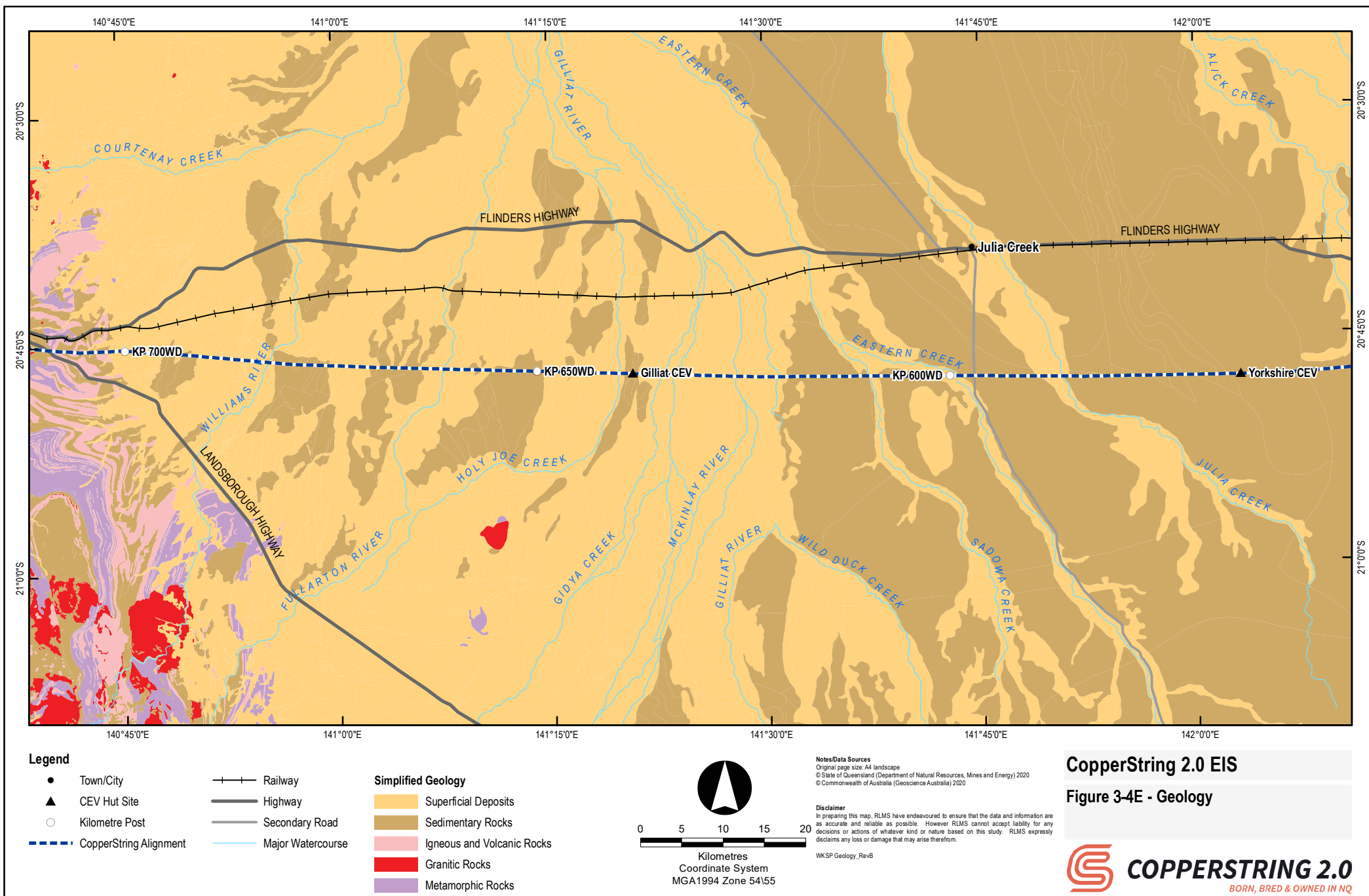
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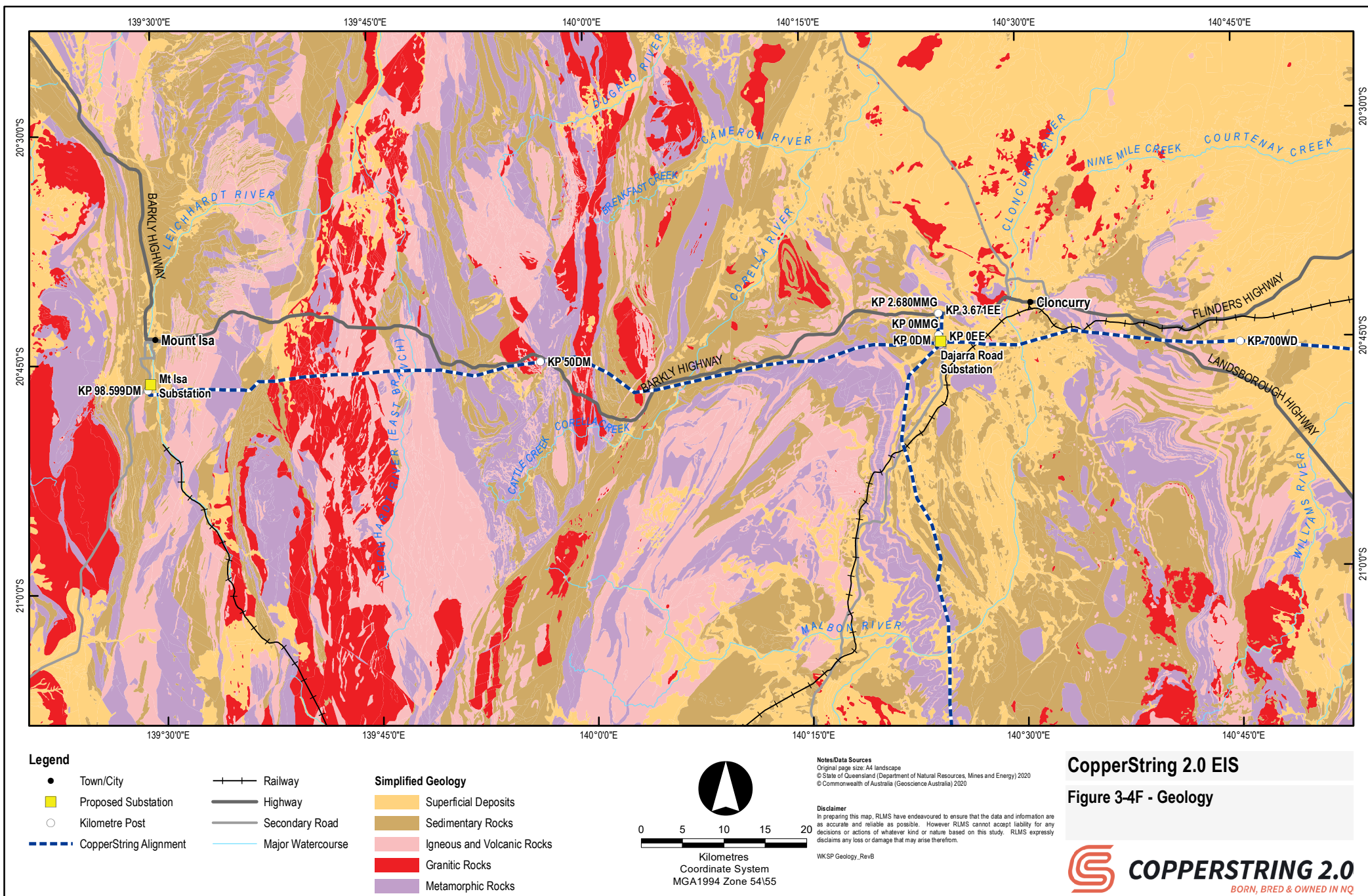
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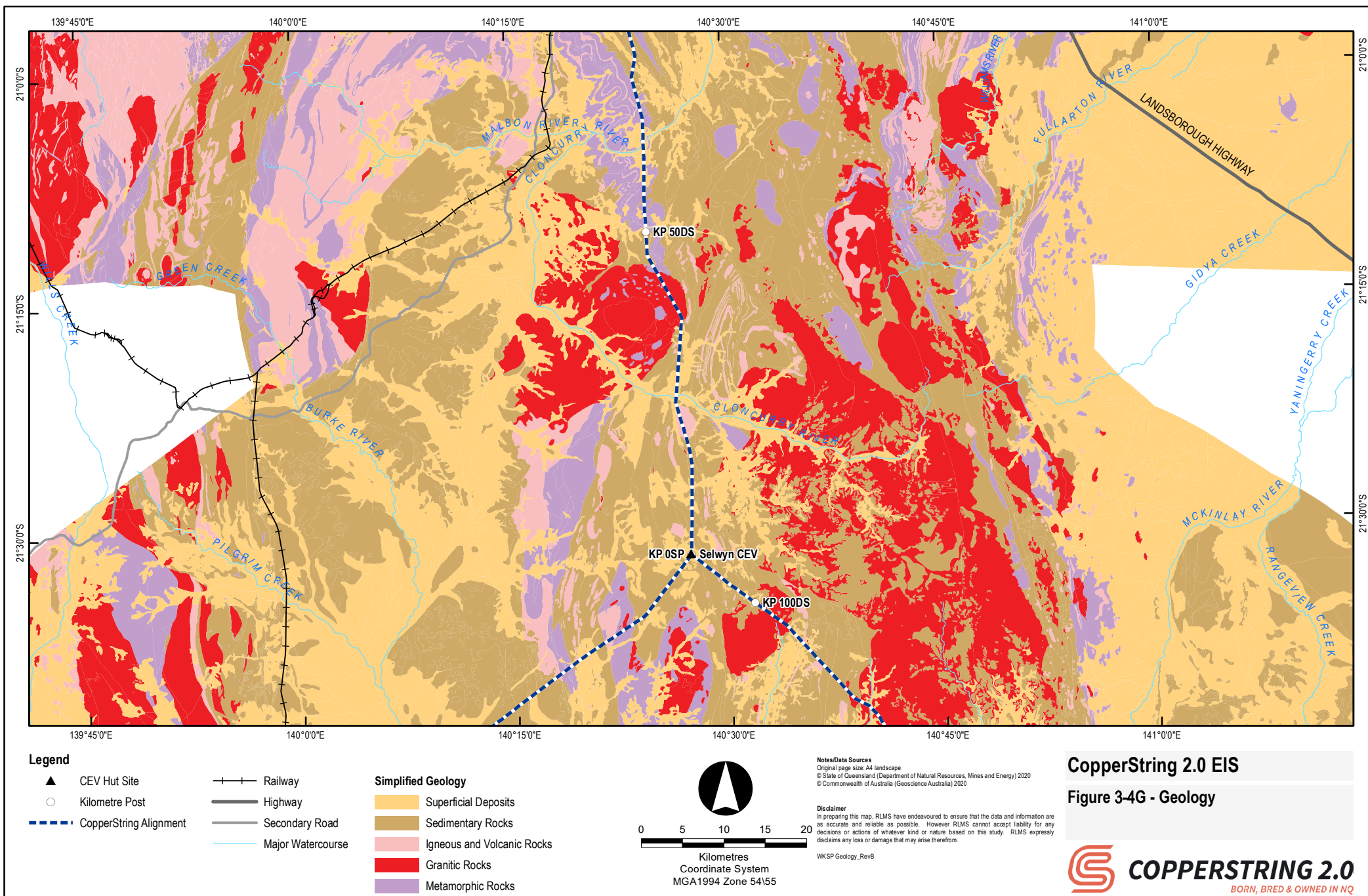
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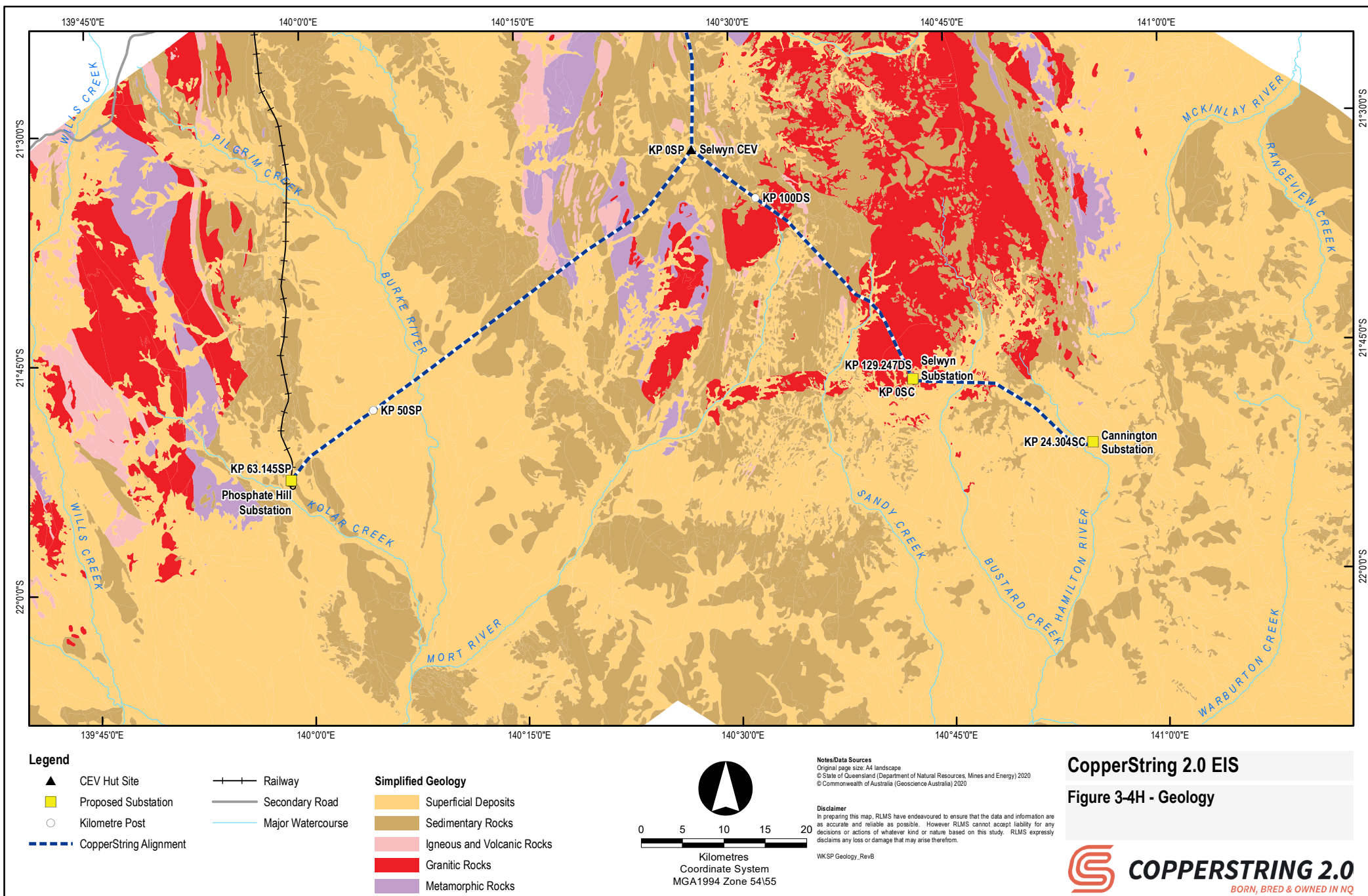
Figure 3-4D - Geology









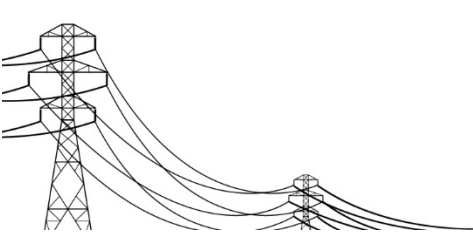


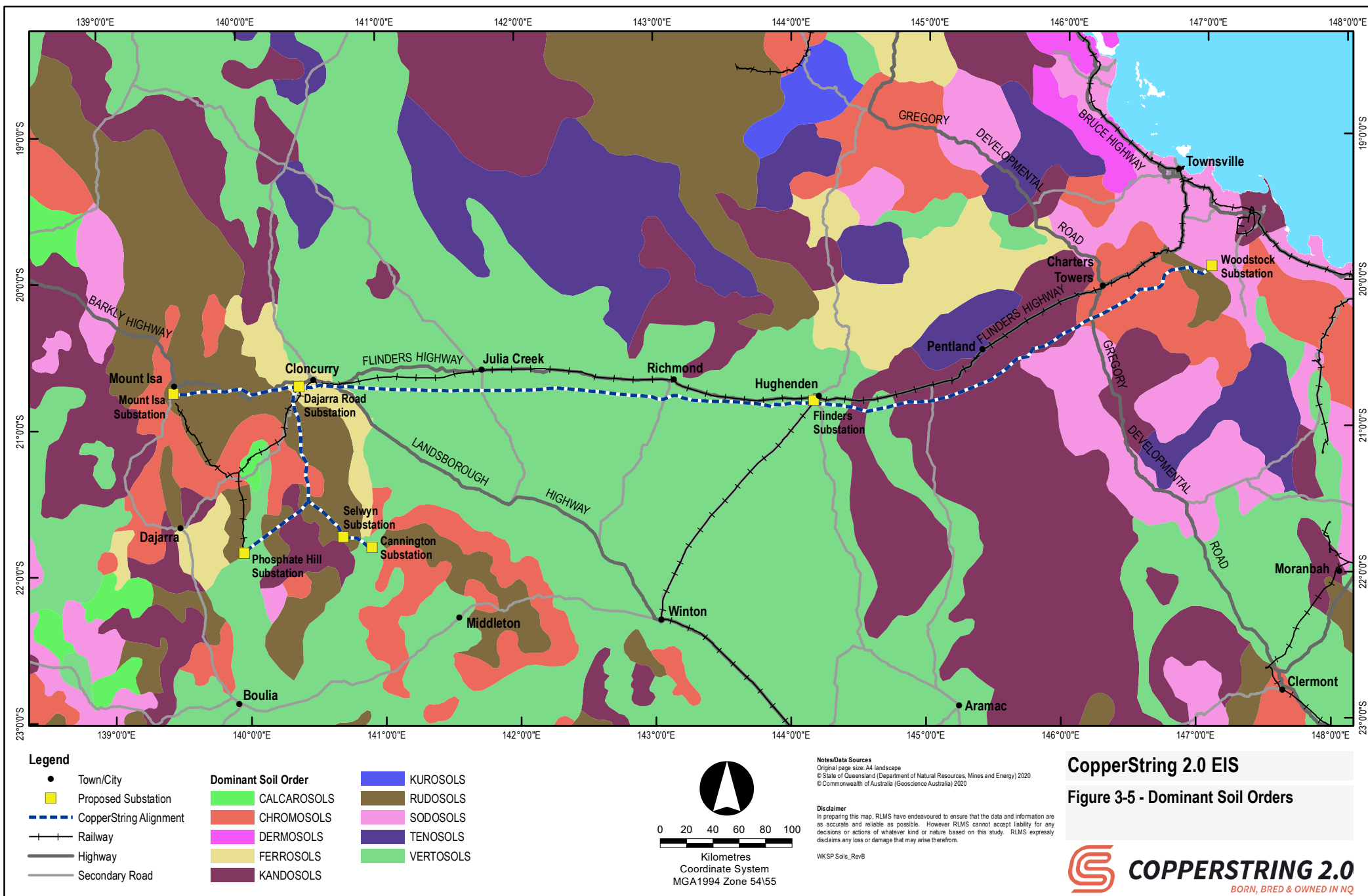
Soil types

The dominant soil types found in the corridor selection are described in Table 3-2 and are shown in Figure 3-5. Soils are discussed further in Volume 2 Chapter 6 Geology and soils.

Table 3-2 Dominant land units within bioregions of the study area

Soil type	Description
Einasleigh Uplands	
Sodosols	Strong texture contrast (i.e. shows a clear boundary between the sandy to loamy surface soil and the clay subsoil)
Rudosols	Either deep layered alluvial soils (stratic) or shallow stony soils (leptic), associated with watercourses
Chromosols	Strong texture contrast with surface loamy soil and clay subsoil. May be located on flat alluvial areas and on sloping land
Desert Uplands	
Kandosols	Sandy loam in the surface which may increase in clay content with depth to sandy light clay in the subsoil
Sodosols	Strong texture contrast
Vertosols	Cracking clay soils of uniform texture
Mitchell Grass Downs	
Vertosols	Cracking clay soils
Gulf Plains	
Vertosols	Cracking clay soils
Northwest Highlands	
Ferrosols	High in free iron oxide in the subsoil. Lacking texture contrast
Rudosols	Either deep layered alluvial soils (stratic) or shallow stony soils (leptic), associated with watercourses
Chromosols	Texture contrast with surface loamy soil and clay subsoil. May be located on flat alluvial areas and on sloping land
Kandosols	Sandy loam in the surface which may increase in clay content with depth to sandy light clay in the subsoil





3.3.3 Watercourses

The corridor selection traverses numerous watercourses, with significant river systems that drain to the following catchments:

- Haughton River
- Burdekin River
- Flinders River
- Leichhardt River
- Georgina River.

Many rivers and creeks within the study area are typically ephemeral, only flowing in response to rainfall events. Most watercourses within the study area have steep sides with bed-level lowering. Many show signs of bank erosion and bed scour. The rivers are typically tree-lined, with tree roots increasing bank stability.

River channels display continuous channel patterns (either anastomosing, meandering or braided) that depend largely on the bed slope and flow magnitudes.

Major watercourses are indicated on Figure 3-1. More detailed information about watercourses and catchments is included in Volume 2, Chapter 9 Water resources and water quality.

3.3.4 Contaminated land

Contaminated Land Register/Environmental Management Register

Desktop reviews have been undertaken to determine any potential contaminated land within properties in the corridor selection.

There are no properties listed on the Contaminated Land Register within the corridor selection however the Environmental Management Register lists 17 properties that are at risk of becoming contaminated due to Notifiable Activities. Notifiable Activities are defined in the *Environmental Protection Act 1994* as activities that have the potential to cause land contamination, such as service stations, cattle dips, tanneries, wood treatment sites, landfills, fuel storage and refuse tips.

A list of properties on the Environmental Management Register is included in Section 5.3.12 of Volume 2 Chapter 5 Land.

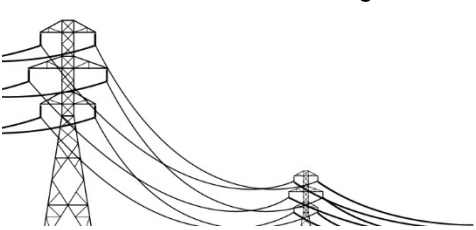
Unexploded ordnance

Unexploded ordnance (UXO) are ammunitions such as artillery shells, mortar bombs and grenades that have not exploded when used. UXO pose a risk to health and safety as they may detonate if disturbed and may also release hazardous chemicals into the environment. UXO are mainly found in Queensland on land formerly used by Australian and Allied Defence Forces for live firing of explosive ordnance, particularly during World War II.

Seven properties within the corridor selection have been identified as potentially containing UXO. These properties are located east of Charters Towers. Further details about UXO is included in Volume 2 Chapter 5 Land.

Locations and activities

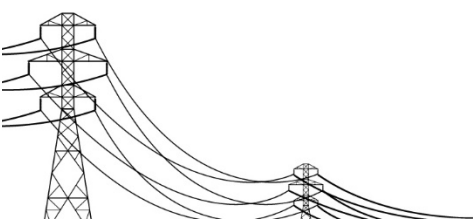
The corridor selection covers a vast area and involves approximately 1,060 km of extra high voltage overhead electricity transmission line. The transmission line will extend from a new

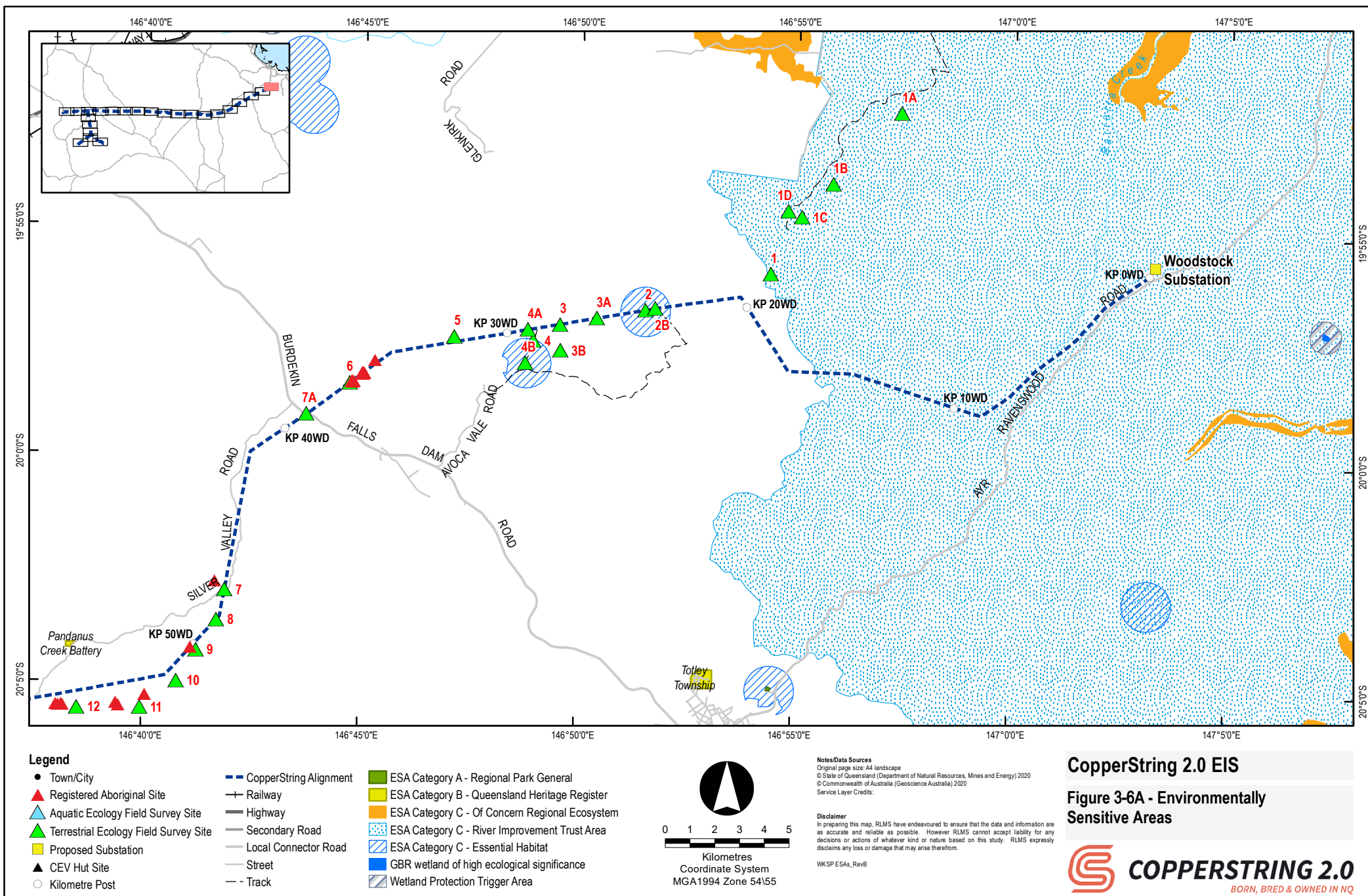


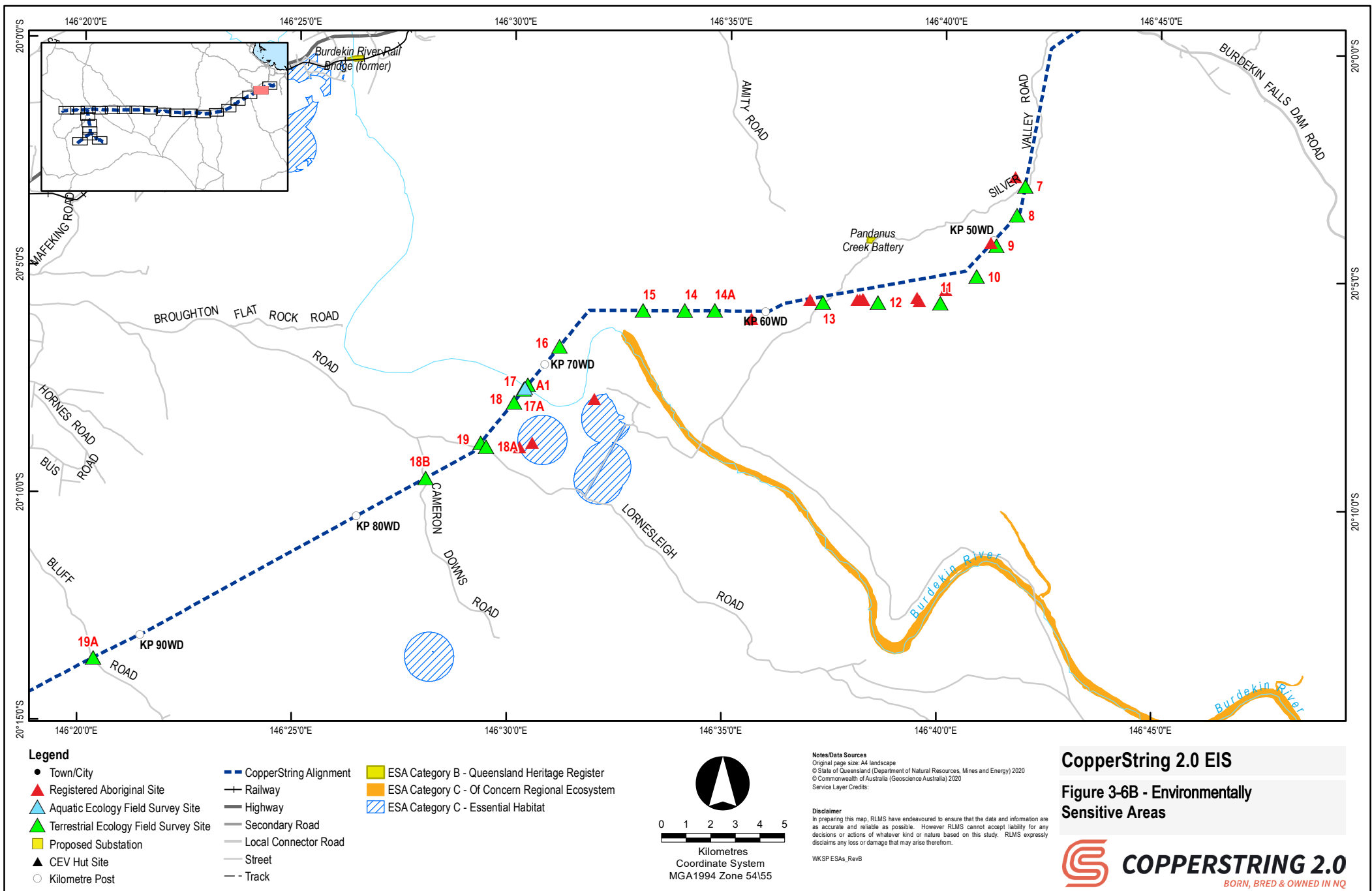
substation approximately 43 km south-east of Woodstock, , to Mount Isa in north-west Queensland. Additional sections of transmission line extend from the Dajarra Road Substation, near Cloncurry, south to Phosphate Hill Mine and Cannington Mine. Construction activities will involve the development of the transmission lines, substations, laydown areas, construction camps, communication huts, access tracks, and vegetation management. Details about these activities is included in Volume 1 Chapter 2 Project description.

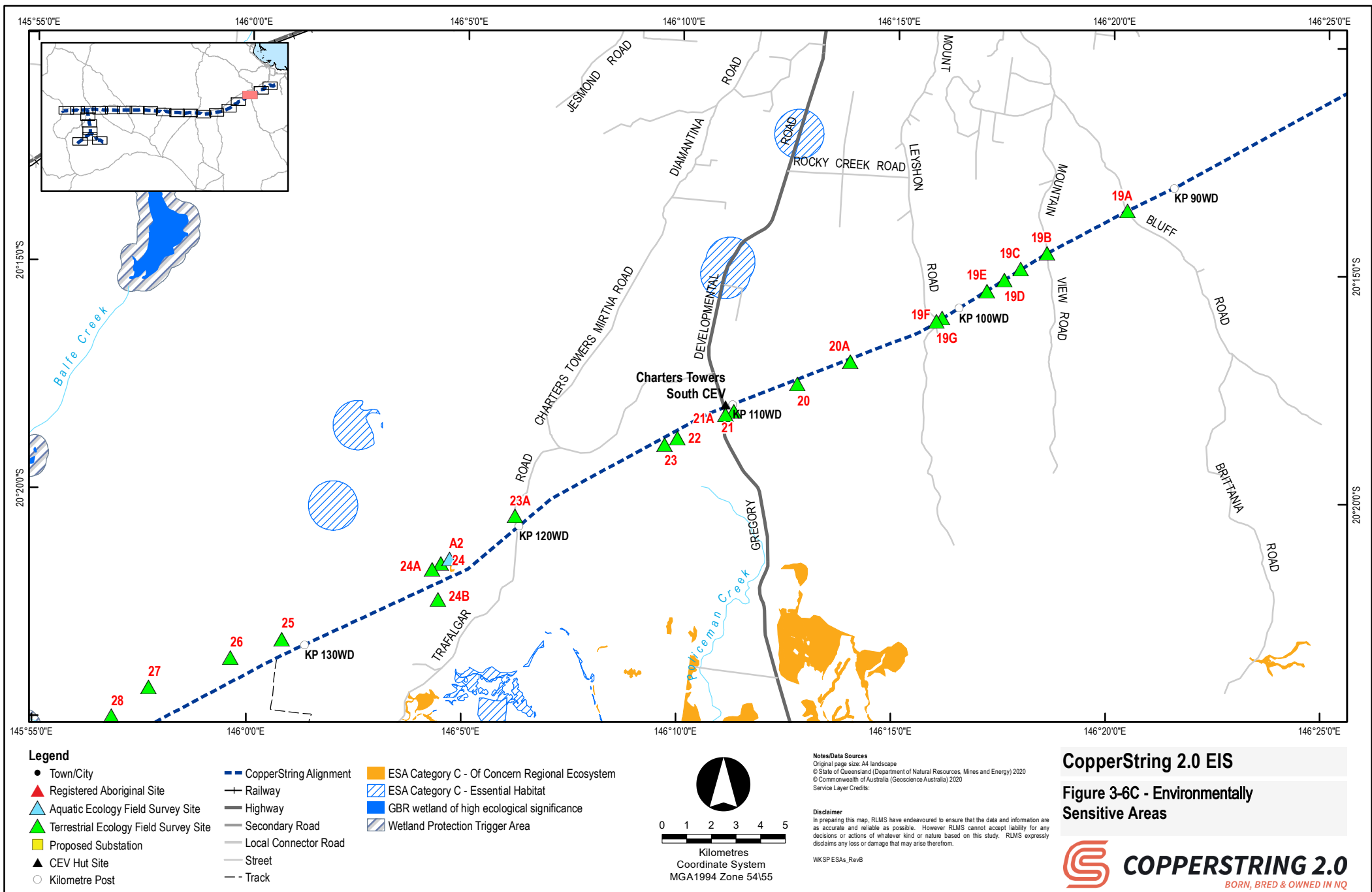
The corridor selection is located within proximity of several areas of conservation significance, including environmentally sensitive areas, regional ecosystems, threatened species, matters of state environmental significance and matters of national environmental significance (MNES). Further details about these areas is described in Volume 2 Chapter 18 Matters of national environmental significance and Volume 2 Chapter 7 Flora and fauna.

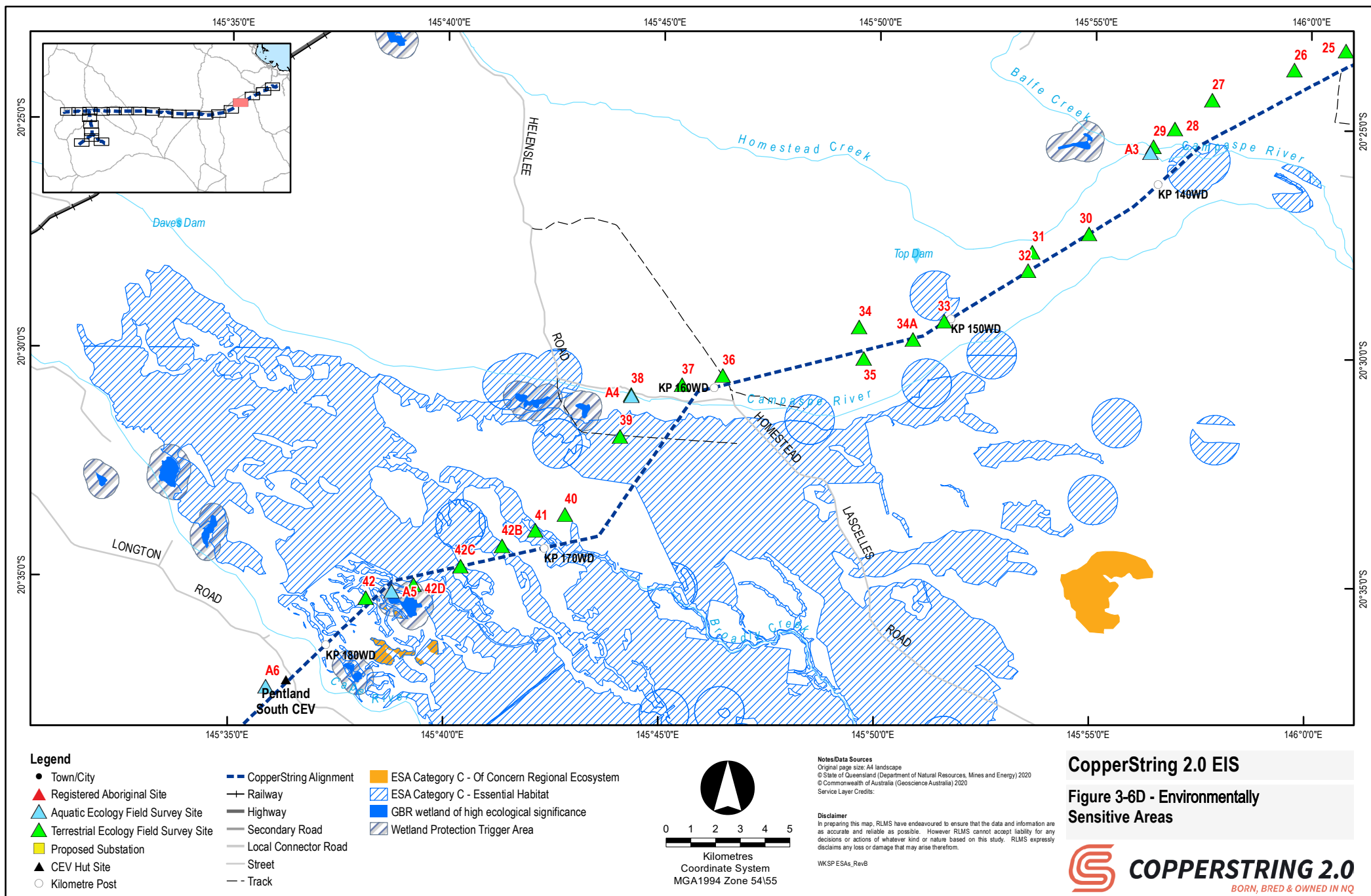
Figure 3-6 shows the Project location in relation to environmentally sensitive areas.

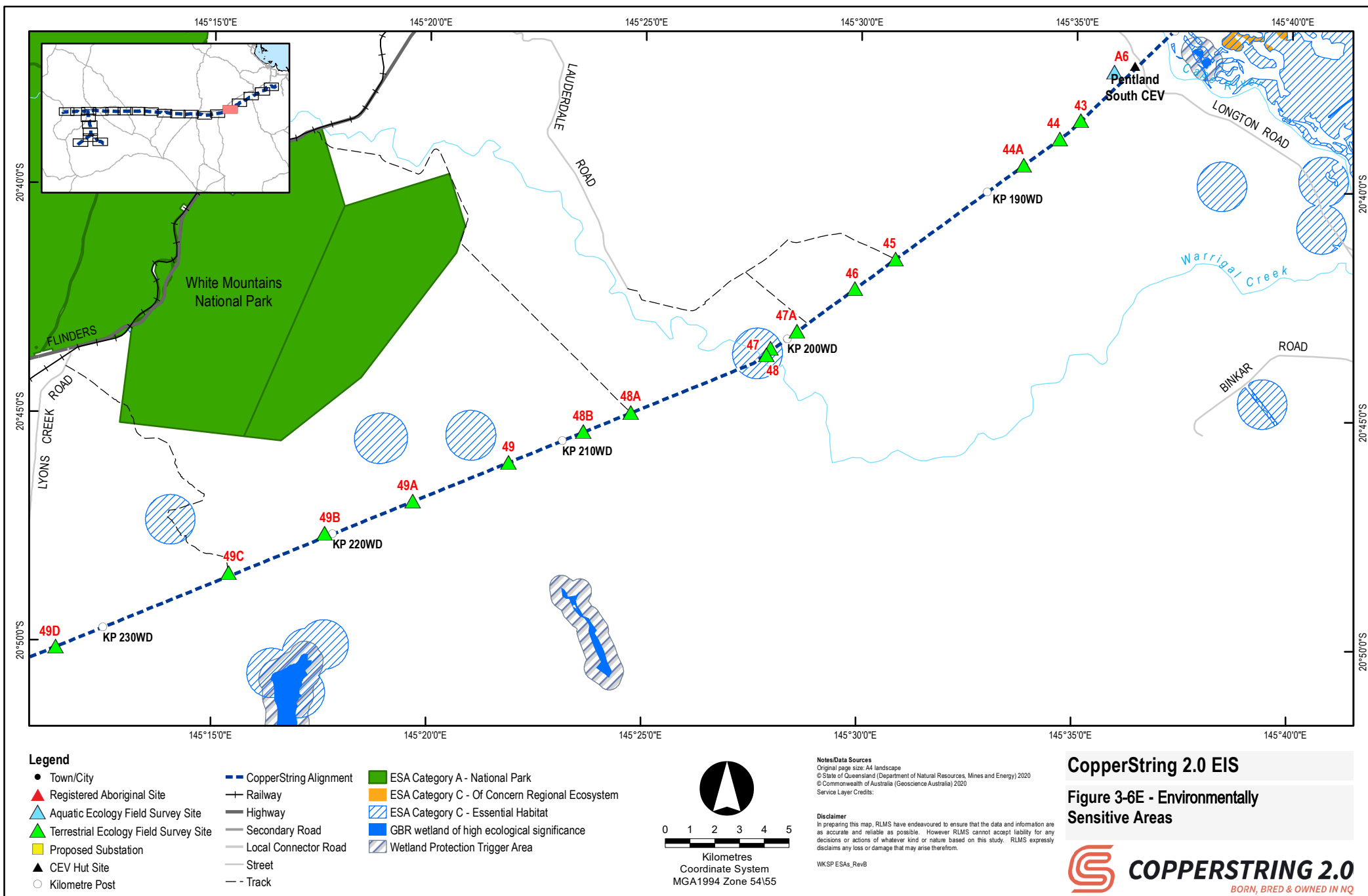






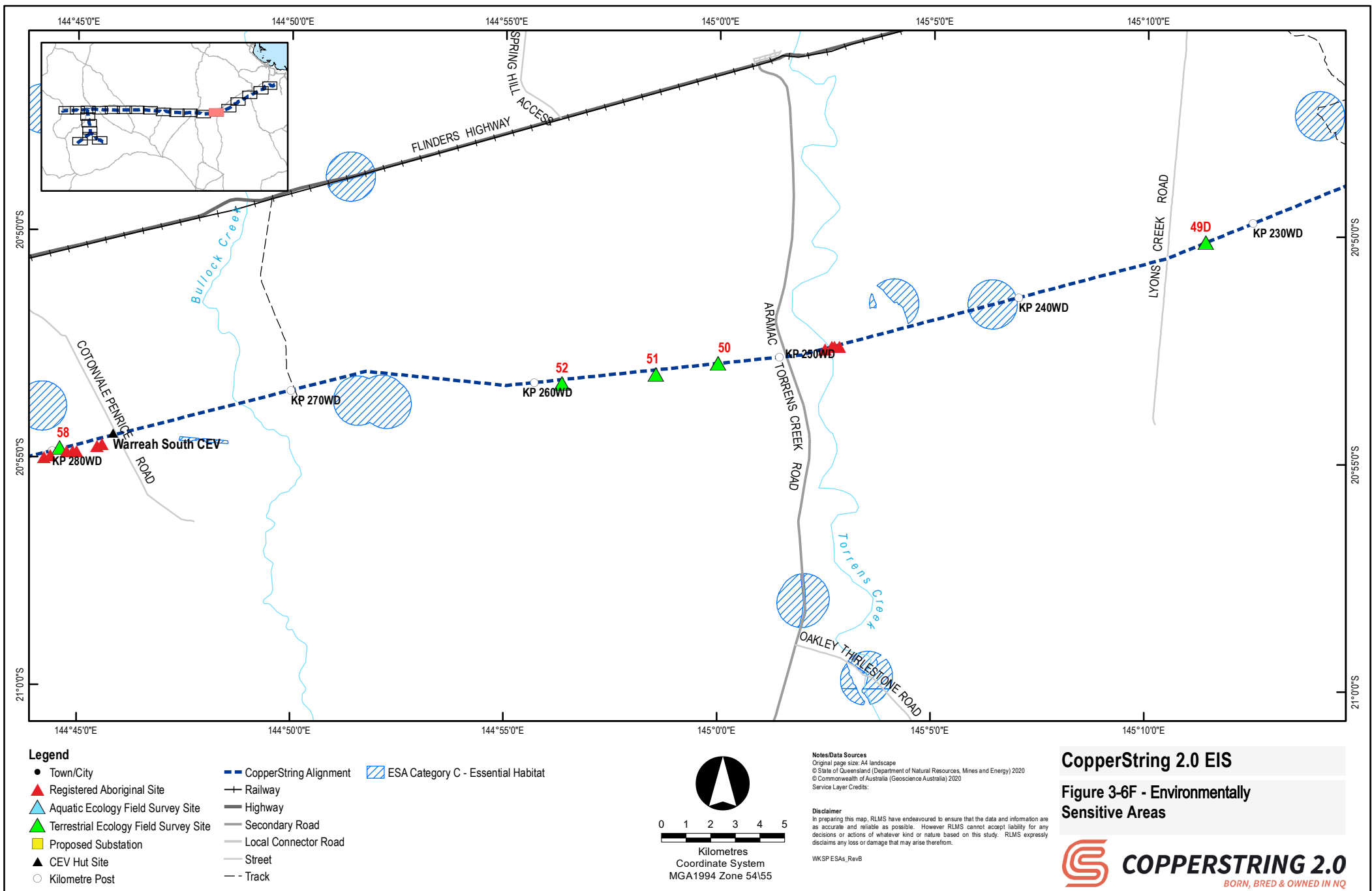


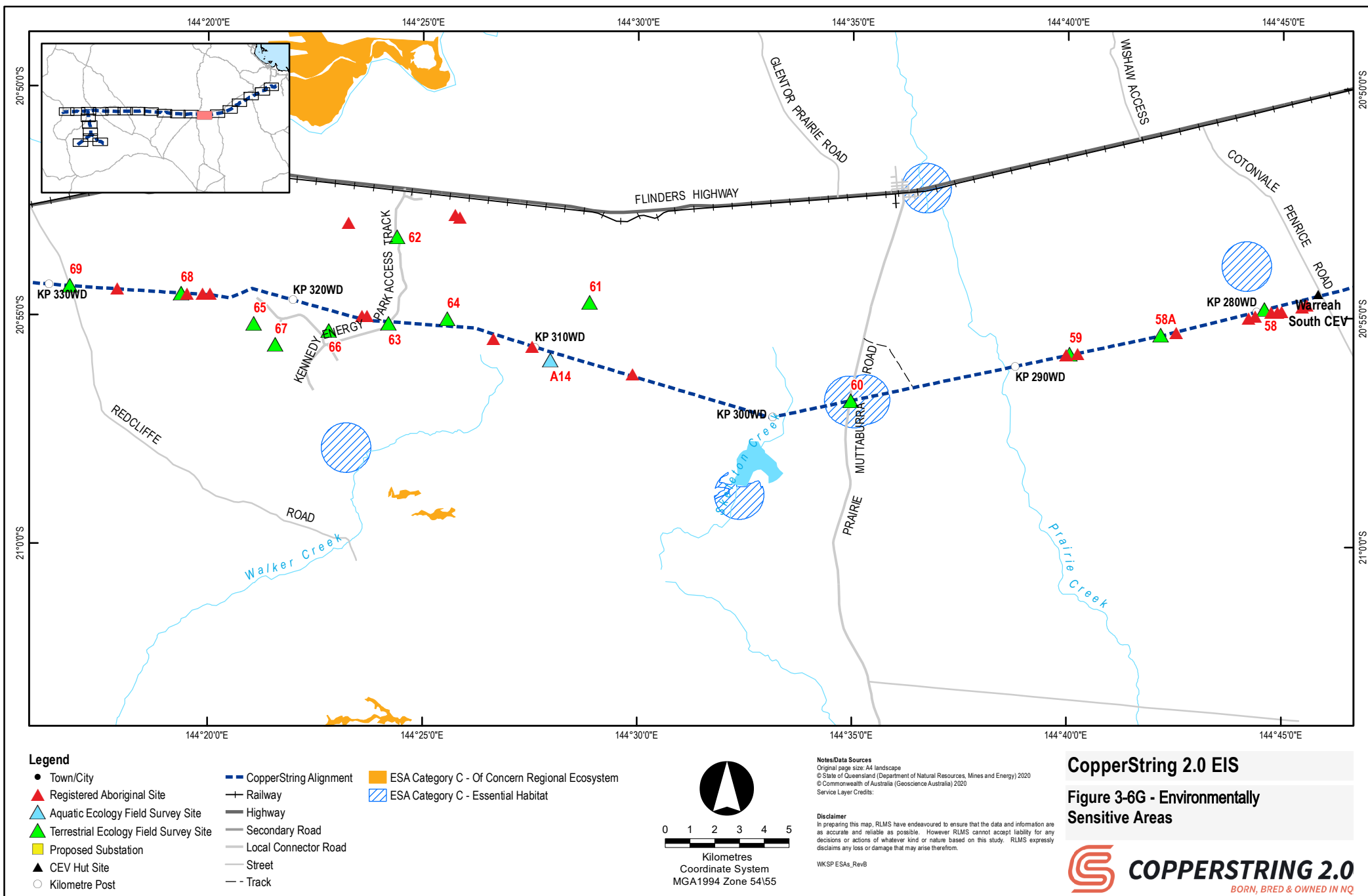


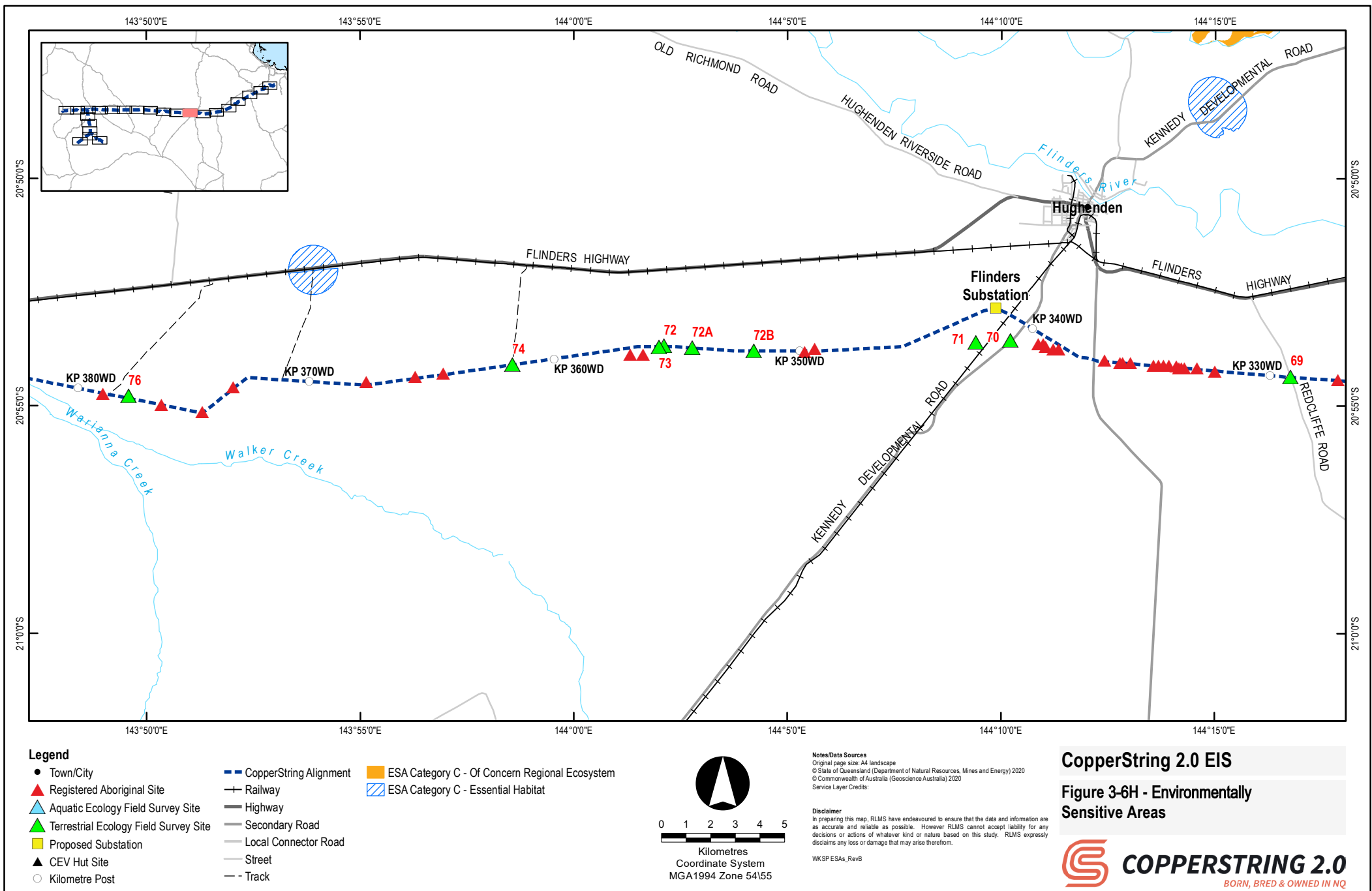


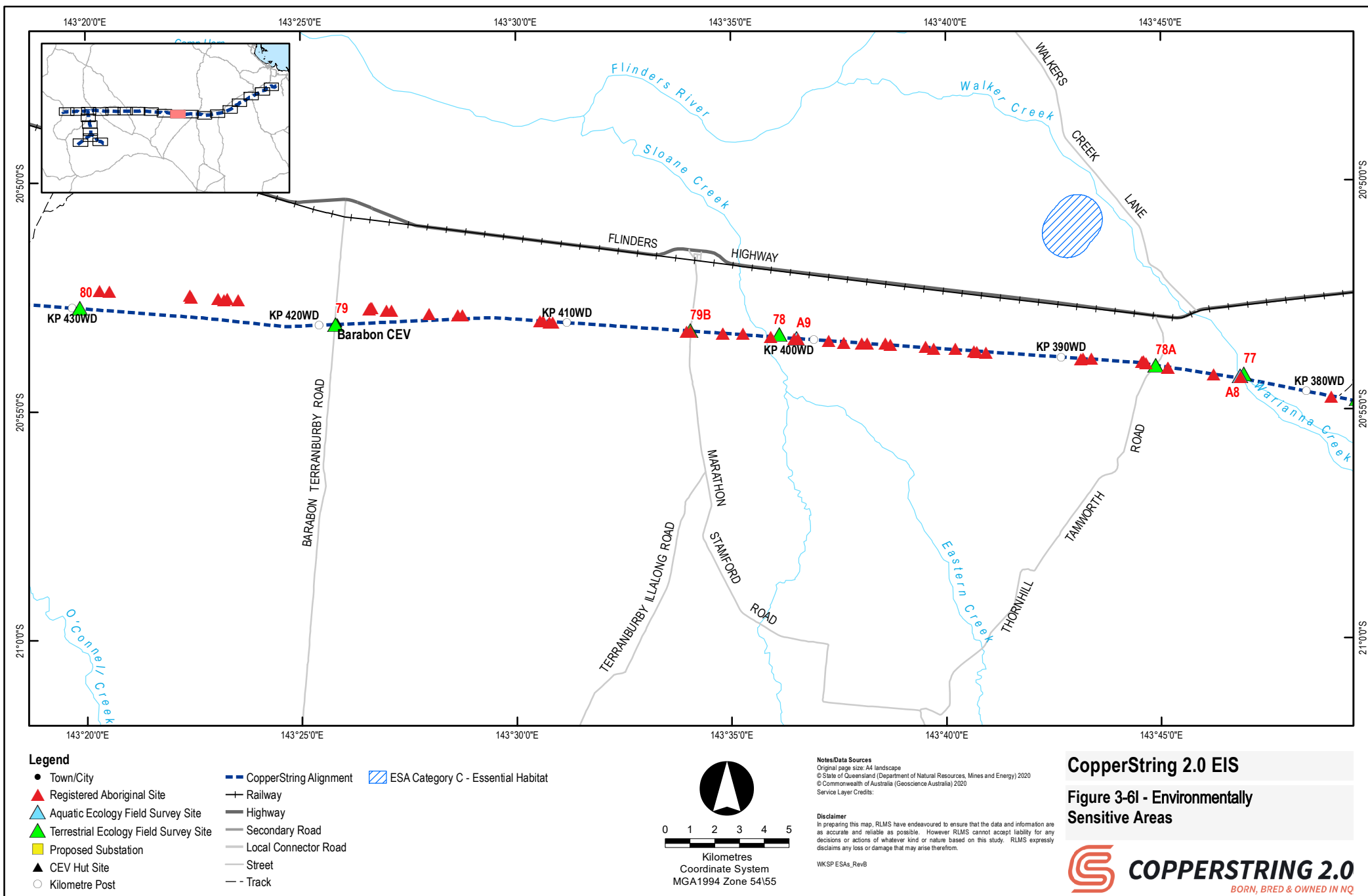
CopperString 2.0 EIS

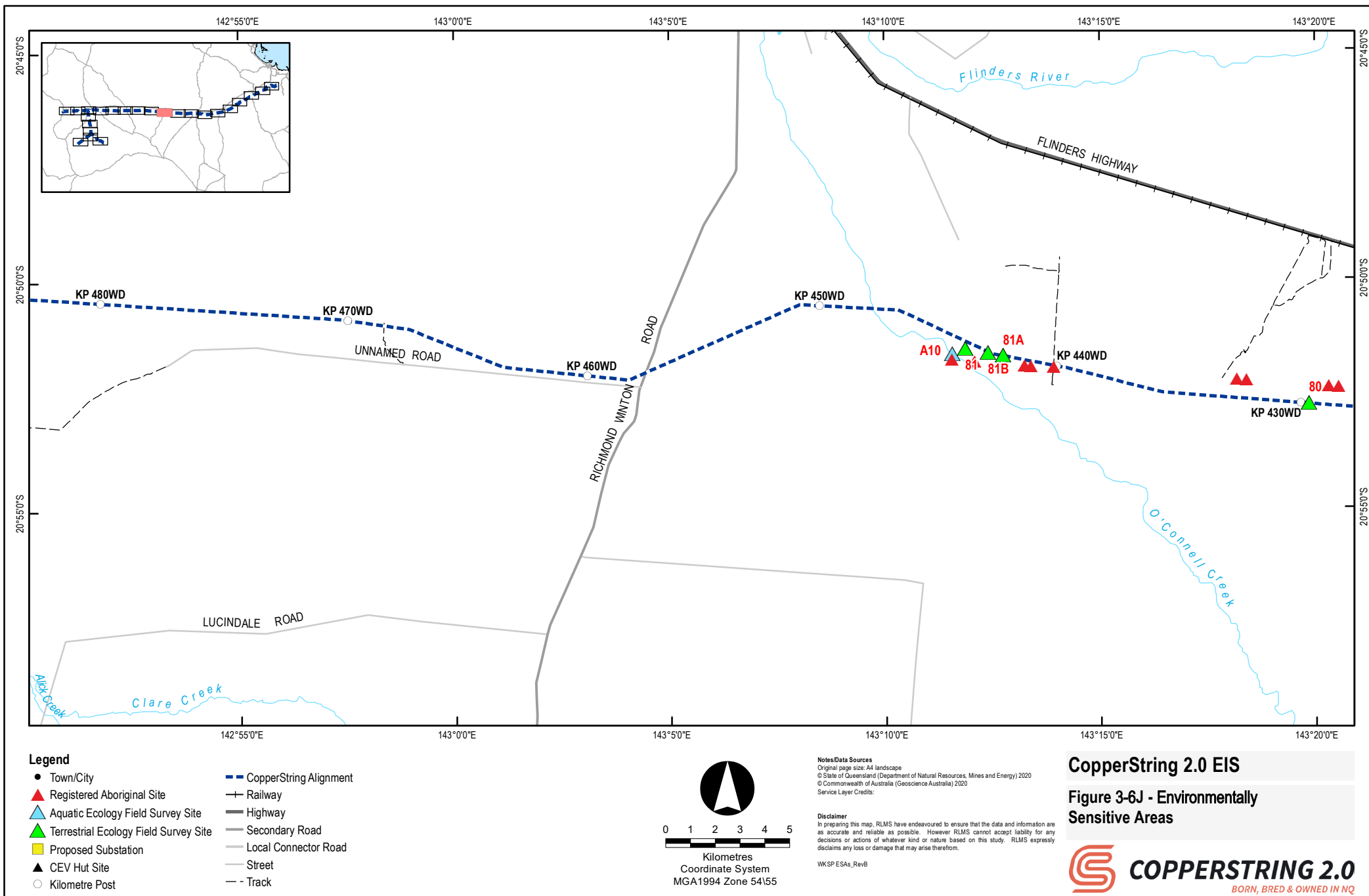
Figure 3-6E - Environmentally Sensitive Areas

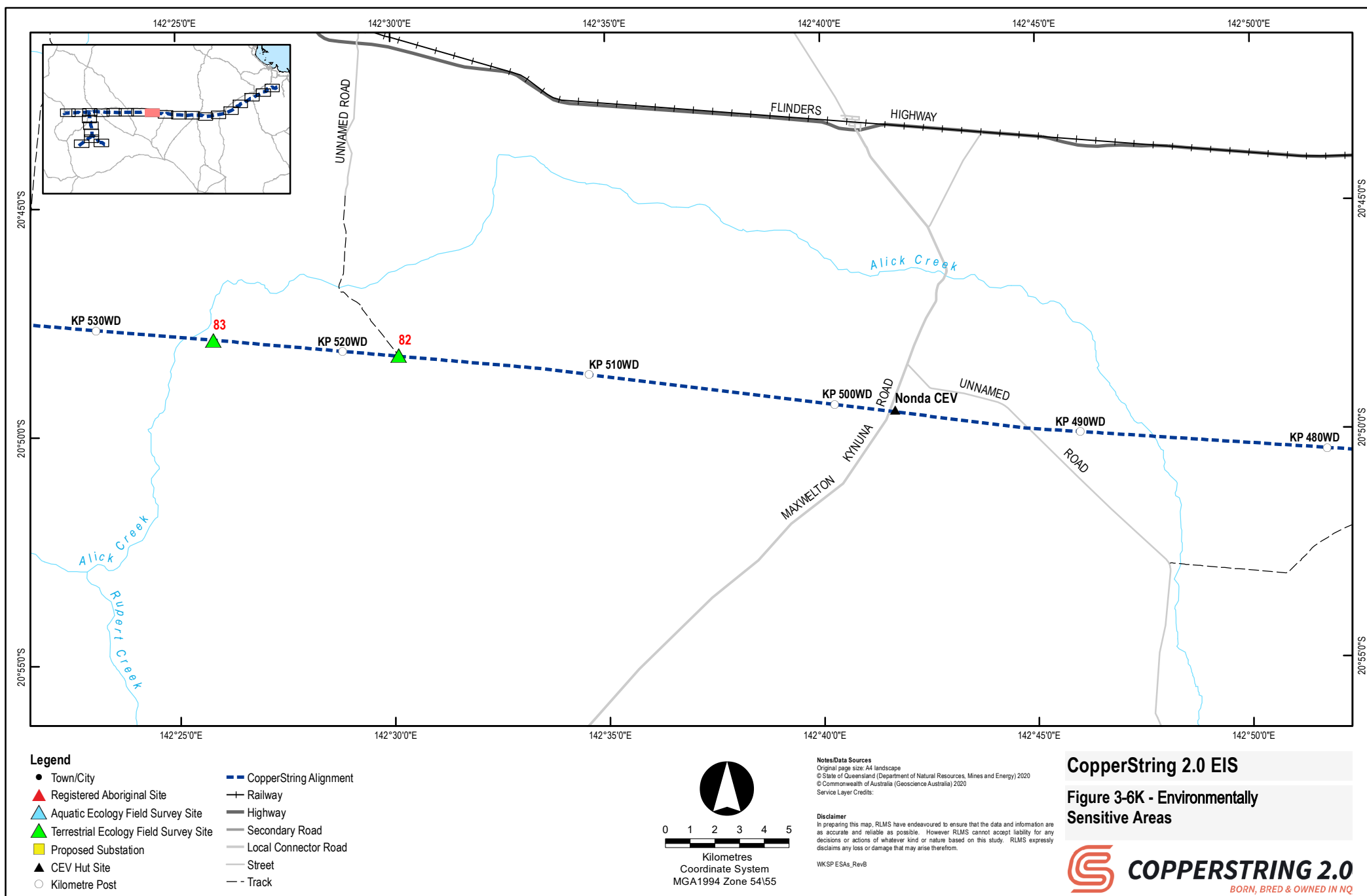


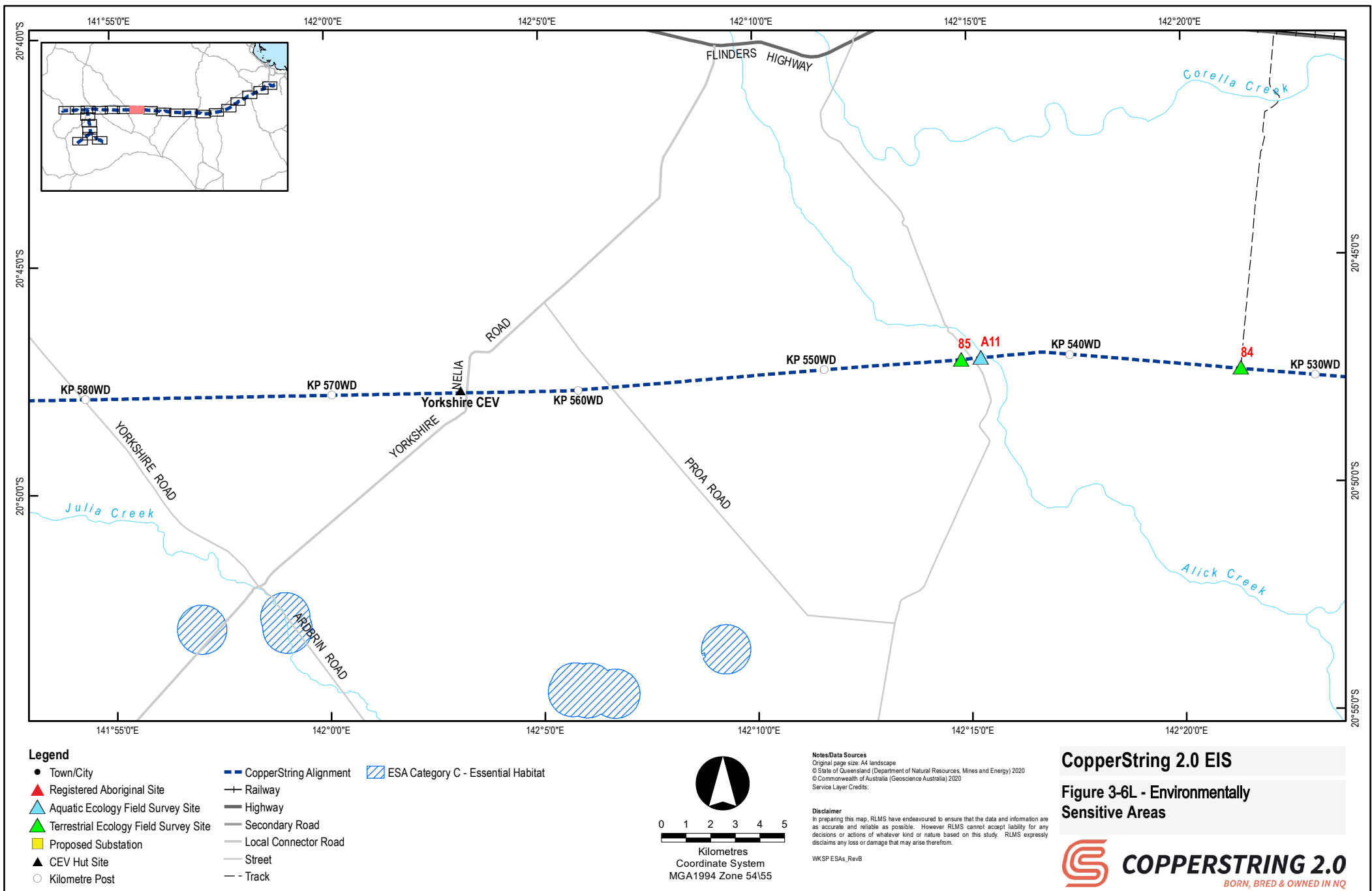


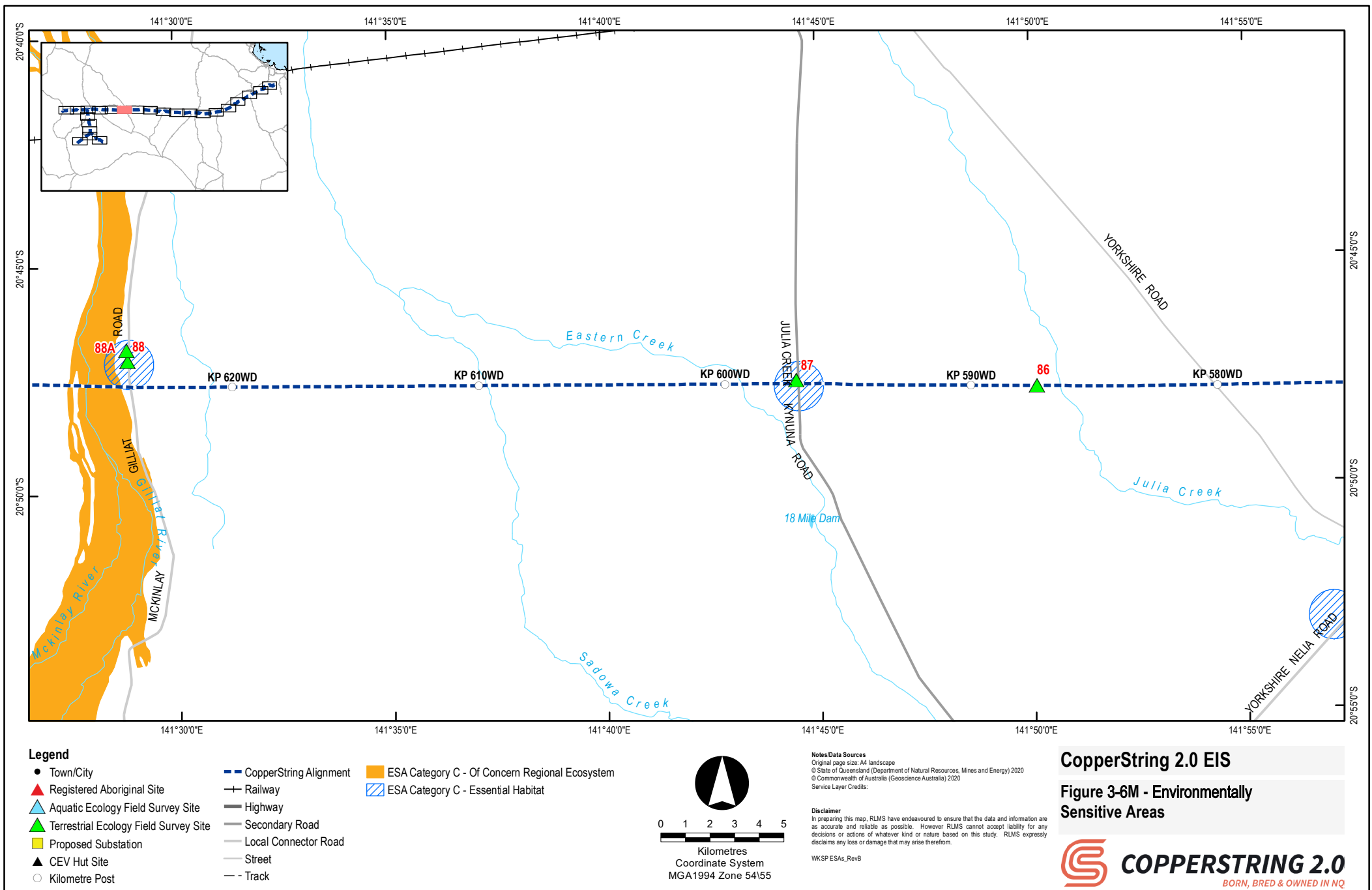


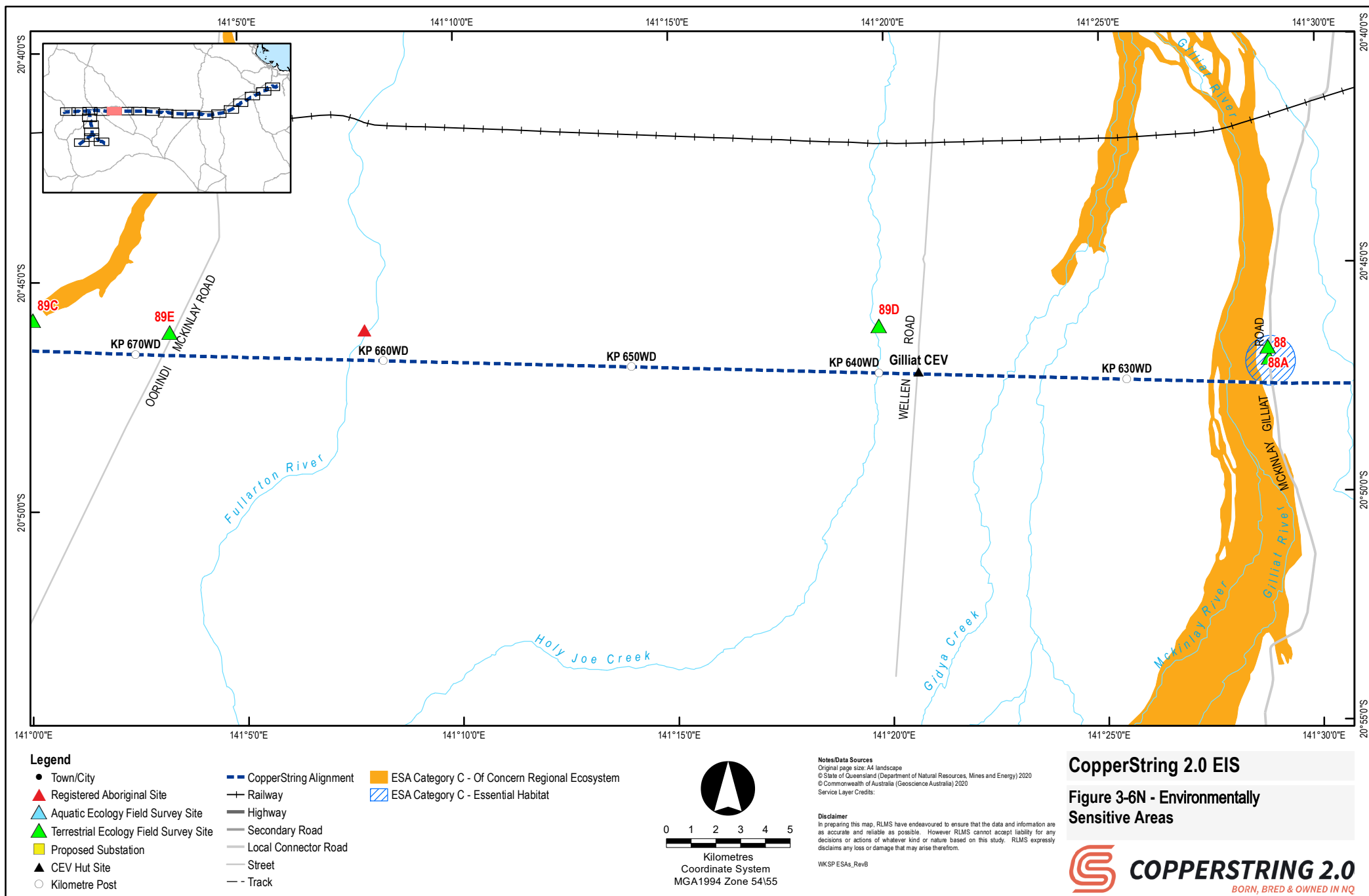


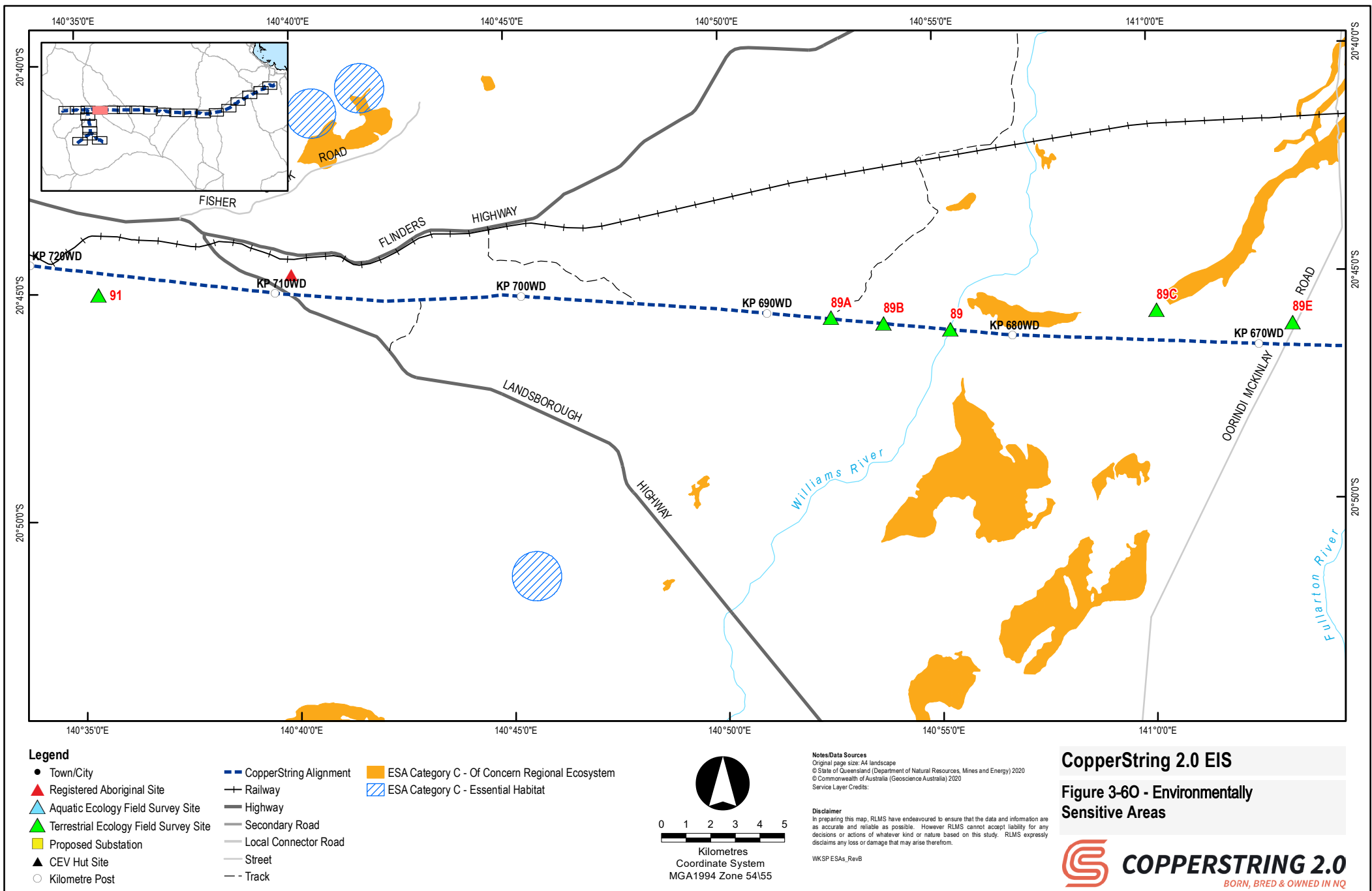


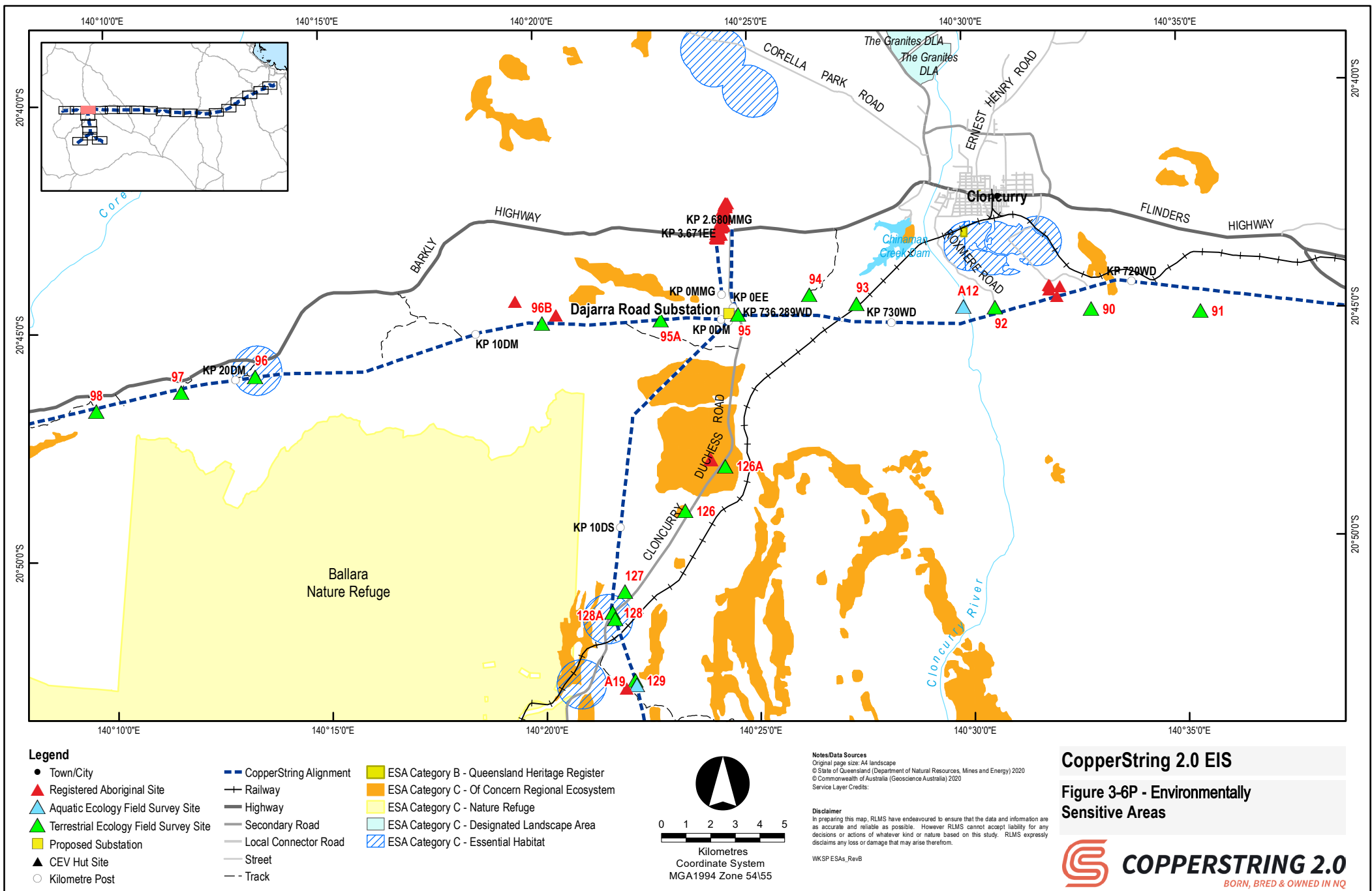


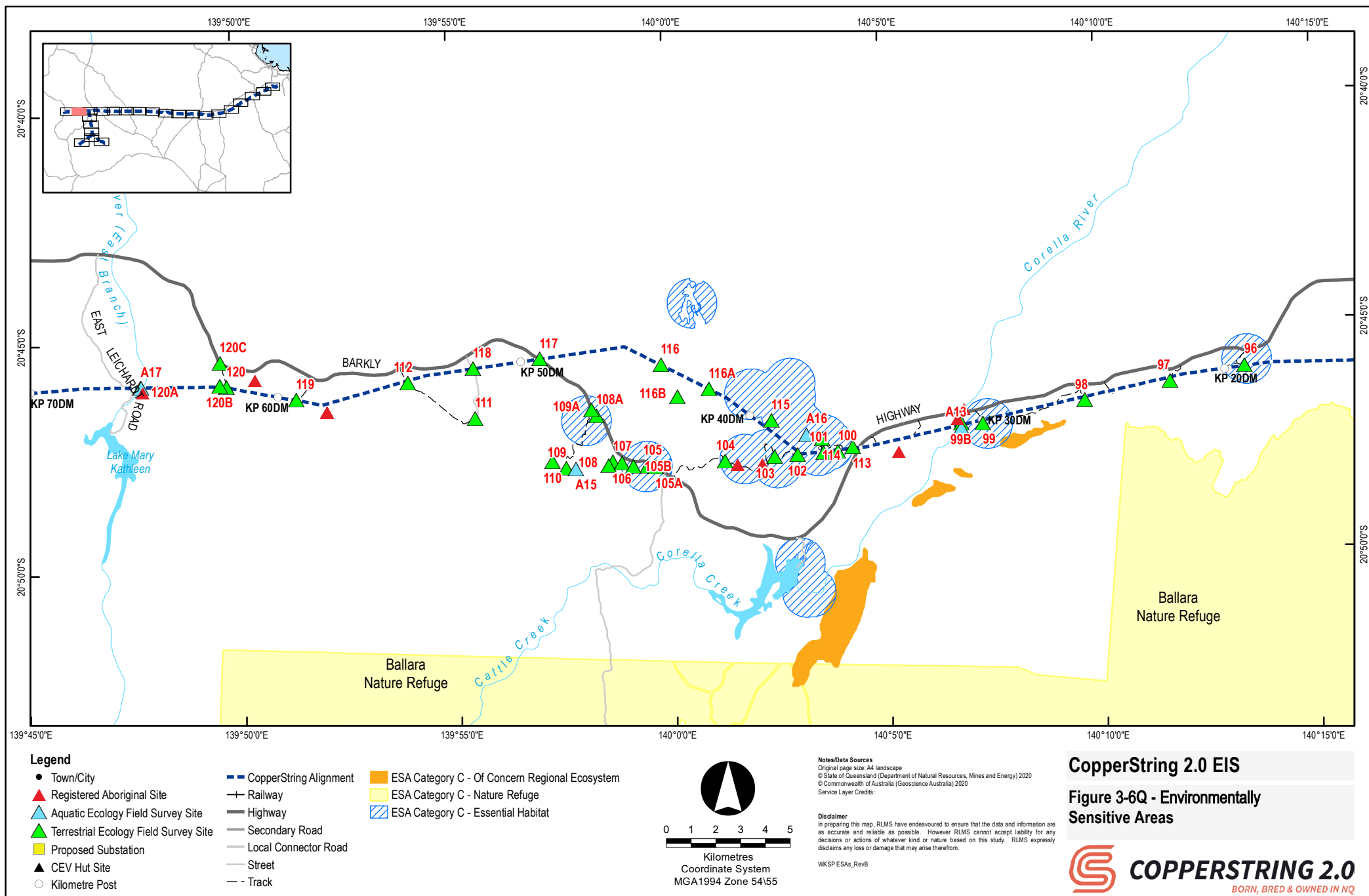


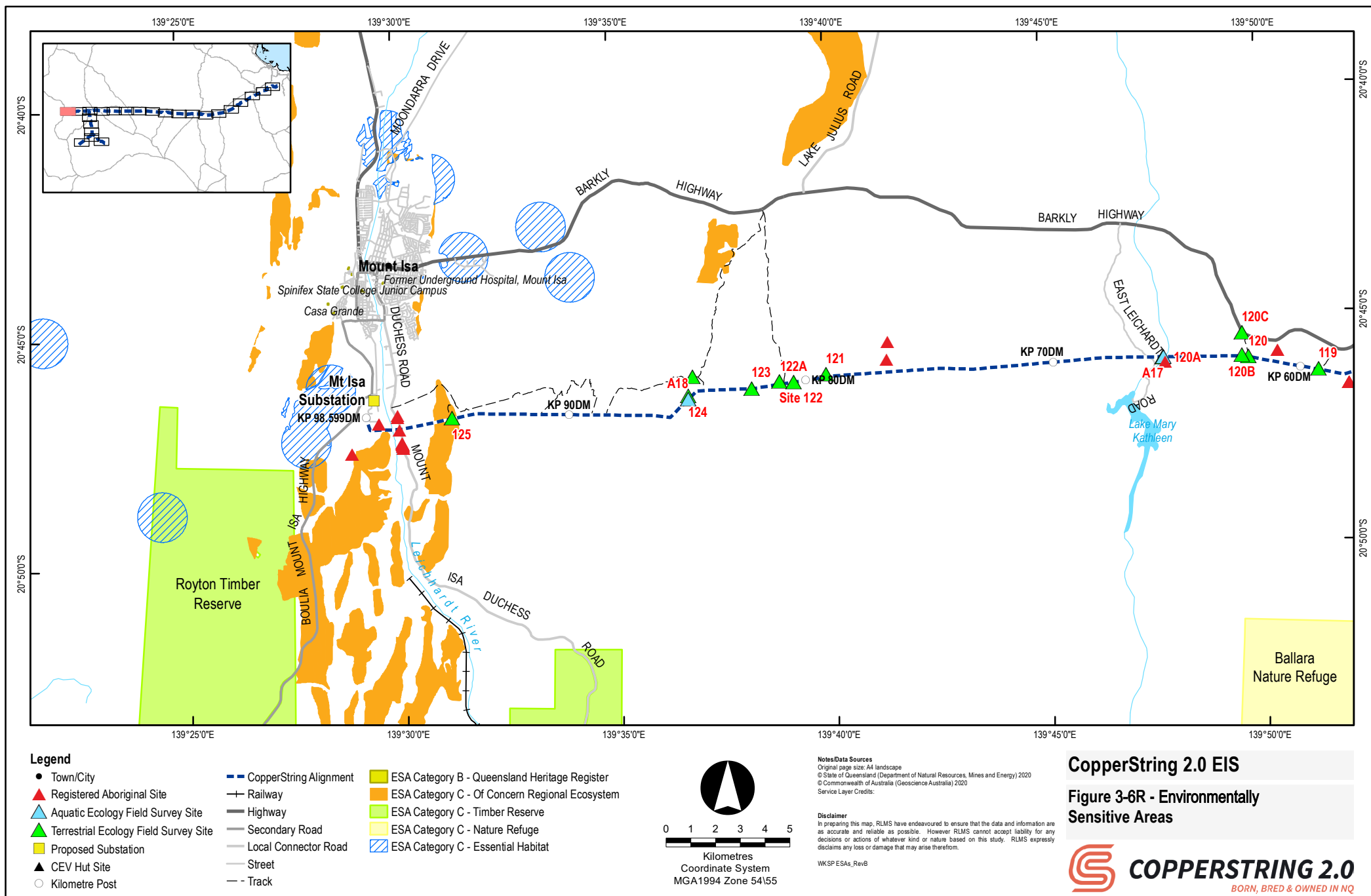


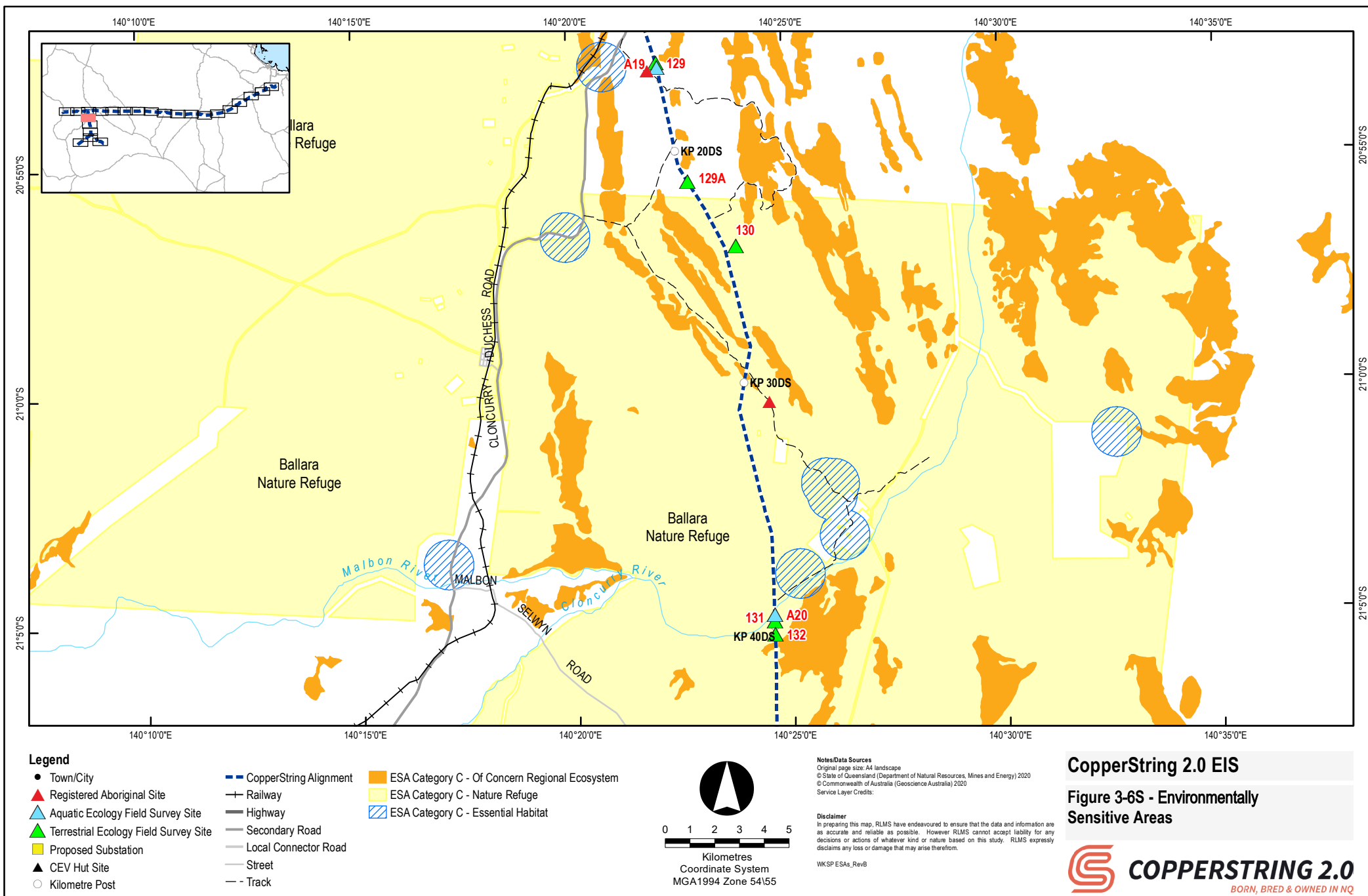






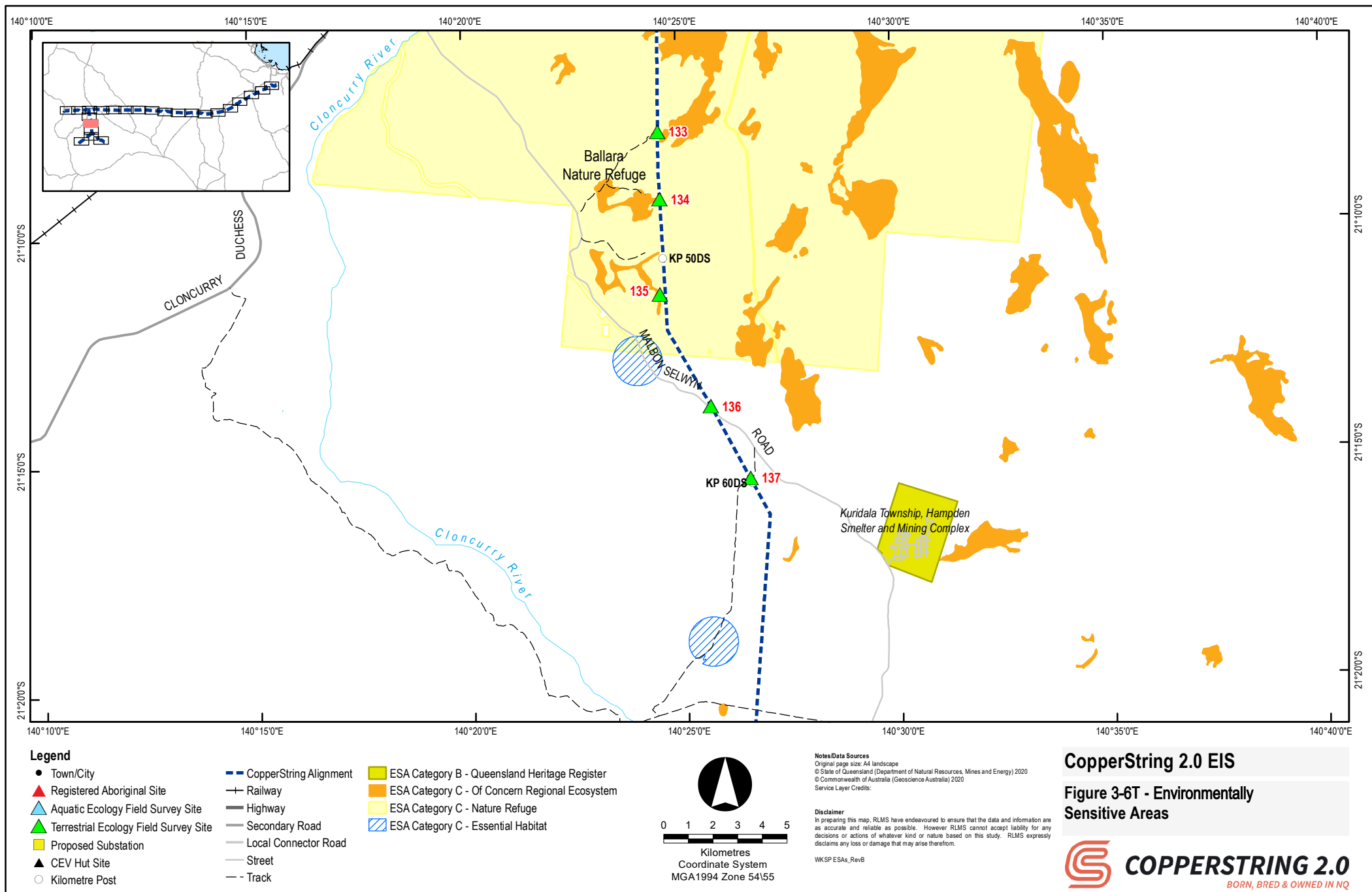


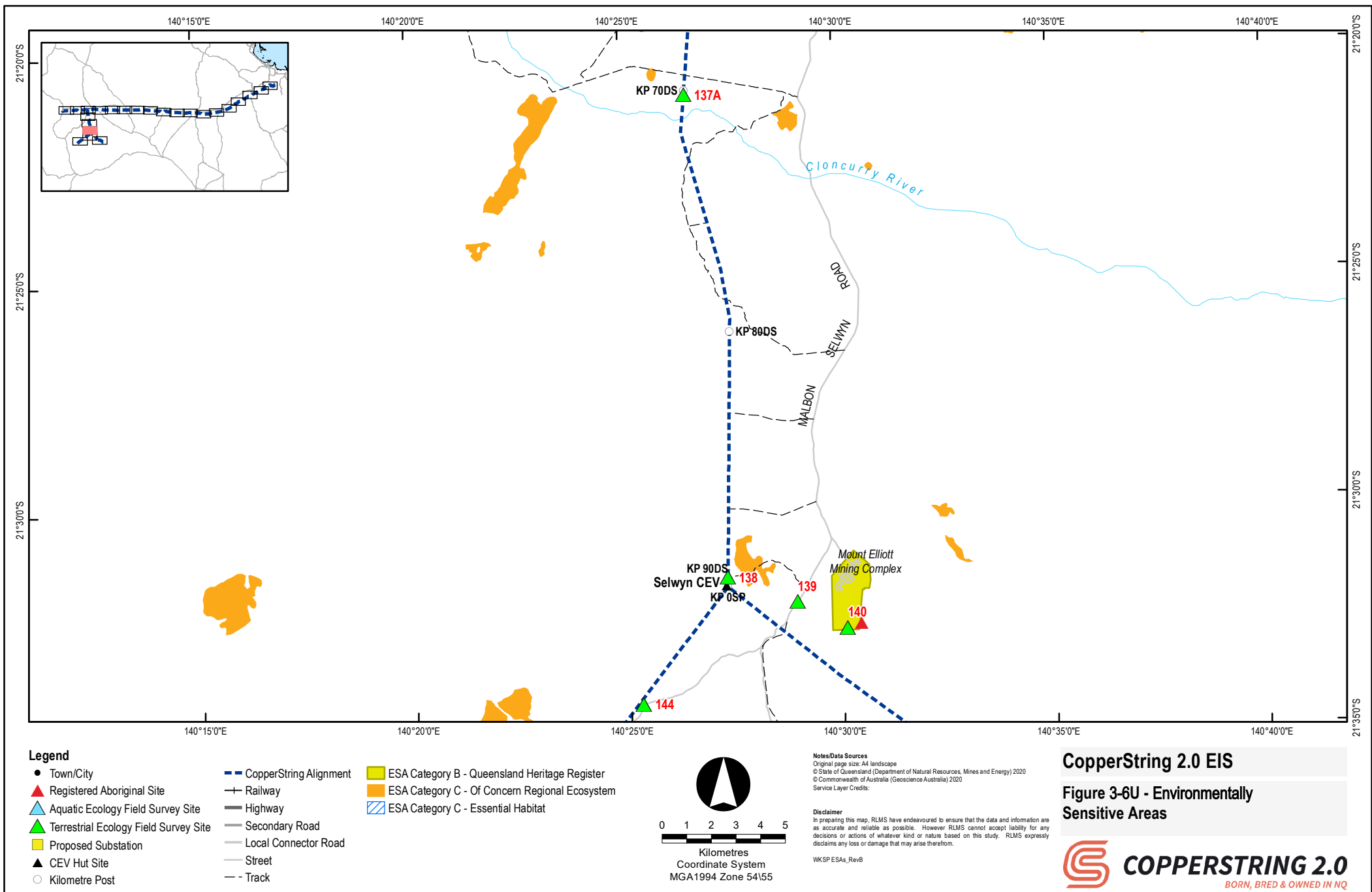


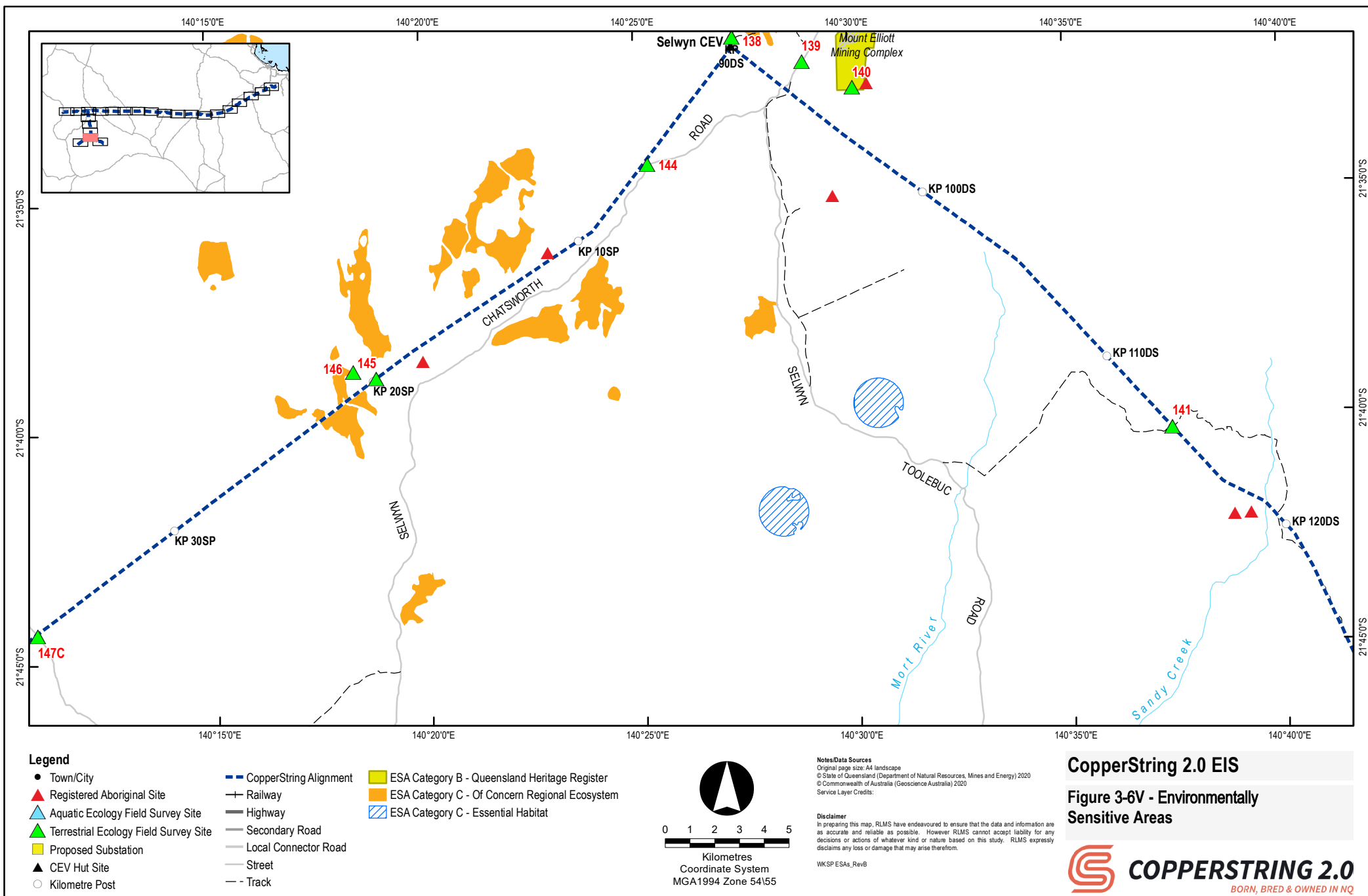


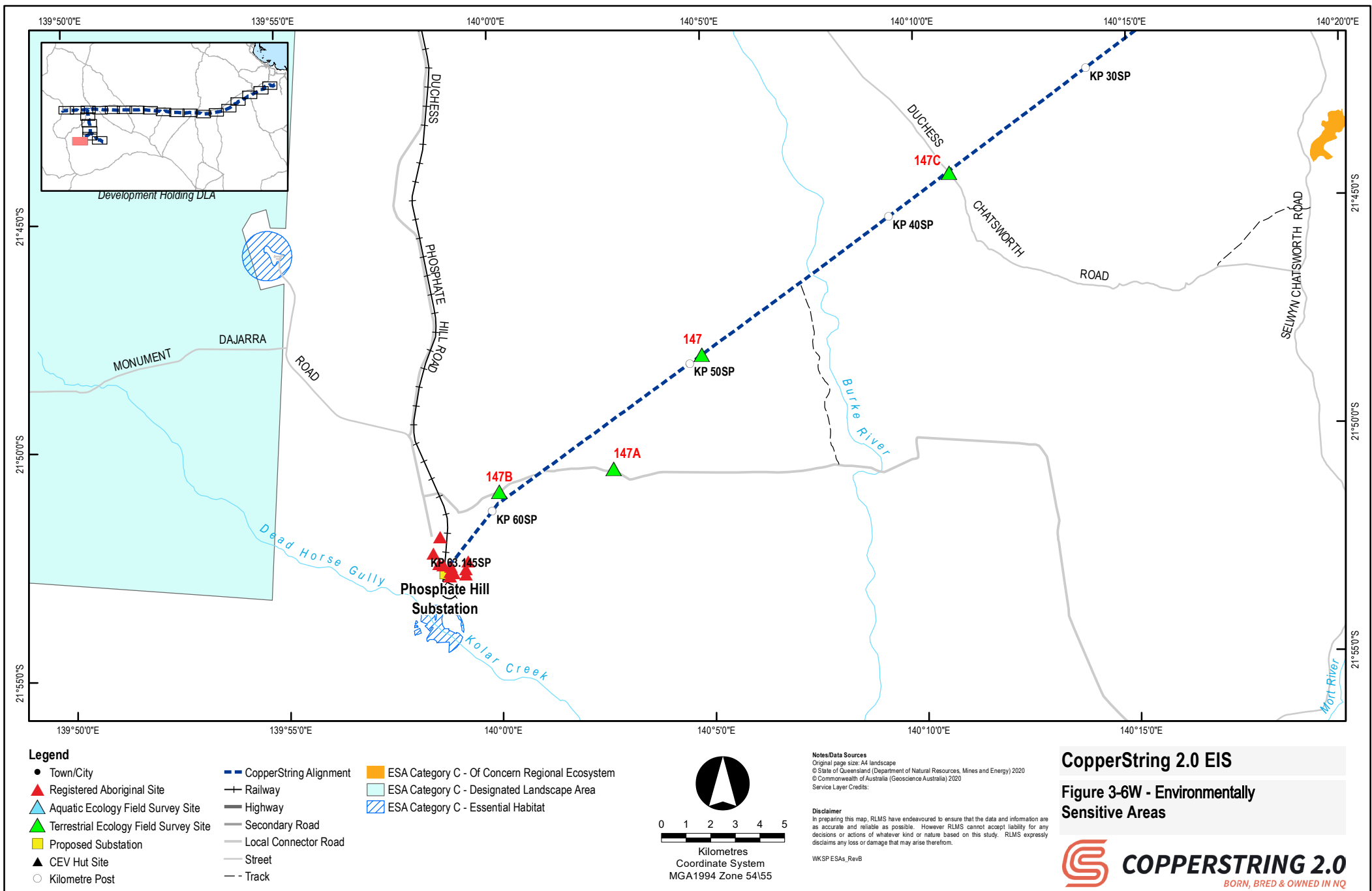
CopperString 2.0 EIS

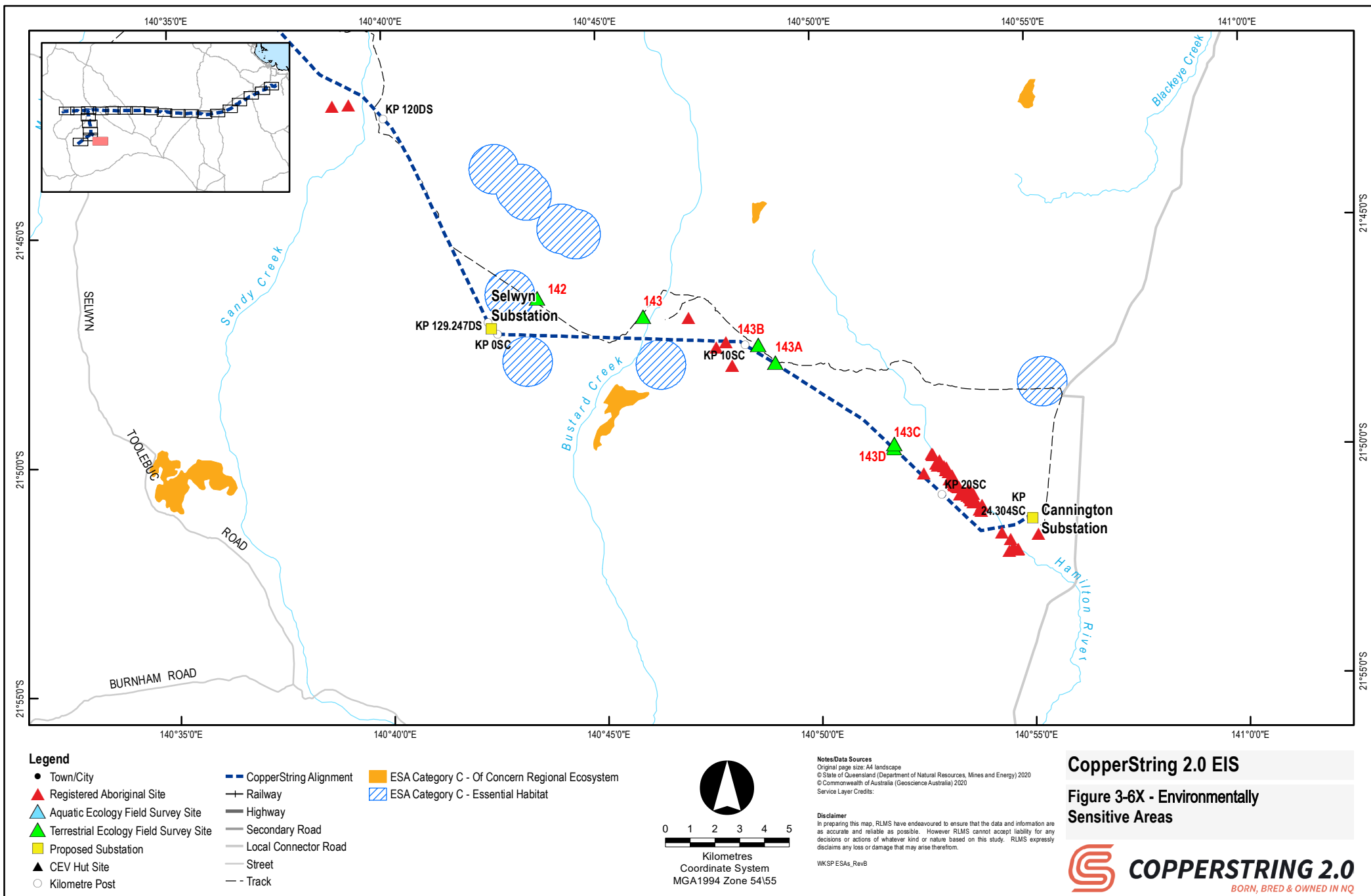
Figure 3-6S - Environmentally Sensitive Areas











3.3.5 Landscape types

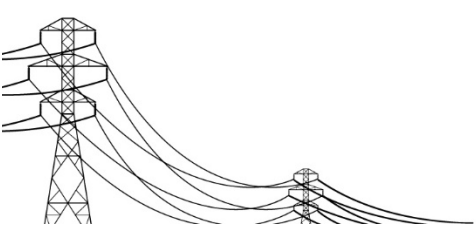
The following six general landscape types occur across the study area, based on mapped remnant broad vegetation groups (BVG) and other features such as watercourses. The landscape types have been identified for the purposes of discerning impacting activities along the corridor selection, and include:

- Open forest to open woodland (eucalypt/melaleuca/belah dominated) on flat to undulating plains
- Riparian zone and fringing vegetation along ephemeral channels, watercourses and channelised floodplains
- Low open woodland to wooded spinifex grassland (eucalypt/acacia dominated) on slopes, crests and scarps
- Mixed low woodland with spinifex (gidgee/mulga/eucalypt dominated) on plains
- Tussock/hummock grassland
- Cleared grazing land with scattered trees.

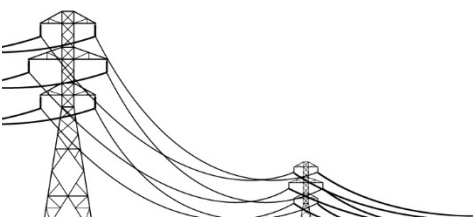
These are further described in Table 3-3 in terms of typical tree heights and densities, habitat features and associated mapped broad vegetation groups.

Table 3-3 General landscape types across the study area

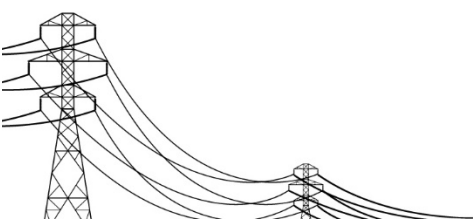
Feature	Description
Open forest to open woodland (eucalypt, melaleuca or belah dominated)	
	
Landform	Flat to gently undulating plains
Location	Between Woodstock and Hughenden



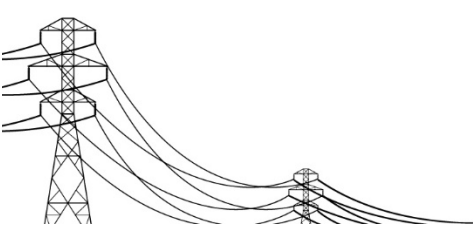
Feature	Description
Habitat feature	Mature hollow-bearing trees. Some ground cover vegetation and shrub layer providing shelter and food resources. Potential habitat for conservation significant species – short-beaked echidna, grey falcon, northern greater glider, black-throated finch.
Height range / cover	Trees 10-30 m Very sparse to mid-dense (<20-80% cover)
Riparian zone and fringing vegetation along ephemeral channels/watercourses/ channelised floodplains	
	
Landform	Fringing drainage lines on alluvial plains. Alluvial terrace (eg adjacent Burdekin River). Sand, rock or water river bed
Location	Whole of corridor selection



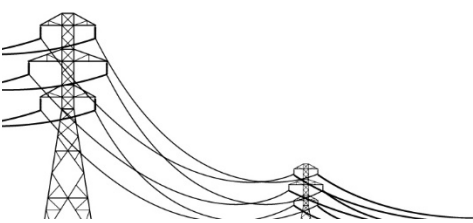
Feature	Description
Habitat feature	Movement corridor and flyway Ephemeral pools an important source of drinking water Mature hollowing bearing trees provide blossoms and nesting opportunities. Sparse shrub layer provide nesting habitat and foraging opportunities Ground-level microhabitats Ground cover vegetation contains variety of grasses, burrs, legumes, piles of woody debris and large logs providing food resources and protection. Potential habitat for conservation significant species – painted honeyeater, masked owl, grey falcon, common death adder, plains death adder
Height range / cover	Trees 10-30 m 20-80% cover Narrow and linear, sometimes extending adjacent waterway.
Low open woodland with spinifex or other grasses (eucalypt or acacia dominated)	
	
Landform	Scarps, crests, plateaus and slopes
Location	West of Cloncurry to Mt Isa and south to Selwyn



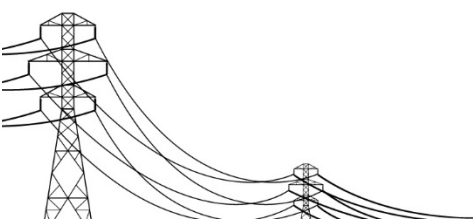
Feature	Description
Habitat feature	Large rock formations with large to small crevices, large openings providing shelter for larger fauna and large surfaces that have the potential to be used as basking areas for snakes, geckos and lizards. Grass tussocks (e.g. <i>Spinifex</i> spp.) and sparse shrubs protrude between the boulders, providing food resources for granivorous birds and shelter for small reptiles (e.g. skinks) and small mammals. Mature, hollow bearing <i>Eucalyptus</i> sp. are canopy dominant, providing foraging and nesting opportunities for birds and arboreal mammals and reptiles. Other habitat resources include termite mounds, small, loose rocks, larger boulders, gidgee provides fallen woody debris and large hollow ground logs, and stags. Potential habitat for conservation significant species – purple-necked rock wallaby, painted honeyeater, southern black-throated finch, masked owl, short-beaked echidna, common death adder, plains death adder
Height range/ cover	Trees 2-10 m Sparse (20-50% cover)
Mixed low woodland with grasses (gidgee, mulga, or eucalypt dominated)	
	
Landform	Gently undulating to flat plains
Location	Between Hughenden and Cloncurry and south to Selwyn



Feature	Description
Habitat feature	Gidgee and sandalwood canopy providing peeling bark, fallen logs and debris for habitat for arboreal and ground dwelling reptiles. Grasses provides shelter for small mammals and reptiles and food resources for granivorous birds. Cracking clay and mulching soils present to provide shelter for ground dwelling species such as snakes and geckoes. Hollow-bearing trees are moderately prevalent (e.g. Eucalyptus sp.), and provides habitat for microbats, hollow-nesting birds (i.e. masked owl, parrots and rosellas) and arboreal reptiles (i.e. geckos, snakes and monitors). Shrub layer is predominately sparse in most areas and provides some nesting and foraging resources for shrub-nesting birds, including finches. Scattered rocks and boulders may be present for shelter and basking opportunity for reptiles and mammals. Termite mounds provide shelter and food resources for ground-dwelling mammals and reptiles. Potential habitat for conservation significant species – painted honeyeater, masked owl, short-beaked echidna, common death adder and plains death adder.
Height range/ cover	Trees to 12 m Very sparse (<20% cover)
Tussock/hummock grassland (Mitchell grass/spinifex)	



Feature	Description
Landform	Flat to undulating plains Cracking clay plains with gilgai
Location	Between Hughenden and Cloncurry
Habitat feature	Red sands and clays present which can be utilised by reptiles and amphibians for shelter. Sparsely distributed mature, hollow bearing <i>Corymbia</i> sp. along the creek line. Habitat hollows providing nesting areas for arboreal mammals and birds. Acacia sp. with peeling bark present, providing habitat for arboreal reptiles such as geckoes. Moderately dense grass species present including buffel and <i>Aristida</i> sp. that is heavily grazed. Some value is present for foraging opportunities by granivorous bird species and shelter for reptiles. Sparse woody debris present to provide shelter for reptiles. Cracking clays present, providing shelter and habitat for reptile species. Area heavily impacted by cattle grazing and trampling which compacted the ground in places. Potential habitat for conservation significant species – Julia Creek dunnart, ornamental snake (gilgai)
Height range/ cover	Very few to no trees Grasses <1 m
Previously cleared/grazing land with scattered trees	

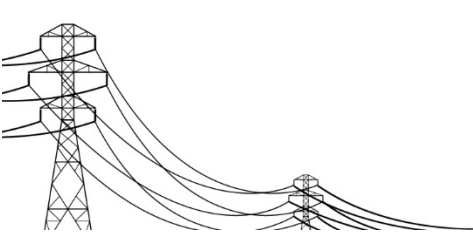


Feature	Description
Landform	Various
Location	Scattered along whole corridor
Habitat feature	Area heavily impacted by cattle grazing and trampling which compacted the ground in places. Red sands and clays can be used by reptiles and amphibians for shelter. Sparsely distributed mature, hollow bearing trees providing nesting areas for arboreal mammals and birds. <i>Acacia</i> sp. with peeling bark present, providing habitat for arboreal reptiles such as geckoes. Moderately dense grass species present including buffel and <i>Aristida</i> sp. that is heavily grazed. Some value is present for foraging opportunities by granivorous bird species and shelter for reptiles. Sparse woody debris present to provide shelter for reptiles.
Height range/ cover	Scattered trees to 20 m Very sparse (<20% cover)

3.3.6 Vegetation canopy heights

Within each segment of the corridor selection, an analysis of available canopy height data extracted from the 2010 Lidar (survey flown along the project as part of the CopperString 1.0 EIS) was undertaken. The current corridor selection in discrete parts deviates outside the boundary of 2010 lidar data; however, this analysis provides a valuable comparison between the landscape types described in Table 3-3.

The canopy height data covers a 1.5 km width along the 2010 CopperString 1.0 project corridor. Canopy heights were compiled and data represented as a representative percentage as shown in Figure 3-7.



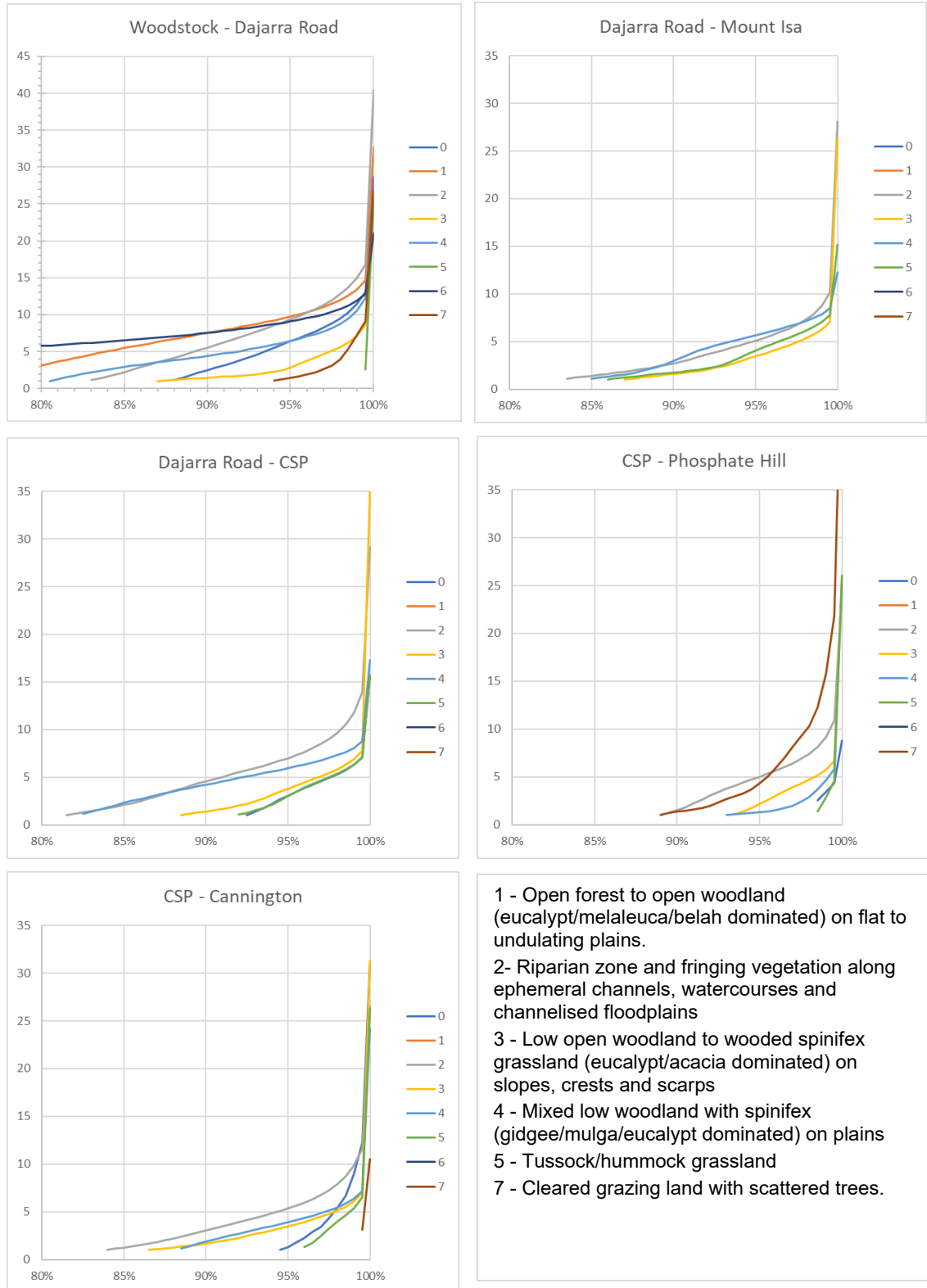
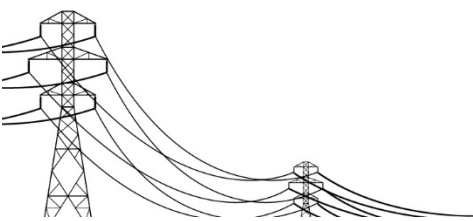


Figure 3-7 Percentage canopy height data analysis



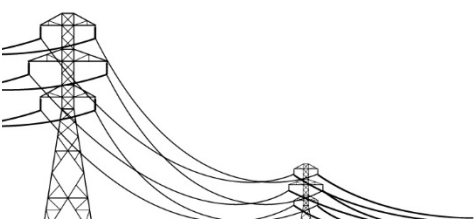
3.3.7 Planning schemes, regional plans and state policies

Planning schemes

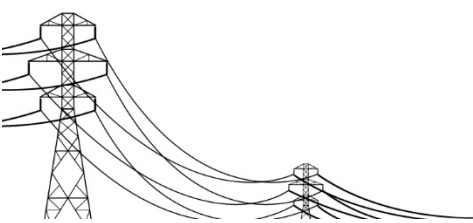
The corridor selection traverses seven local government areas, shown in Figure 3-8. The applicable planning schemes and a summary of their provisions relevant to the Project are included in Table 3-4. Further details about these planning schemes can be found in Volume 2 Chapter 5 Land.

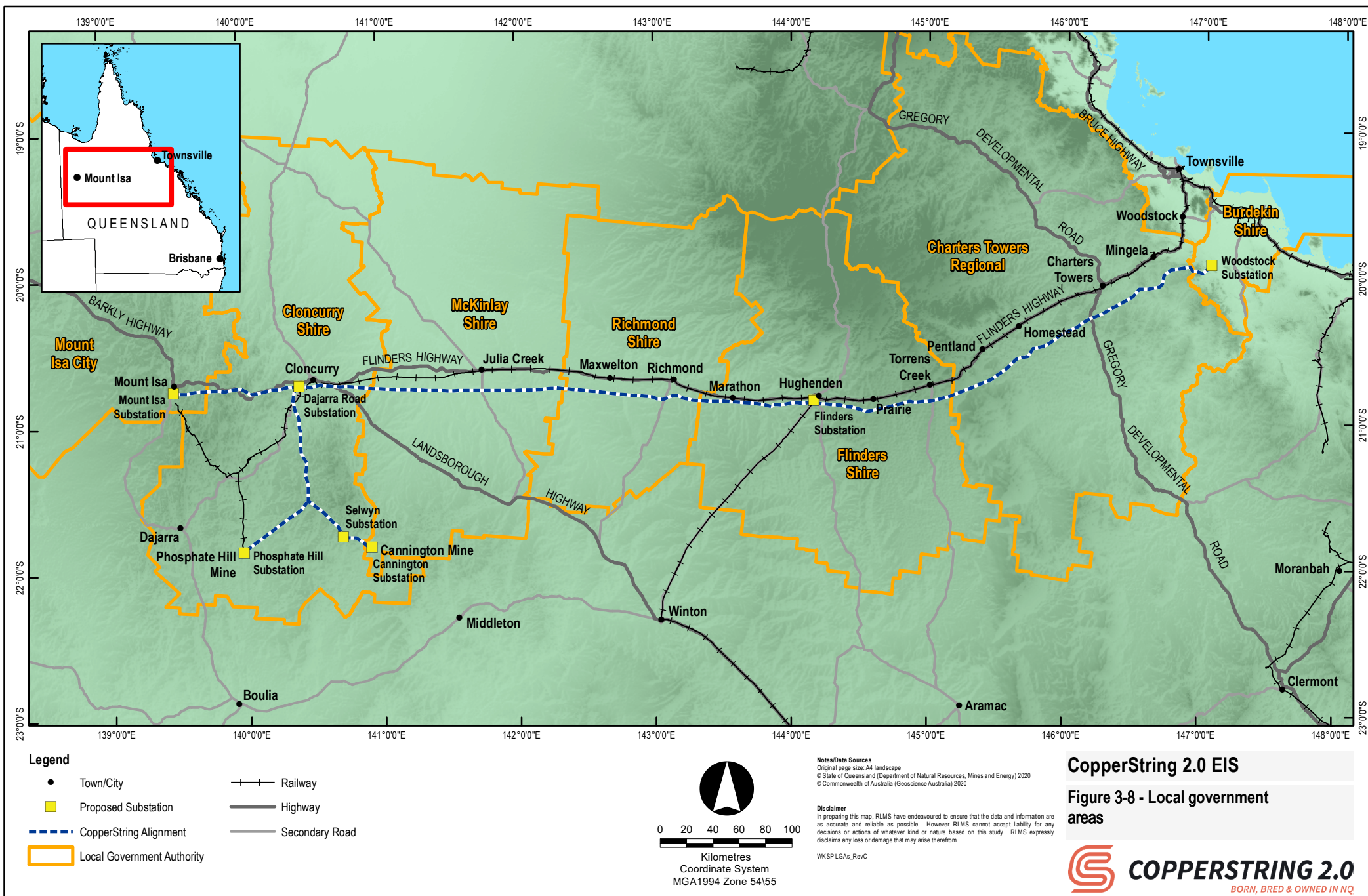
Table 3-4 Relevant planning scheme provisions

Planning scheme	Provisions relevant to Project
Burdekin Shire Council IPA Planning Scheme	The corridor selection is located within the Rural zone
Charters Towers Regional Town Plan	The Project is defined as major electricity infrastructure, which may trigger a development application for Material Change of Use. Activities such as construction camps may also require a development application in the Rural zone
Shire of Flinders Planning Scheme	The Project is defined as major electricity infrastructure and may trigger a development application for Material Change of Use. Activities such as construction camps and operational works may also require a development applications
Planning Scheme for the Shire of Richmond	The Project is defined as a public utility including the supply of electricity, which may trigger a development application for Material Change of Use. Activities such as construction camps may also require a development application
McKinlay Shire Planning Scheme	The Project is located in the rural zone and is defined as major electricity infrastructure, which is accepted development in the rural zone, provided the Project meets the accepted development criteria. Where the accepted development criteria cannot be met, major electricity infrastructure projects are code assessable. Activities such as construction camps and operational works may require a development application or code assessable application
Cloncurry Shire Planning Scheme	The Project is defined as major electricity infrastructure and may trigger a development application for Material Change of Use. Operational works associated with the Project may be accepted development if applicable criteria is met, or where the accepted development criteria cannot be met, code assessment may be required



Planning scheme	Provisions relevant to Project
City of Mount Isa Town Planning Scheme	The Project is defined as a public utility including the supply of electricity and may trigger a development application for Material Change of Use. Activities such as construction camps are considered accepted development provided they are established for no longer than two years. Development approvals for Operational works are only required if works are proposed for flood prone areas or involve privacy issues.





Regional plans

There are two regional plans that are applicable to the corridor selection. These plans provide frameworks to support established and emerging industries, manage growth and development, and address changes in their respective regions.

The North Queensland Regional Plan 2020 covers local government areas including:

- Burdekin Regional Council
- Charters Towers Regional Council

The major goals of the North Queensland Regional Plan 2020 are:

- North Queensland be a leading economy in regional Australia
- The region maintains a rich and healthy natural environment
- To create liveable, sustainable and resilient communities that promote living in the tropics
- Infrastructure networks support a safe, connected and efficient North Queensland.

The North West (NW) Regional Plan 2010 applies to the following local government areas:

- Flinders Shire Council
- Richmond Shire Council
- McKinlay Shire Council
- Cloncurry Shire Council
- Mount Isa City Council.

The NW Regional Plan includes a number of provisions that support infrastructure development in the north-west region, including improved access to essential services and improved liveability of regional communities. The NW Regional Plan recognises water and energy as limiting factors to future regional development. The NW Regional Plan also includes energy objectives to support reliable and cost effective energy infrastructure. Further details about these regional plans can be found in Volume 2 Chapter 5 Land.

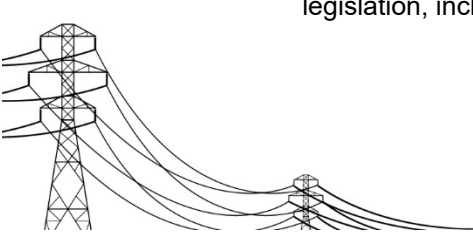
State planning policy

The current State Planning Policy (SPP) commenced in July 2017 and is a statement of planning principles and guidance for planning schemes and development assessment in Queensland. It defines the Queensland Government's policies about matters of State interest in land use planning and development. These apply to the making or amending of a local planning instrument and are also applicable to certain types of development or development in areas where the SPP has not yet been integrated into the relevant local planning scheme.

The following State interests are considered applicable to the Project:

- Liveable communities and housing (liveable communities)
- Economic growth (extractive resources – Key Resource Areas)
- Environment and heritage (biodiversity, cultural heritage and water quality)
- Safety and resilience to hazards (natural hazards risk & resilience)
- Infrastructure (energy and water, infrastructure integration, and transport infrastructure).

The planning schemes listed in Table 3-4 have been prepared under various planning legislation, including repealed legislation. Accordingly, the level of integration of the State's



interests into these planning schemes varies according to the relevant legislation under which the planning scheme was prepared. Where a State interest has not been integrated into a local government's planning scheme, an assessment in compliance with the SPP is required.

Further information about relevant State interests and how they are required to be integrated into planning schemes can be found in Volume 2 Chapter 5 Land.

3.3.8 Climate

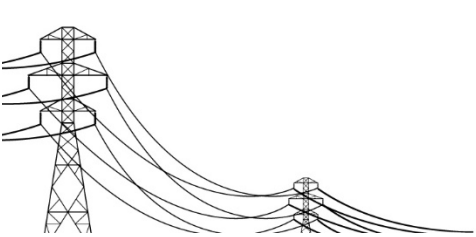
Meteorological monitoring stations

Data has been sourced from the Bureau of Meteorology (BOM), which has multi-parameter monitoring stations at various locations along the corridor selection. Data is collected from the monitoring stations and reported at 9.00 am and 3.00 pm daily. Long term averages can be assembled to provide typical climatic values of relevant parameters, which may be presented as annual, seasonal, or monthly trends of expected conditions.

Nine BOM reporting stations were chosen as relevant to the study area and a description of each site is presented in Table 3-5. Locations of monitoring stations are shown on Figure 3-9.

Table 3-5 Meteorological monitoring stations

Australian weather station number	Location of monitoring station	Commenced	Latitude	Longitude	Elevation (metres above sea level)
33002	Ayr Department of Primary Industries (Now DEEDI) Research Centre	1951	19.62°S	147.38°E	10
32040	Townsville Aero	1940	19.25°S	146.77°E	4
33307	Woolshed	1998	19.42°S	146.54°E	556
34084	Charters Towers Airport	1942	20.05°S	146.27°E	290
30022	Hughenden Airport	2001	20.82°S	144.23°E	316
30045	Richmond Post Office	1889	20.73°S	143.14°E	211
29058	Julia Creek Airport	2001	20.67°S	141.72°E	123
29141	Cloncurry Airport	1978	20.67°S	140.51°E	186
29127	Mount Isa Aero	1966	20.68°S	139.49°E	340



Climatic zones

Section 3.3.2 characterises the landscape zones of the corridor selection into six different physiographic areas. Whilst climate and landscape characterisations generally complement each other, for the purposes of this assessment, three distinct climatic zones have been identified as covering the proposed corridor selection. The three climatic zones described in this section are illustrated in Figure 3-9.

Coastal lowlands

This section of the corridor selection lies between the Woodstock Substation in the east and the Great Dividing Range. It generally equates to the Einasleigh Uplands and Desert Uplands bioregions. The climate in this zone is characterised by data from the Townsville Aero monitoring station and the Ayr Department of Primary Industries Research Station.

The coastal lowlands experience a tropical climate, typified by monsoonal summers that are generally hot, wet and humid with afternoon sea breezes. South-east trade winds characterise the winter months with fine weather and relatively cooler nights.

On average, the coastal lowlands receive approximately 1,000 mm of rainfall with most falling in summer months. The coastal lowlands zone is likely to be affected by more intense storms and tropical cyclone events, which may lead to localised flooding, storm surges or damage to infrastructure.

Great Dividing Range

Westward from the coastal lowlands the corridor selection rises and crosses the Great Dividing Range. This climate zone is generally equated with the Desert Uplands bioregion. The influence of the elevated range on climate is characterised by data from the Woolshed and Charters Towers Airport monitoring stations. The western margin of the range is represented by the Hughenden Airport monitoring data.

This area is very similar to the coastal lowlands although the elevation at the Woolshed monitoring site (>500 m) results in reduced temperature, and higher relative humidity averages.

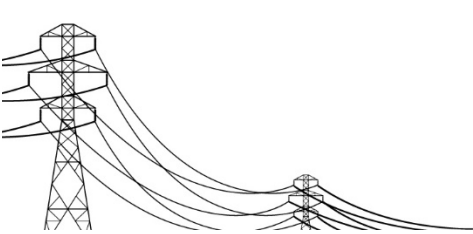
Inland zone

The inland zone can be further divided into the Flinders River Catchment and the Mount Isa zones. The Flinders River Catchment is generally equated with the Mitchell Grass Downs and Gulf Plains bioregions, whilst the Mount Isa zone is equated with the Northwest Highlands bioregion.

The Flinders River Catchment is characterised by undulating plains within the Flinders River Catchment and may experience seasonal flooding. Climatic conditions are determined by monitoring conducted at Hughenden Airport in the east, Richmond Post Office and Julia Creek Airport in the middle section, and Cloncurry Airport in the west.

Generally, the inland sections are characterised by hotter maximum temperatures, lower relative humidity and reduced rainfall comparative to the coastal lowlands. During summer months the temperature can exceed 40 degrees on several days.

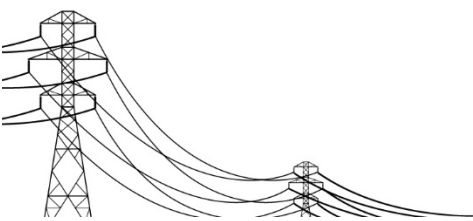
This Mount Isa zone commences west of Cloncurry and extends across the remainder of the corridor selection from Dajarra Road Substation to Mount Isa. The climate data is represented by the monitoring records from the Mount Isa Aero monitoring station.

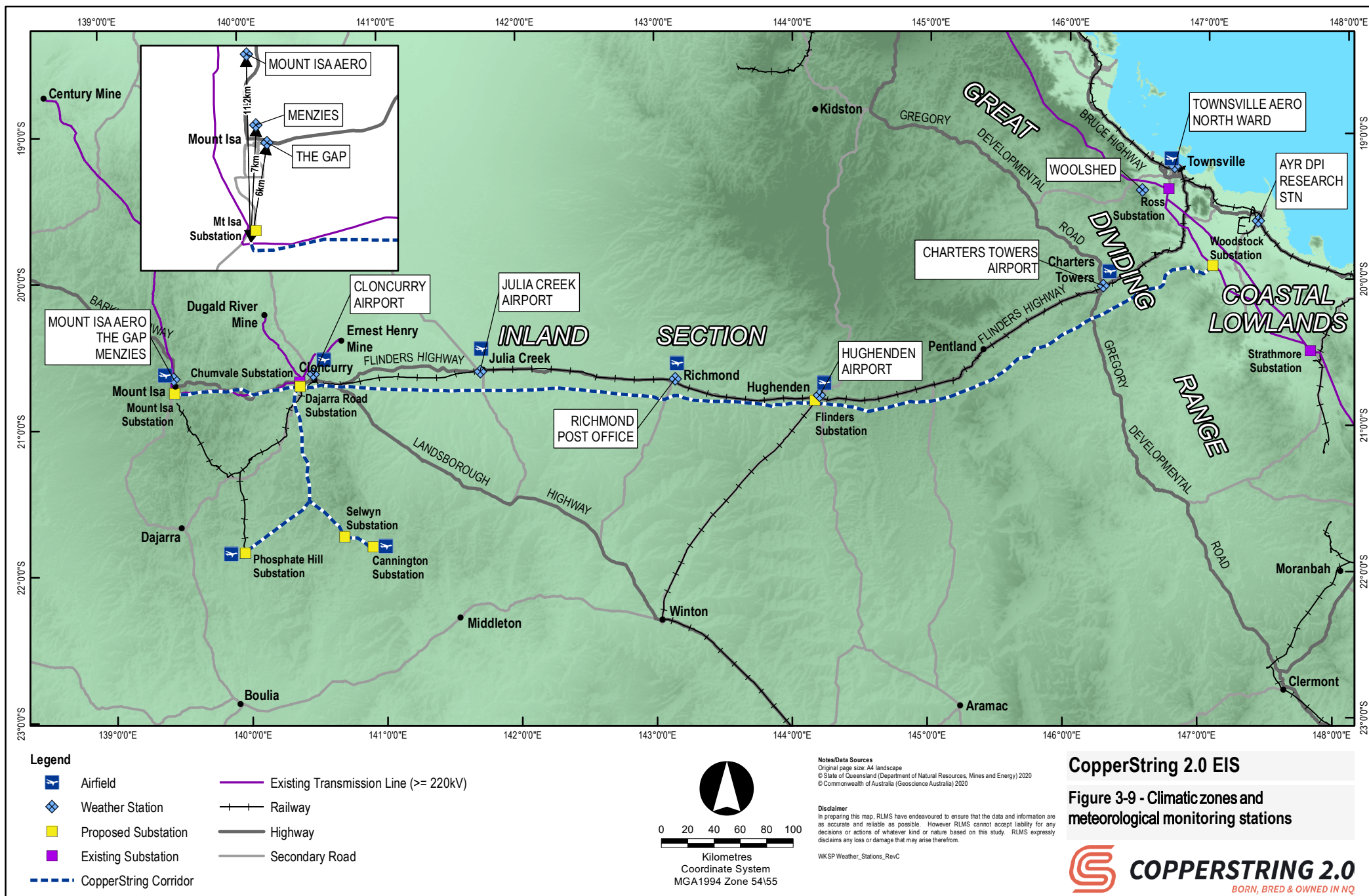


The Mount Isa zone has a higher elevation than the Flinders River Catchment, which tends to slightly reduce maximum temperatures. The Mount Isa zone consists of rugged hills and undulating valleys.

The wet season in the inland zones usually brings 75 percent of the annual rainfall however annual rainfall can vary significantly, with less than 250 mm in one year and greater than 500 mm the following year.

High evaporation rates or a failure of the wet season in the inland zones may cause severe strain on the available surface water supplies and may lead to fires, dust and general land degradation. Subsequent summer rains lead to soil erosion and, in severe events, localised or widespread flooding.





General climatic conditions

This section describes general climatic conditions including air temperature, humidity, rainfall, and wind speed and direction within the corridor selection. Data for temperature, relative humidity, rainfall, and wind speed and direction was obtained from the monitoring locations in Figure 3-9 and compiled to provide an understanding of the long term climatic values relevant to the Project.

Air temperature

There is a significant difference in recorded air temperatures between the coastal and inland zones of the corridor selection. Generally the coastal lowlands show less variation between the maxima and minima temperatures. The ocean tends to provide a stabilising influence and reduces the daily variation between daytime maximum and night time minimum. Additionally the oceanic influence reduces the daytime maximum temperatures to around 30 degrees in summer and 25 degrees in winter.

Air temperature in the Great Dividing Range section of the corridor selection is influenced by its higher elevation and generally has cooler minimum temperatures compared to the coastal zone and cooler maximum temperatures compared to the inland zone. The inland zone exhibits large daily ranges in temperature. These sections are characterised by hot to very hot summer daytime temperatures and cooler nights.

Annual average temperatures, derived from the regional monitoring station records, are presented in Figure 3-10. Monitoring station records range from 19 years to 127 years of data.

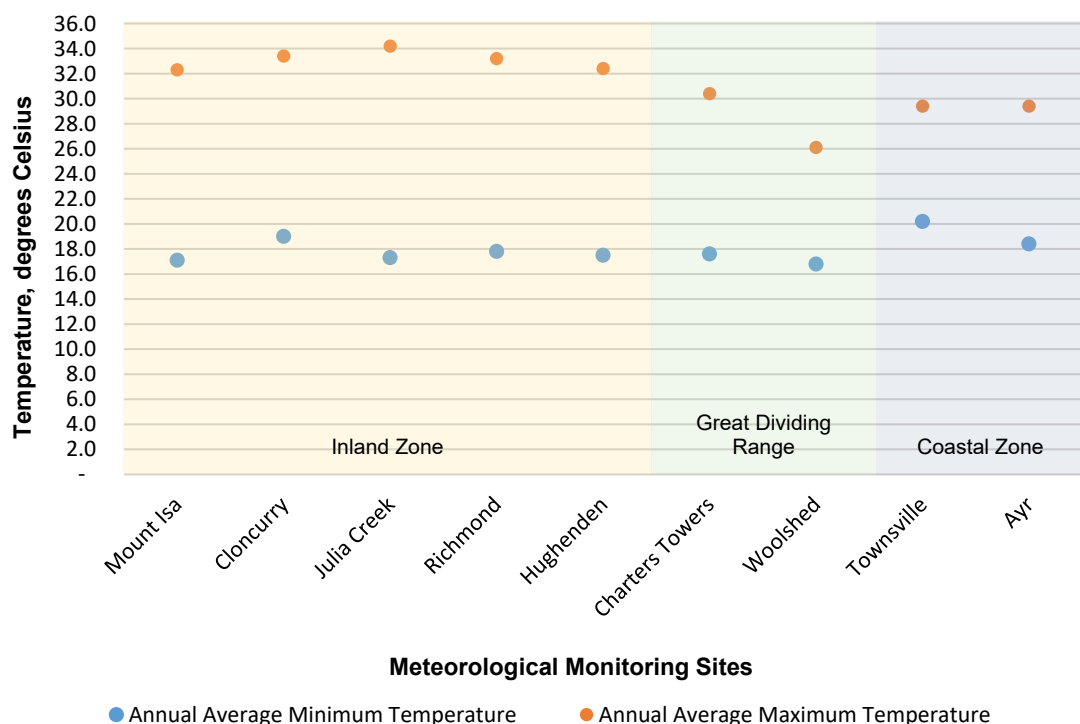
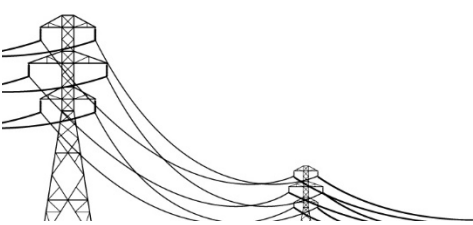


Figure 3-10 Annual average temperature statistics (Source: BOM, 2020)

Relative humidity

Relative humidity is a ratio of the actual amount of water vapour in the air as a percentage of the amount of water vapour required to saturate the air at that temperature (BOM, 2000). The relative humidity will show a cyclical nature and is often highest in the mornings (rain and fog



are defined as 100 percent humidity) and lowest in the afternoon. Additionally, relative humidity is generally higher in summer and autumn and lower in winter and spring.

Relative humidity data is presented from the 9.00 am and 3.00 pm monitoring data. The data shows that the coastal and Great Dividing Range zones have higher relative humidity than the inland zones. The coastal and Great Dividing Range zones average between 66 and 76 percent at 9.00 am, and 41 and 62 percent at 3.00 pm, in contrast to the inland zone, which averages between 42 and 48 percent at 9.00 am, and between 26 and 29 percent at 3.00 pm.

Annual averages, for each monitoring station, of 9.00 am and 3.00 pm relative humidity are presented in Figure 3-11.

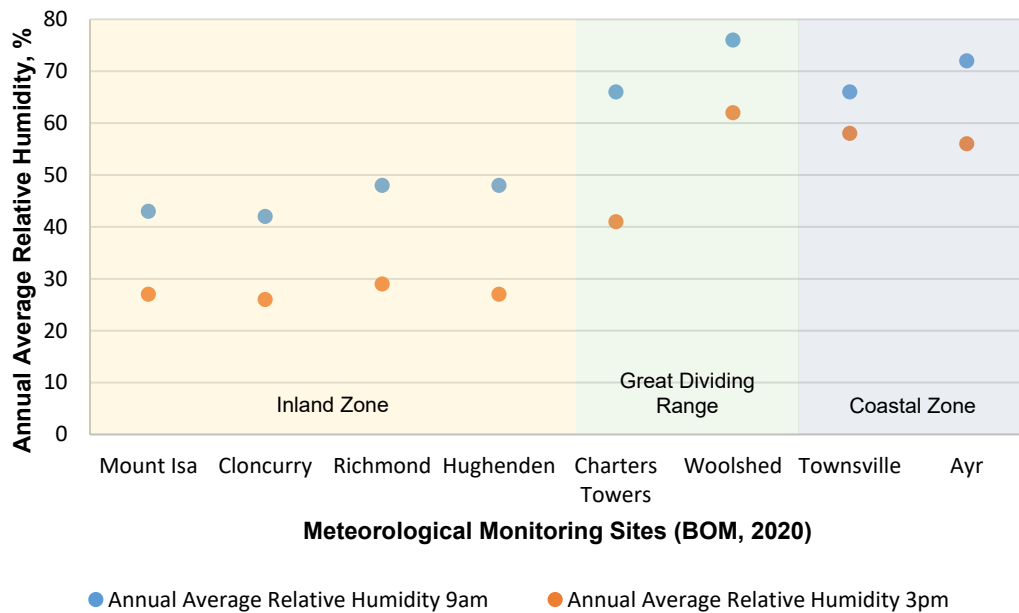


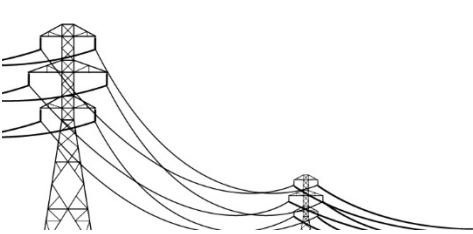
Figure 3-11 Annual average relative humidity statistics (Source: BOM, 2019)

Rainfall

The data shows that north Queensland and north-west Queensland receives most rainfall during the summer wet season. The coastal lowlands receive approximately twice the rainfall as the inland areas, with approximately 1,000 mm in Townsville and 500 mm in the inland monitoring stations. The coastal and Great Dividing Range climate zones can expect to receive 80 rain days per annum (days with 0.25 mm rain or greater), whereas the Flinders River Catchment and Northwest Highlands Bioregion can expect to receive 40 rain days per annum (BOM, 2000).

Summer rainfall tends to come from monsoonal troughs which cross from west to east producing widespread flooding rains. Additionally, summer storms can result in intense short duration rainfall over more localised areas. Storm rain can result in localised flooding events which can cause disruptions to localised Project infrastructure (such as construction camps, access roads and wastewater containment areas).

Annual rainfall is presented below in both Figure 3-12 (annual average) and Figure 3-13 (annual rainfall).



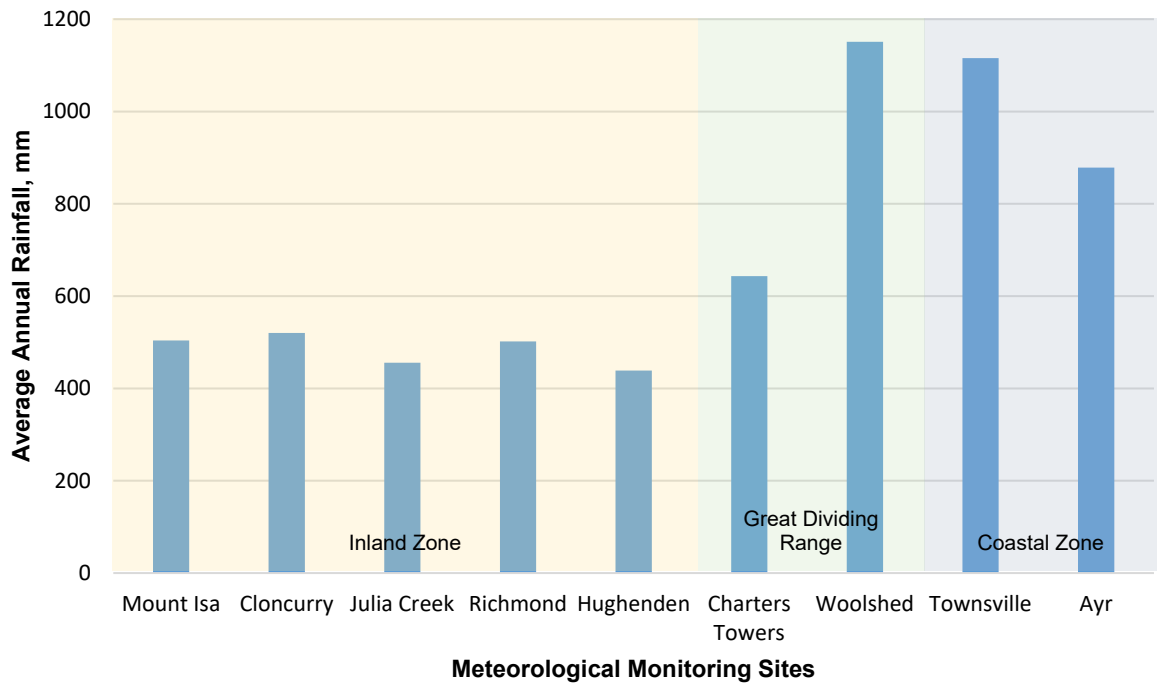


Figure 3-12 Annual average rainfall statistics (Source: BOM, 2020)

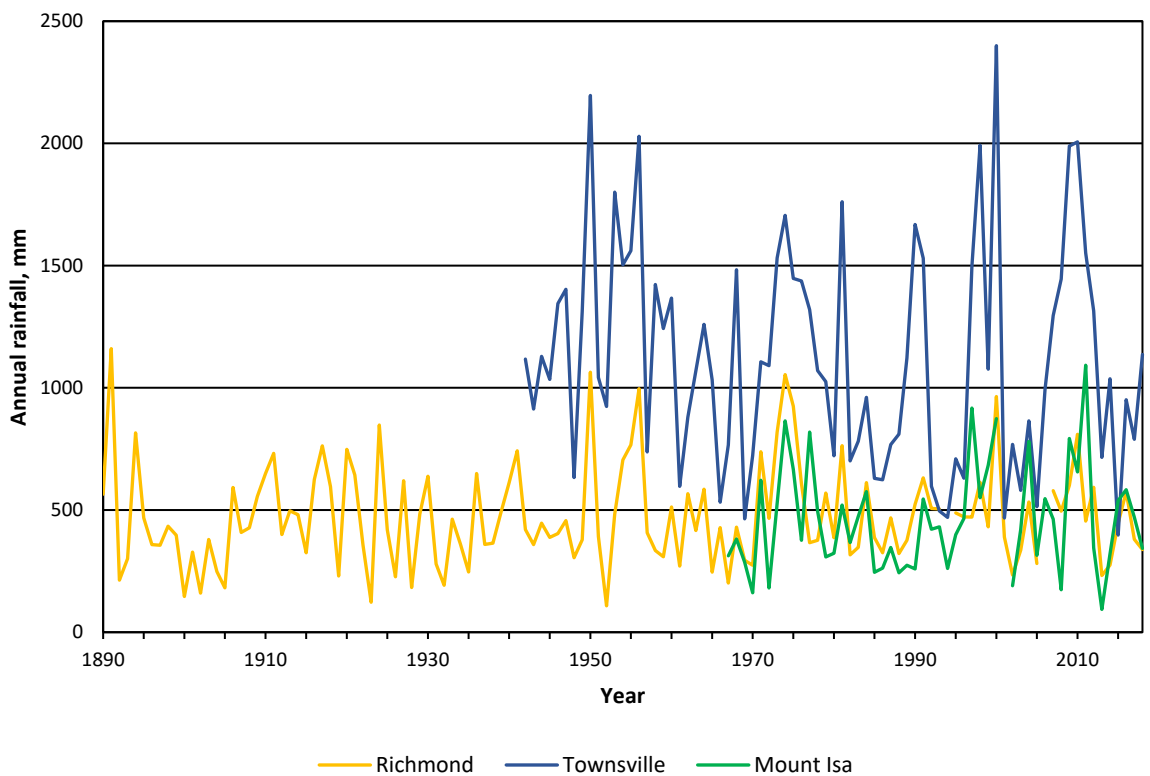
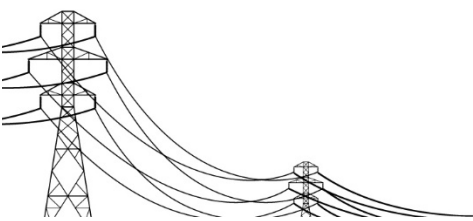


Figure 3-13 Annual rainfall in Richmond, Townsville and Mount Isa



Wind

Wind conditions are related to impacts to air and noise from the Project. The impact assessments related to air and noise are included in Volume 2 Chapter 10 Air and greenhouse gas, and Volume 2 Chapter 11 Noise and vibration, respectively.

Prevailing winds within the study area are typically south-east to north-east however there is significant variation between inland and coastal locations. Monitoring data from four meteorological monitoring stations (Townsville Aero, Charters Towers Airport, Richmond Post Office and Cloncurry Airport) was used to develop wind roses representative of annual average and seasonal winds at each location along the corridor selection.

The wind roses provide information about the strength and direction of the wind. Wind directions are divided in to eight compass directions. Branches are displayed on the wind roses according to the direction wind is blowing from. The branches are segmented with colour and width of the branch segment representing the wind speed, and the segment length representing the fraction of time for that combination of wind direction and speed. The inner circle represents calm, whilst the circles around the image represent the various percentages of occurrence of the winds. For example, if the branch to the west just reaches the 10% ring it means a frequency of 10% from that direction. An observed wind speed that falls precisely on the boundary between two divisions will be included in the lower range (BOM, 2020). The BOM wind roses are based on at least 15 years of records.

The annual average wind rose (Figure 3-14) for the Townsville Aero monitoring station indicates that the prevailing breeze is from the north-east. This direction is consistent in all seasons, as indicated in Figure 3-15. Townsville is assumed to represent winds in the coastal lowlands climatic zone of the corridor selection.

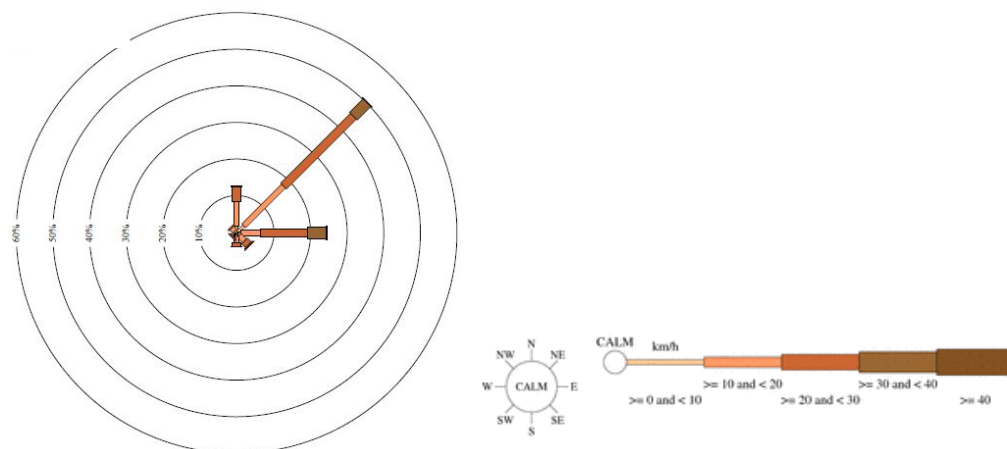
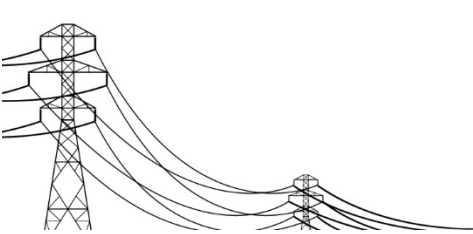
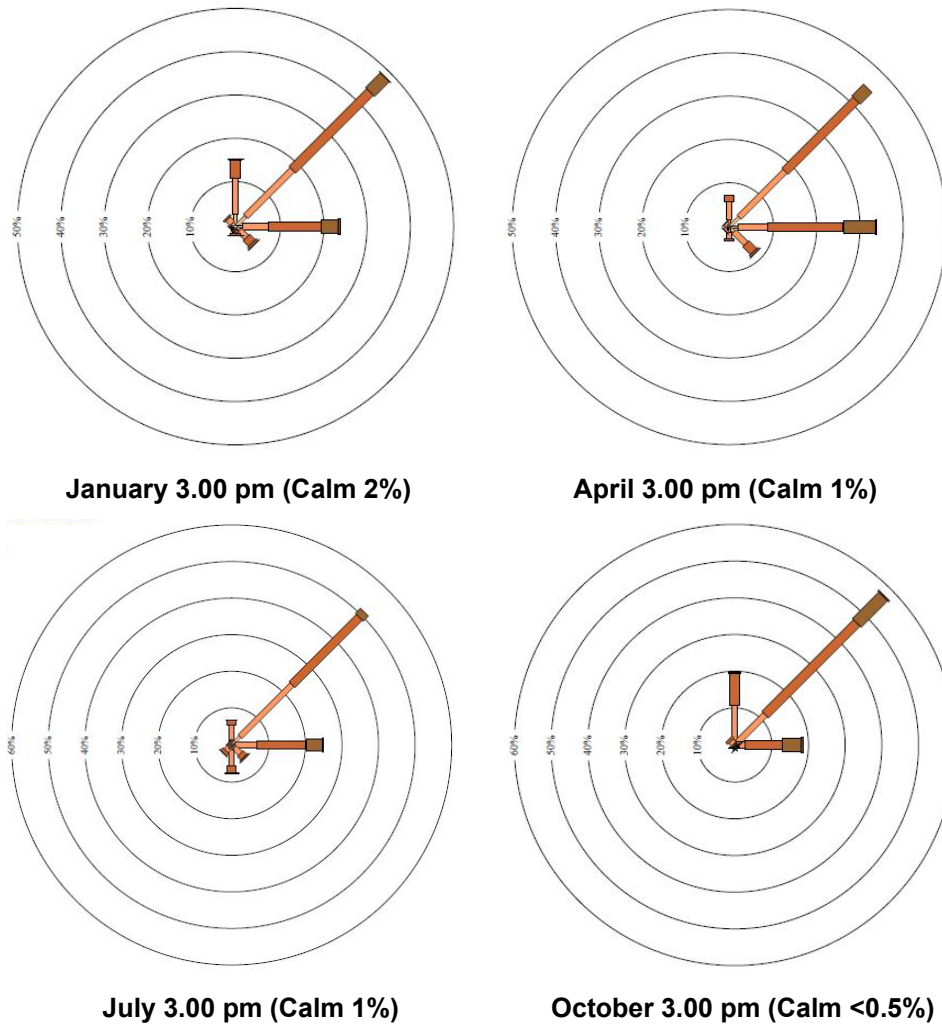


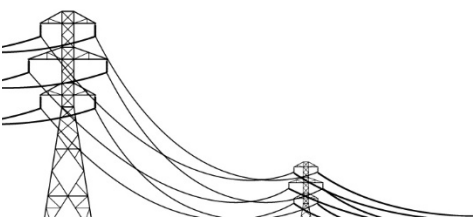
Figure 3-14 Annual average 3.00 pm wind speed vs direction (Calm 1%) – Townsville Aero (Source: BOM, 2020)





**Figure 3-15 Average seasonal wind speed vs direction at Townsville Aero
(Source: BOM, 2020)**

The annual average wind rose (Figure 3-16) for the Charters Towers Airport monitoring station indicates that the prevailing breeze is from the east. This direction is dominant in all seasons, as indicated in Figure 3-17. Charters Towers is assumed to represent winds in the Great Dividing Range climatic zone of the corridor selection.



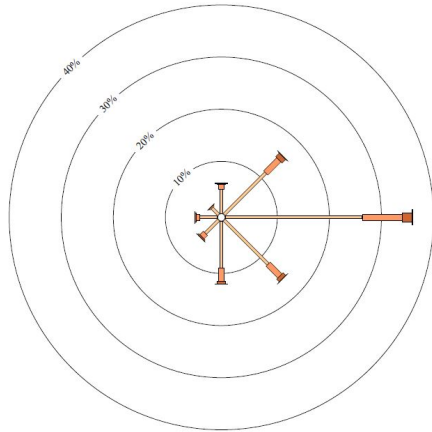
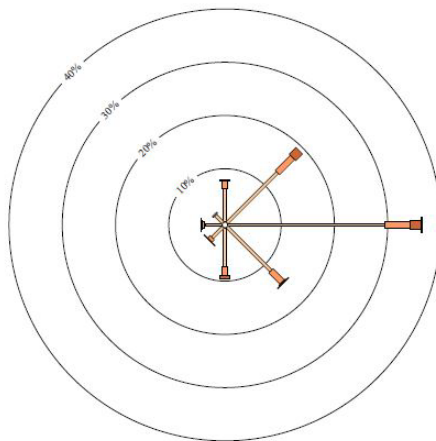
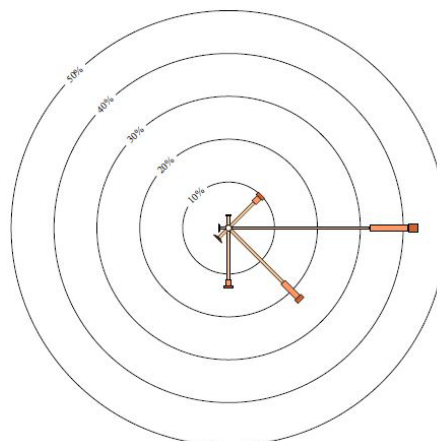


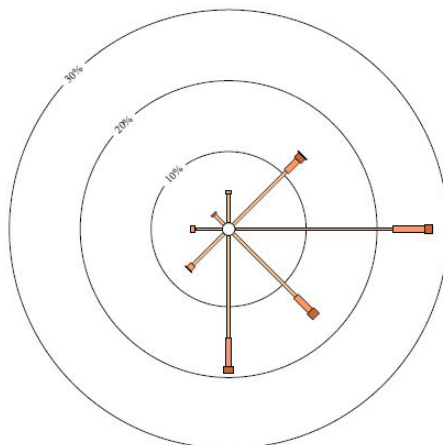
Figure 3-16 Annual average 3.00 pm wind speed vs direction (Calm 4%) - Charters Towers Airport (Source: BOM, 2020).



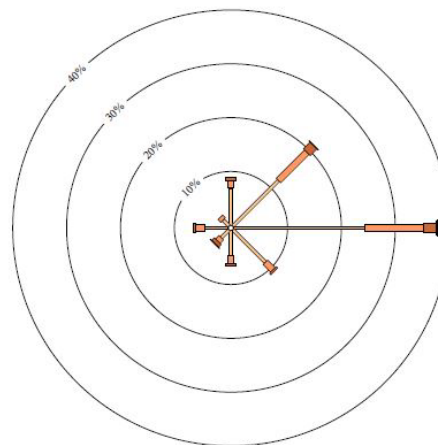
January 3.00 pm (Calm 3%)



April 3.00 pm (Calm 3%)

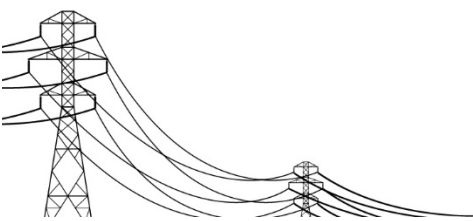


July 3.00 pm (Calm 4%)



October 3.00 pm (Calm 2%)

Figure 3-17 Average seasonal wind speed vs direction at Charters Towers Airport (Source: BOM, 2019)



The annual average wind rose (Figure 3-18) for the Richmond Post Office monitoring station indicates that the prevailing breeze is from the east and south-east. This direction is dominant in all seasons, as indicated in Figure 3-19. Richmond is assumed to represent winds in the inland zone (Flinders River catchment) of the corridor selection.

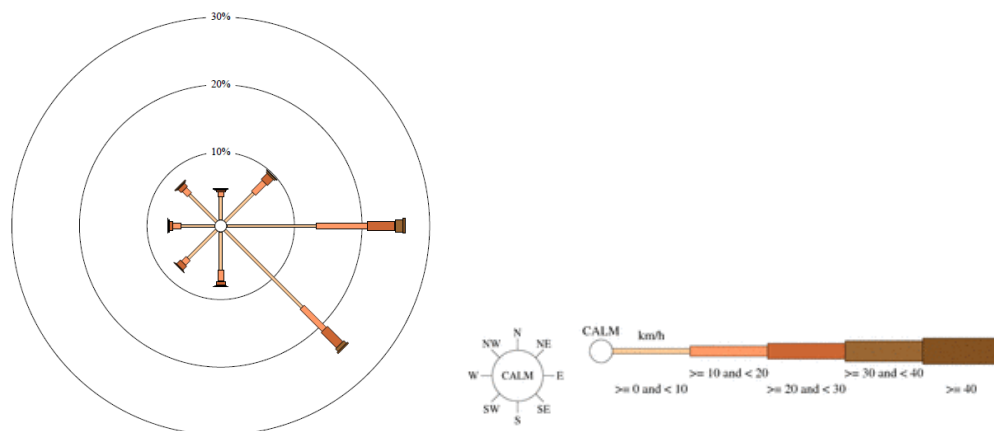


Figure 3-18 Annual average 3.00 pm wind speed vs direction (Calm 4%) - Richmond Post Office (Source: BOM, 2019)

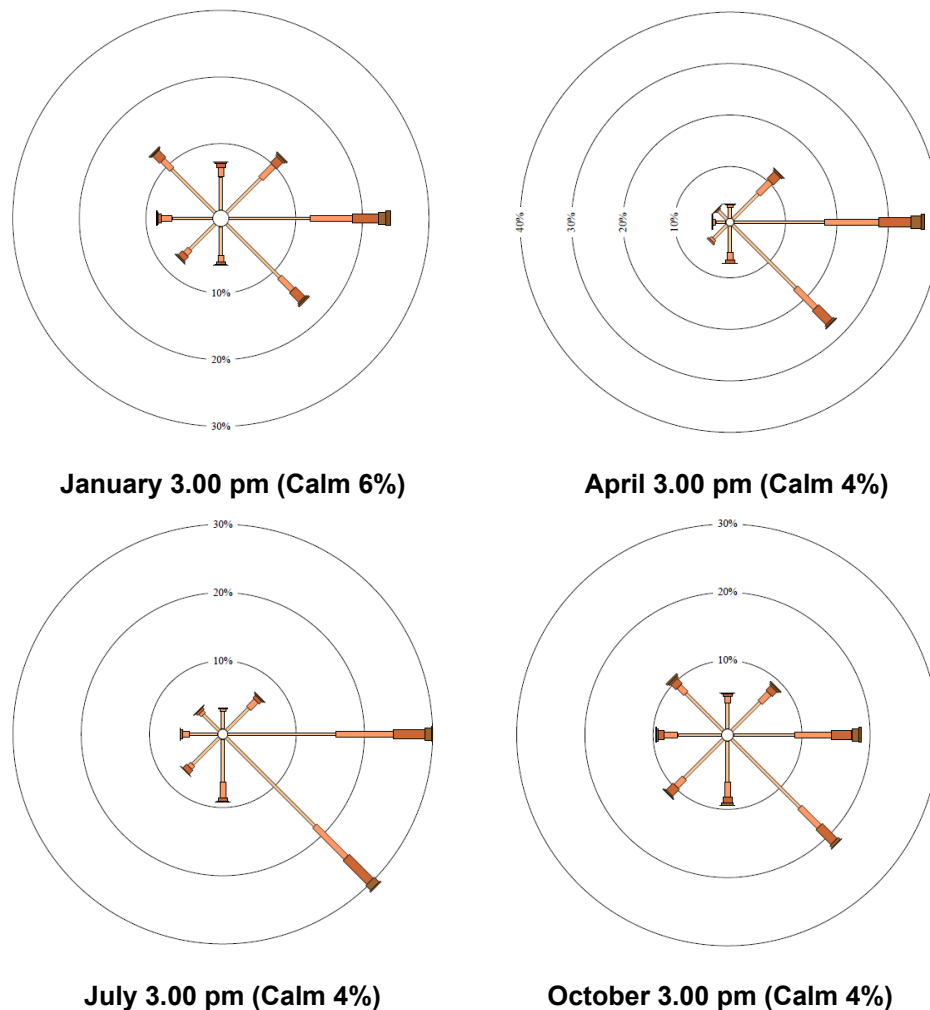
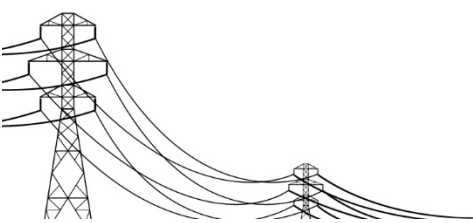


Figure 3-19 Average seasonal wind speed vs direction at Richmond Post Office (Source: BOM, 2019)



The annual average wind rose (Figure 3-20) for the Cloncurry Airport monitoring station indicates that the prevailing breeze is from the south and south-east. The wind direction at Cloncurry Airport varies between seasons, as indicated in Figure 3-21. In autumn, winter and spring, the prevailing winds are from the south-east while in summer prevailing winds are from the east and north. Cloncurry is assumed to represent winds in the inland zone (Mount Isa) of the corridor selection.

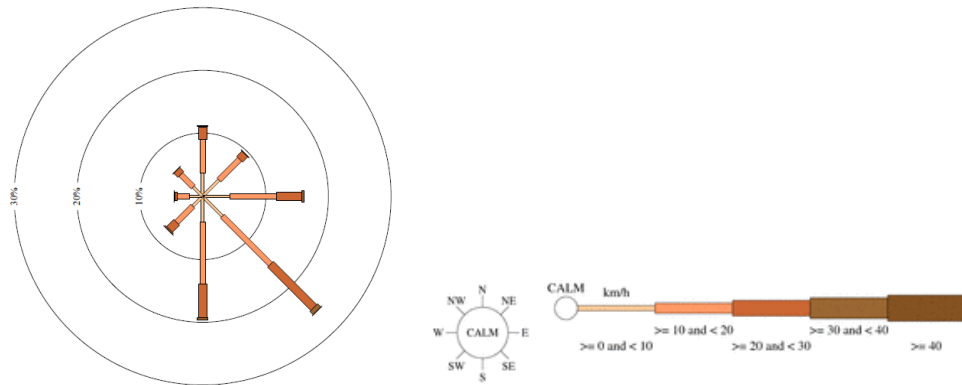


Figure 3-20 Annual average 3.00 pm wind speed vs direction (Calm <0.5%) - Cloncurry Airport (Source: BOM, 2019).

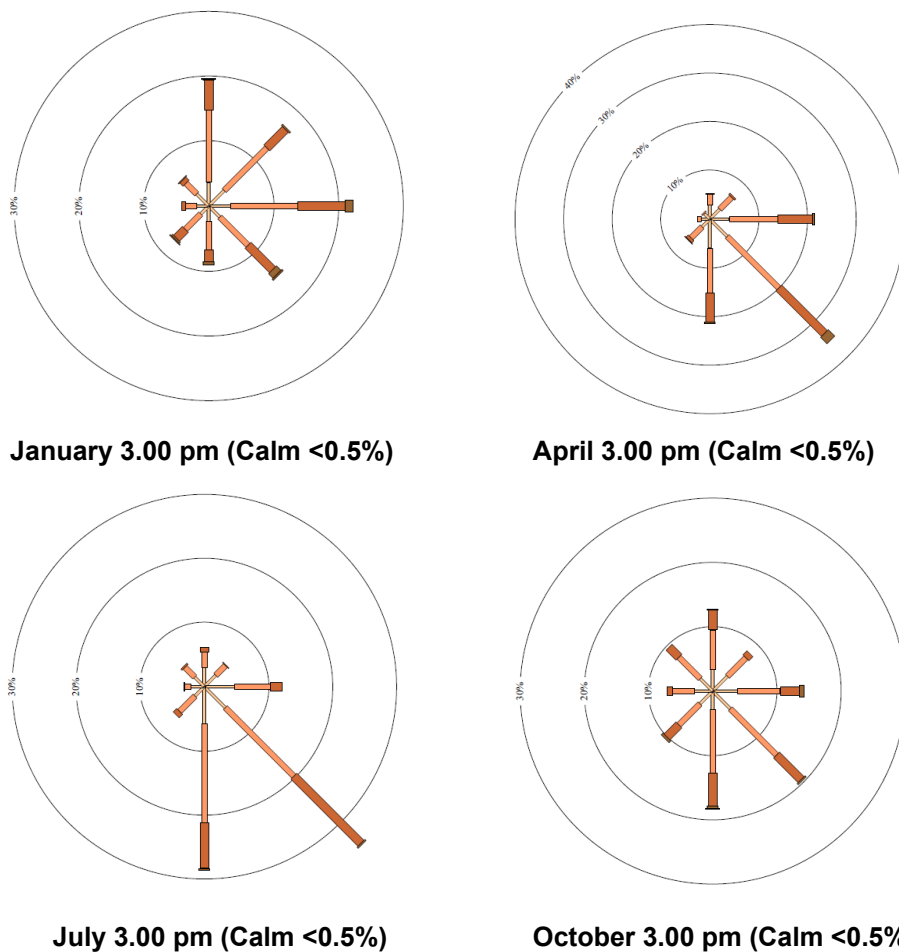


Figure 3-21 Average seasonal wind speed vs direction at Cloncurry Airport (Source: BOM, 2019)

Climate extremes and natural hazards

Seasonal conditions and climate extremes constitute natural hazards that may impact on the Project. Climatic extremes and natural hazards that are experienced in the climate zones identified for the corridor selection include extended periods of extreme temperatures, drought, storm events, cyclones, flooding, bushfire, and, to a lesser extent, earthquakes. Climate extremes and natural hazards are summarised in the following sections. A more detailed analysis is including in Volume 2 Chapter 17 Hazards, health and safety.

Drought

Drought is defined as consecutive years of below average rainfall. Within the study area significant years of drought have included periods between:

- 1985 - 1989
- 1992 - 1996
- 2001 – 2006
- 2013 – 2019.

There are records of longer periods where below average rainfall was recorded, and although not every one of these years is dry there was a drying trend across these years. Periods of drought are typically associated with increased evaporation (especially during summer months). The inland climatic zone exhibits high rainfall variability and with approximately 75 percent of the rainfall falling in the summer, a wet season failure can result in severe water shortages.

Due to the relatively short period of construction, the impact of drought on construction of the Project is not expected to be significant and can be managed should a drought occur. The direct impact on operations is also low. However, drought is often associated with other climate extremes which can result in a number of other issues that may affect operations including an increased risk of fire, dust storms and land degradation.

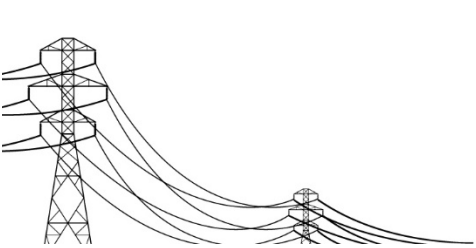
Storm events

Storms may be expected in the study area between October and April. These events can bring heavy rain, locally strong winds, hail and lightning. There is some risk to the Project infrastructure and operational or construction activities from storm events.

Additionally, storm events may results in short term localised flooding along access tracks and construction areas including temporary construction camps.

Lightning

Lightning is a natural hazard that could impact Project infrastructure, particularly transmission line infrastructure once constructed. It is also a hazard to construction and operational/maintenance workers and others outdoors. Thunder is the sound caused by the electrical discharge of lightning. Hence a thunderstorm is always associated with lightning (BOM, 2020). Figure 3-22 shows the average annual number of thunder days, based on observed thunderstorm activity at approximately 300 weather stations across Australia over a 10 year period (1990-1999). The map shows that the average annual number of thunderstorm days ranges from 15-20 in the Coastal Lowlands zone to 40-50 in the Mount Isa zone.



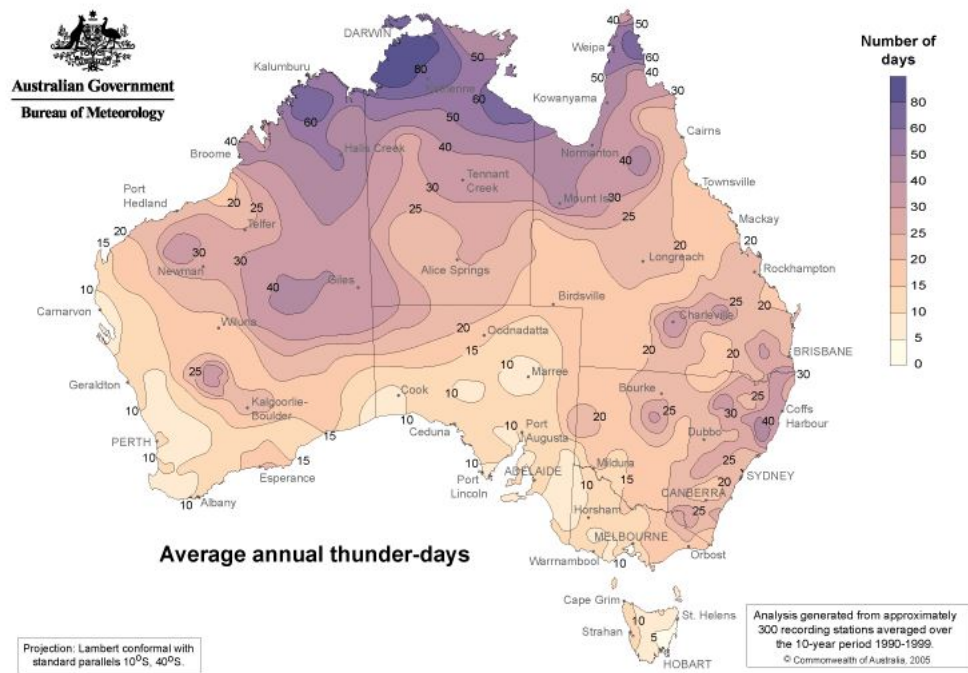


Figure 3-22 Average annual thunder days (Source: BOM, 2020)

Figure 3-23 shows the geographical distribution of both cloud-to-ground and cloud-to-cloud lightning flashes per km², while Figure 3-24 shows only cloud to ground lightning flashes. The ground lighting flash density is higher in the Inland climatic zone than the Great Dividing Range and Coastal Lowlands.

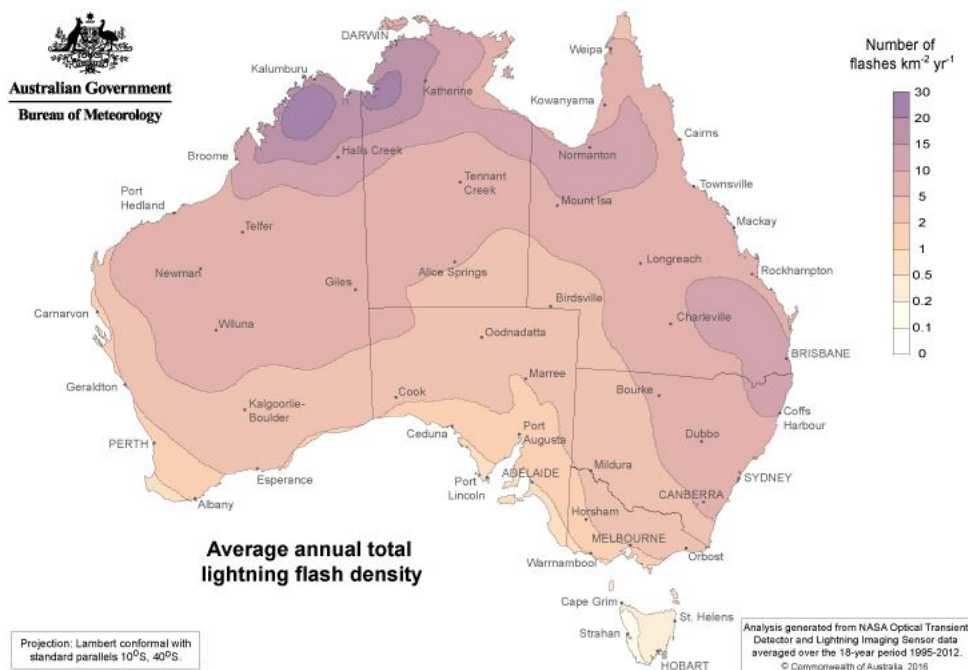
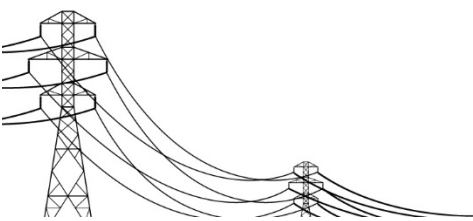


Figure 3-23 Average annual total lightning flash density (Source: BOM, 2020)



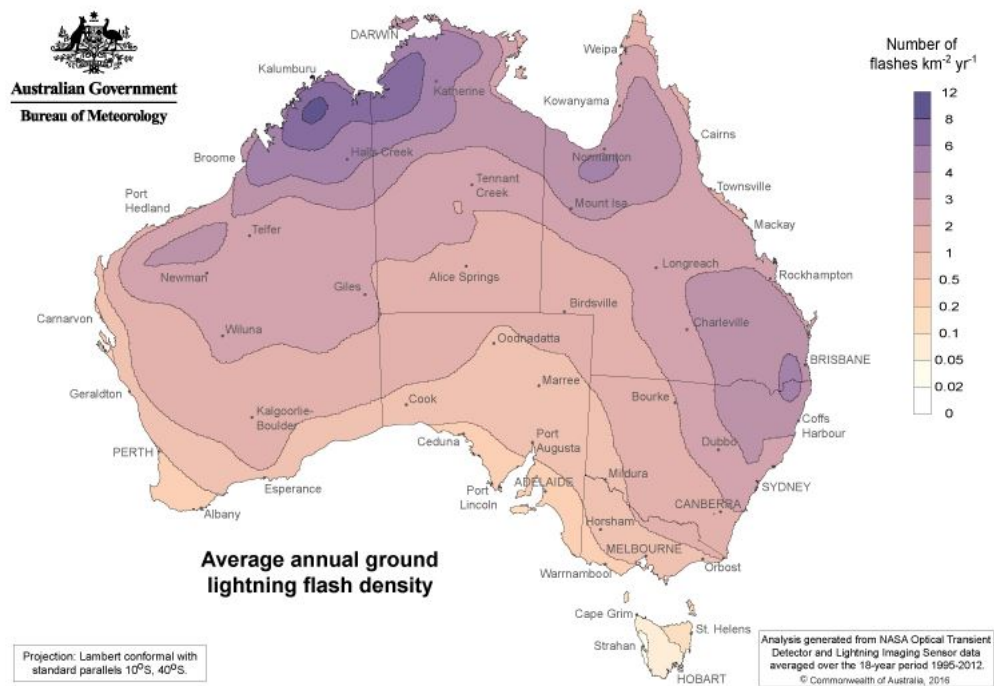


Figure 3-24 Average annual ground lightning flash density (Source: BOM, 2020)

Figure 3-25 and Figure 3-26 show the average annual ground lightning flash density for the warm season and cool season respectively. The ground lightning flash density along the corridor selection varies from 0.2-0.5 flashes/ km^2 /year in the cool season to 3-4 flashes/ km^2 /year in the warm season. This is consistent with the increased level of rainfall experienced during the warm season (wet season) along the corridor selection however dry thunderstorms may also be experienced.

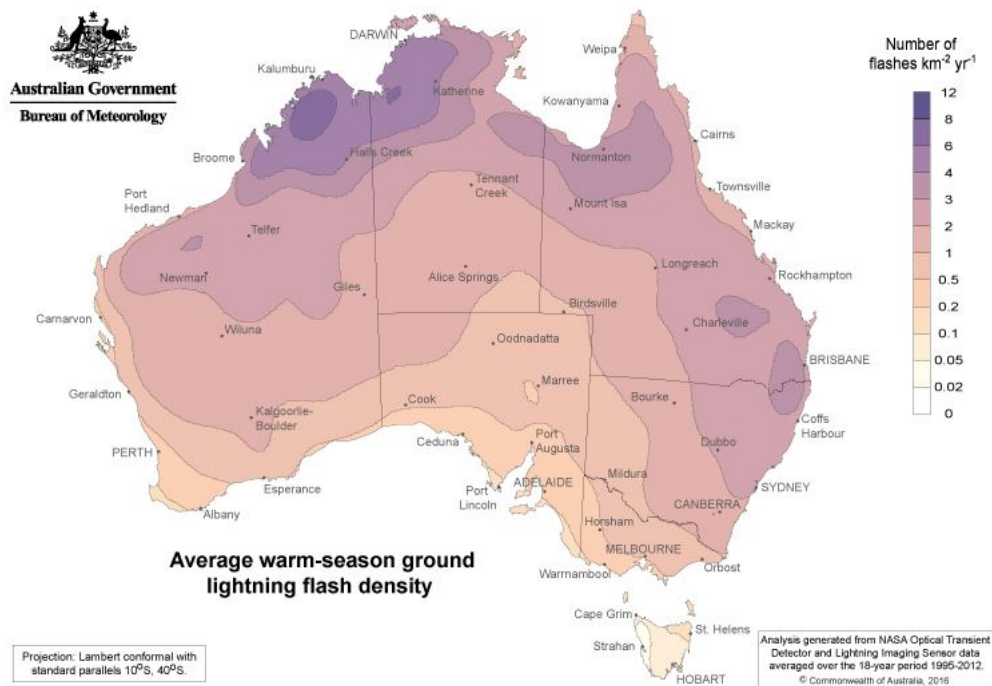


Figure 3-25 Average warm season ground lightning flash density (Source: BOM, 2020)

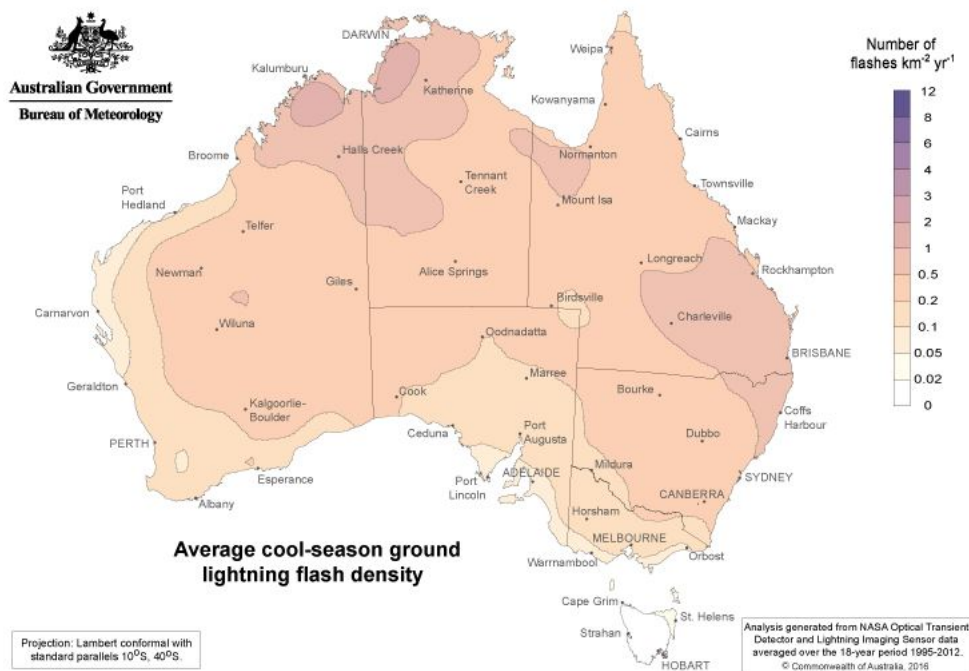


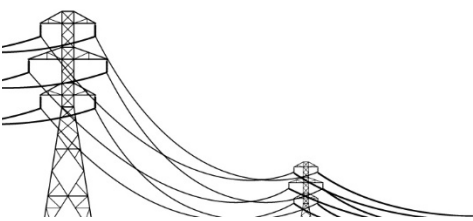
Figure 3-26 Average cool season ground lightning flash density (Source: BOM, 2020)

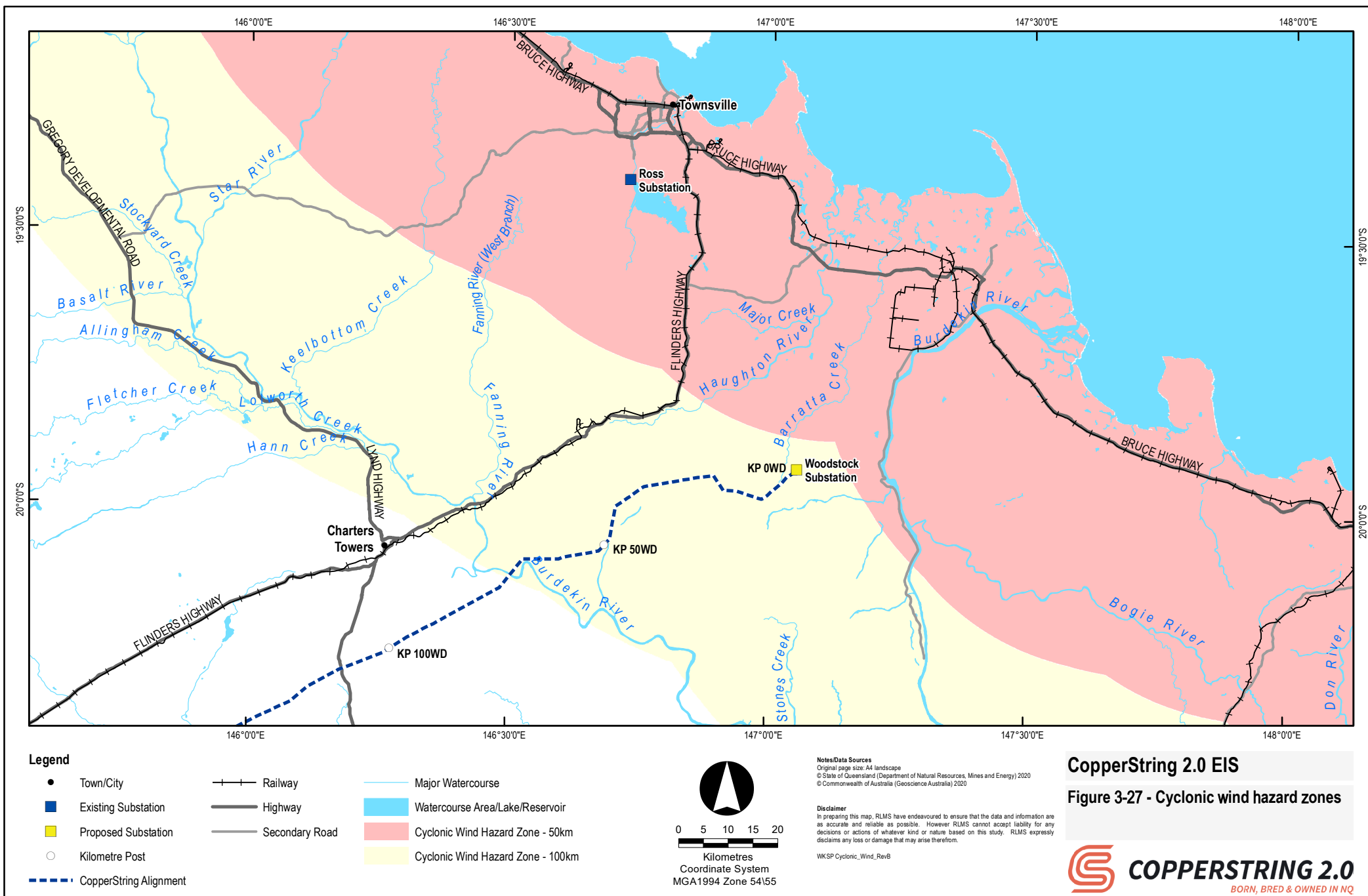
Cyclones

Tropical cyclones are a risk in coastal areas in north Queensland and are likely to impact on the coastal lowland climatic zone (refer Figure 3-27). The cyclone season in Australia is between November and April.

Tropical cyclones can bring destructive winds, flooding rains and storm surges. Storm surges will not present an issue for the Project as the nearest site of Project infrastructure (Woodstock Substation) is located approximately 50 km from the coast.

Risks associated with tropical cyclones are greatest in coastal areas. After crossing the coast they quickly degrade into a rain depression and less destructive winds. Although the risks are greatest in coastal areas, the rains associated with cyclonic influences can result in significant widespread flooding. This flooding can isolate communities for extended periods.





Floods

The corridor selection traverses several large catchment areas and includes 29 major watercourse crossings. The five major river systems and associated catchments include:

- Burdekin River
- Cooper Creek
- Flinders River
- Leichhardt River
- Georgina River.

The inland zone of the corridor selection (between the Great Dividing Range and the Selwyn Range, east of Mount Isa) is predominantly flat with wide floodplains. The corridor selection traverses approximately 185 km of floodplains. Transmission towers will be constructed at a spacing of 400 to 500 m, depending on topography and conductor clearance requirements.

The flat terrain in the inland zone tends to result in sheet flooding during significant rain events in the wet season. Floods may spread over thousands of square kilometres and last several weeks.

In the coastal areas east of the Great Dividing Range the riverine systems are shorter and stream flow is faster. Flood peaks are generally shorter although these can last several days. Localised flooding may occur during storms and cyclonic events (including storm surges). A number of flood mitigation works (such as dams) have occurred to reduce flood impacts on population centres.

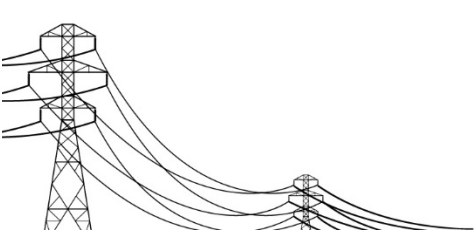
Flash floods may occur on any stream or waterway, generally as a result of high intensity rainfall associated with a storm of defined rain event. These floods pose a localised hazard that requires site specific consideration.

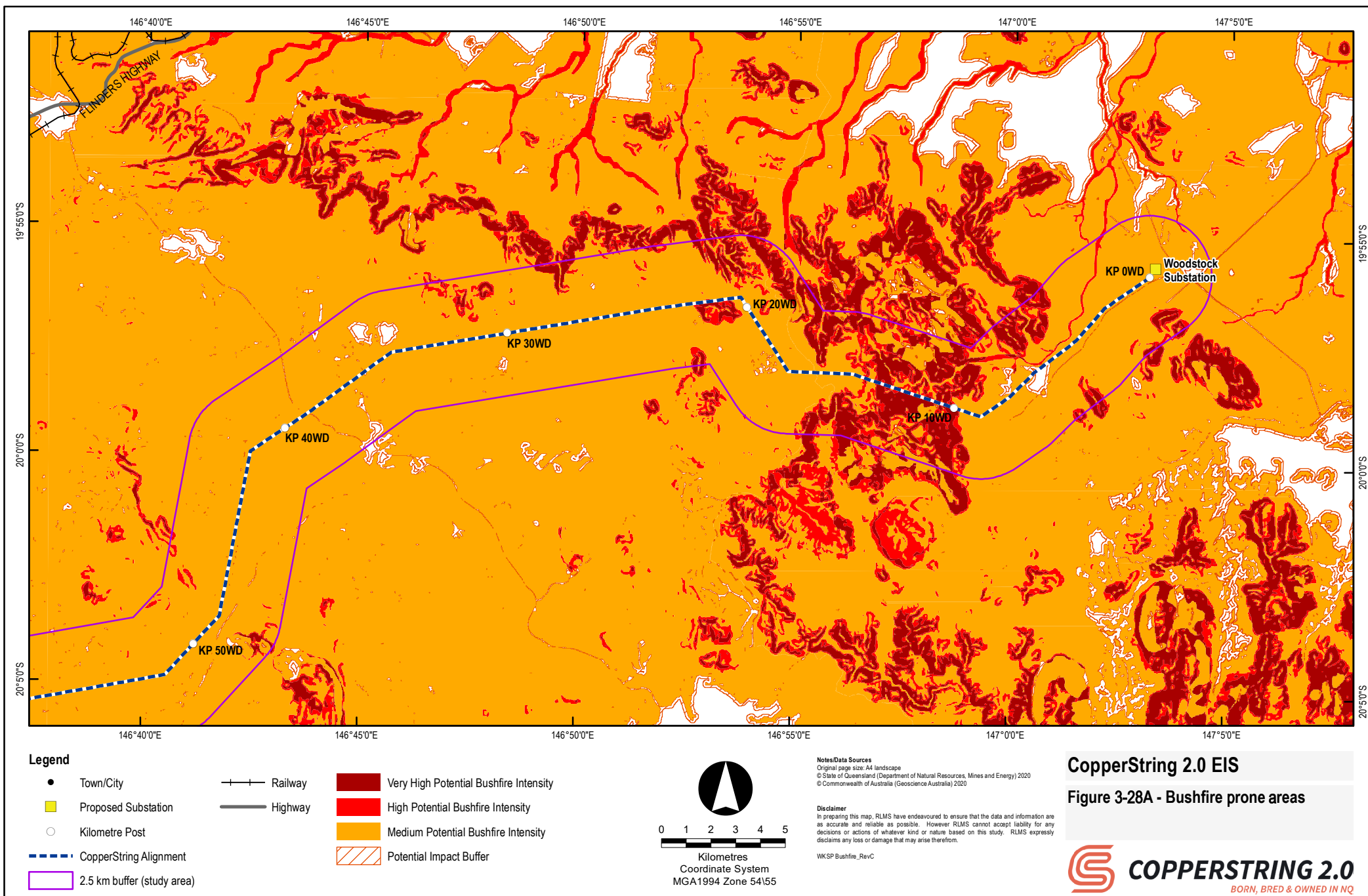
The potential for flooding within the corridor selection and flood plain management is further addressed in Volume 2 Chapter 9 Water resources and water quality.

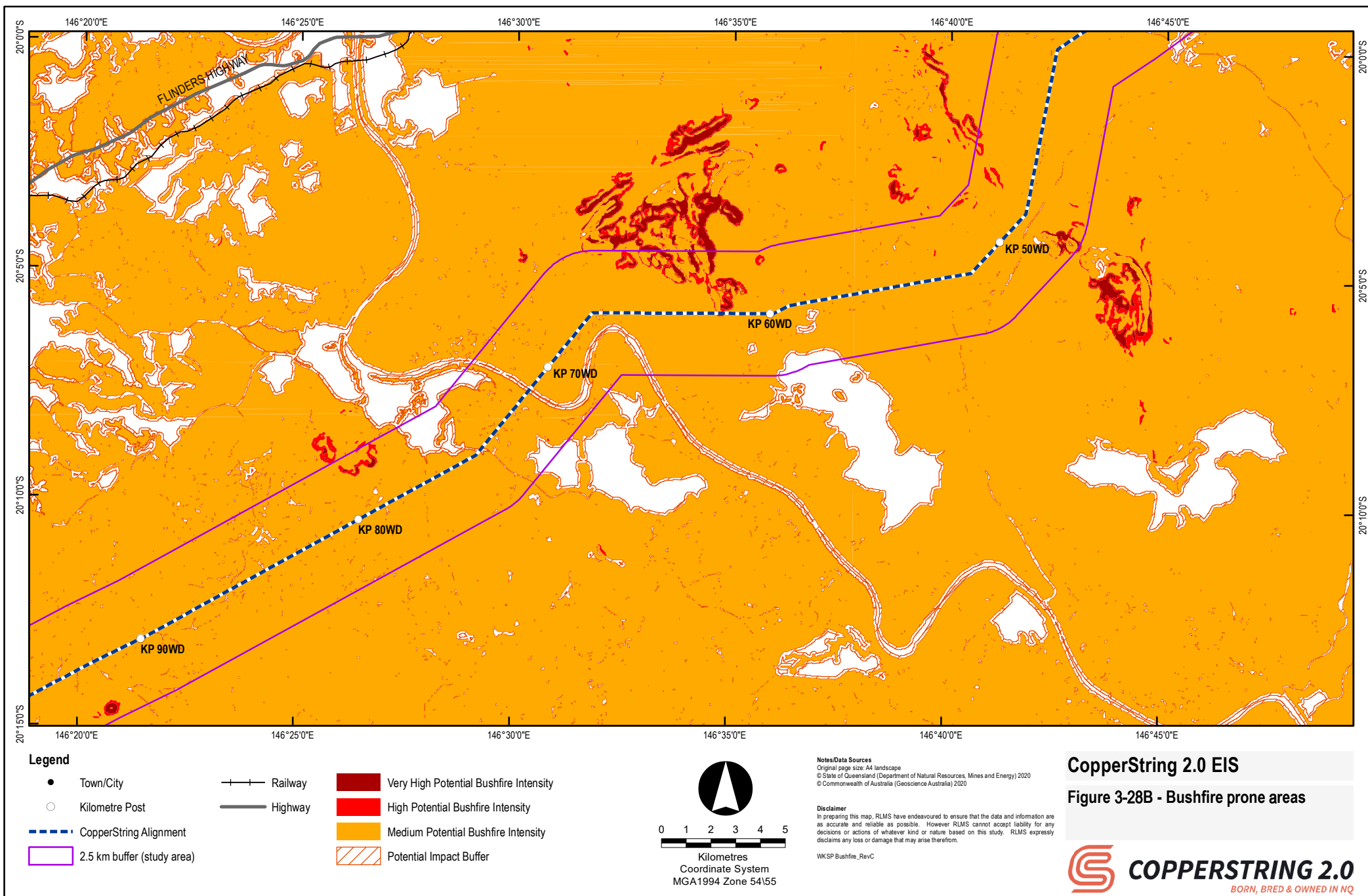
Bushfire

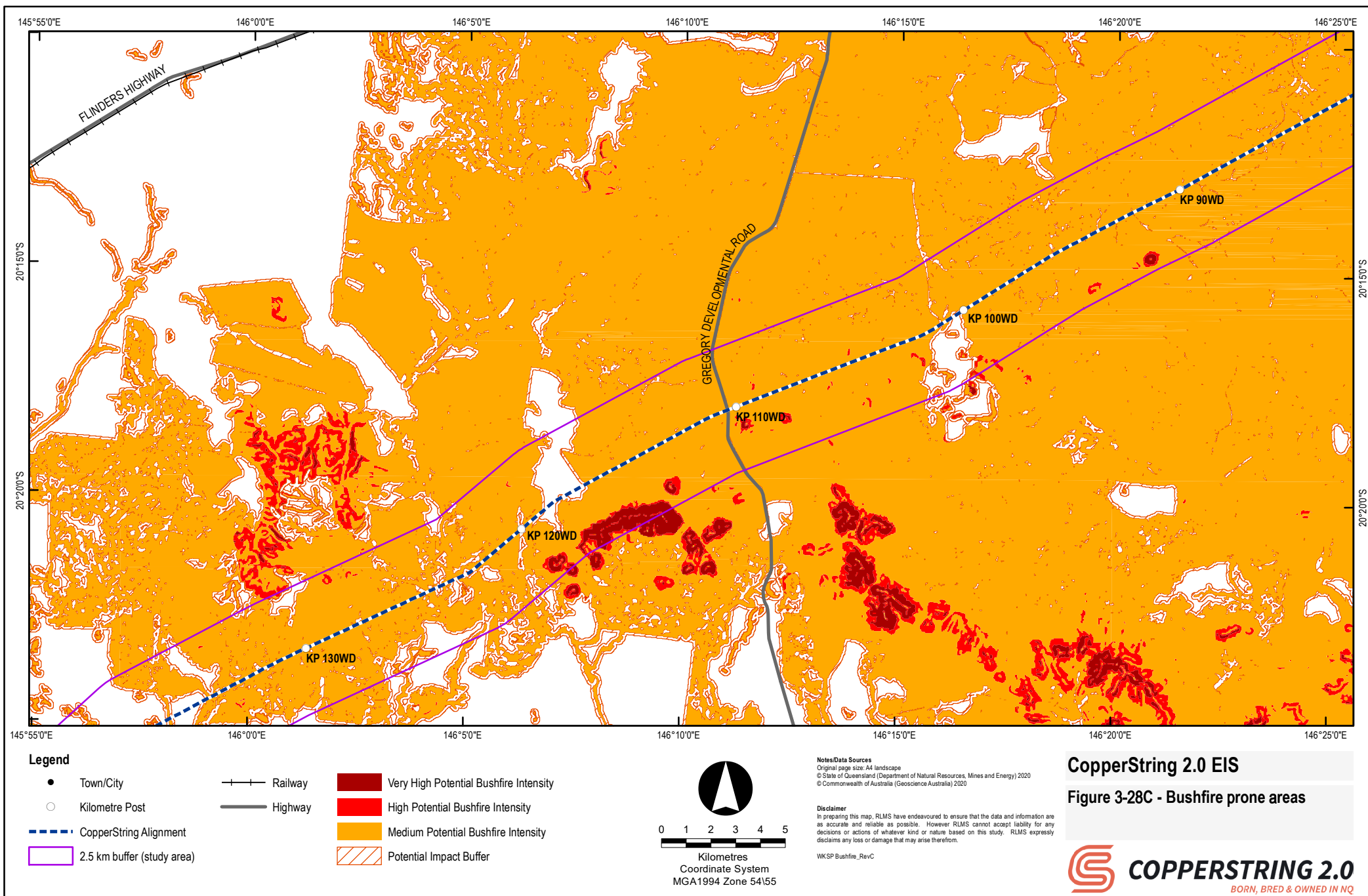
Bushfires can occur at any time of the year in Australia however the peak bushfire season for north Queensland and north-west Queensland is during the dry season, generally throughout winter and spring, when temperatures are higher and fuel loads are dry. Bushfire conditions are influenced by a combination of climate systems but in most case are driven by hot, dry winds blowing from central Australia. The end of the fire season in north Queensland and north-west Queensland is determined by the onset of moister conditions, sometimes as the results of a tropical cyclone developing near the Queensland coast.

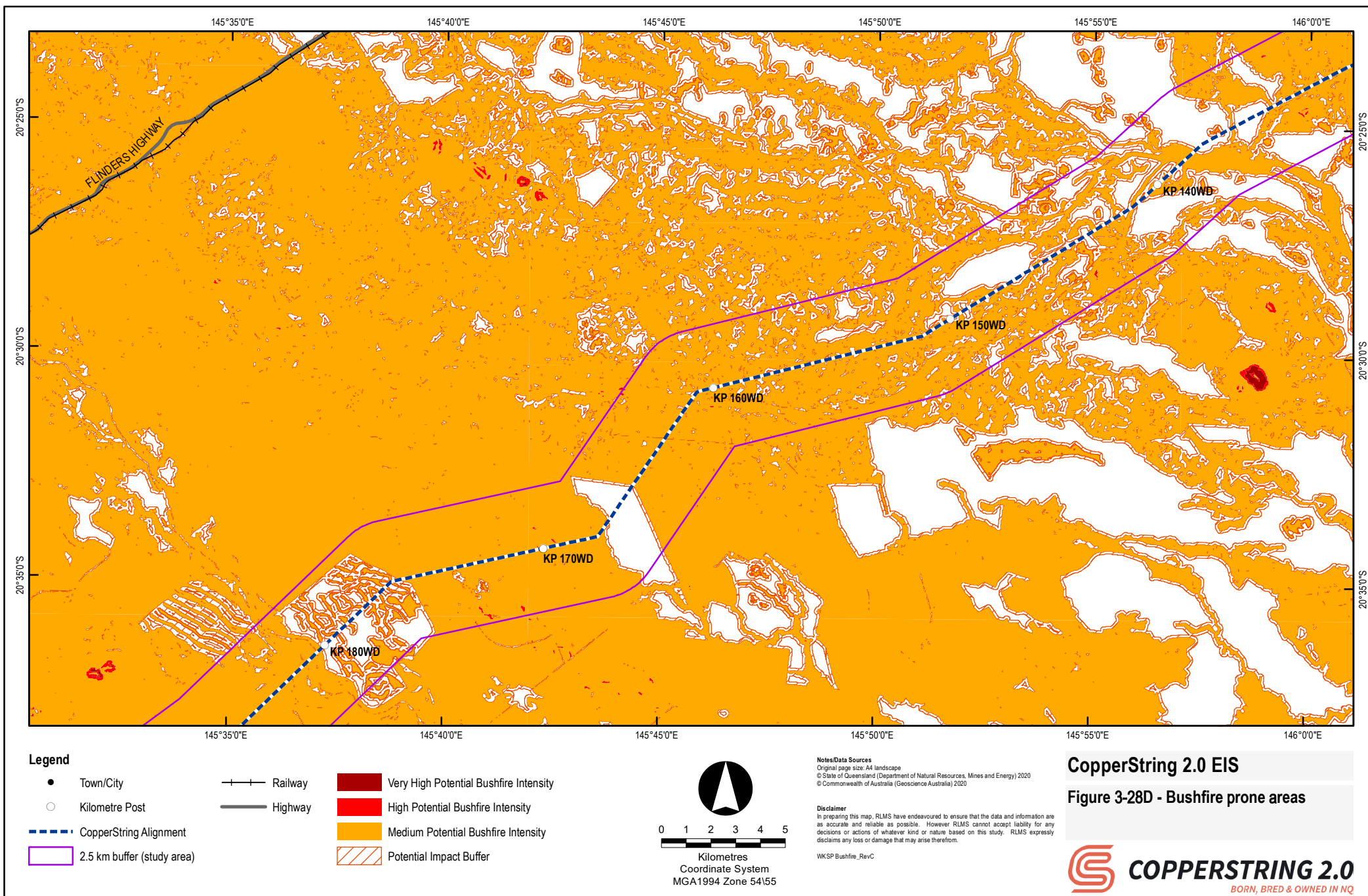
Bushfire prone areas are mapped by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in conjunction with the Queensland Fire and Emergency Services (QFES). The modelling used for mapping bushfire prone areas also includes predicted climate changes. Bushfire hazard is highest in the Renewable Energy Hub, Mount Isa Augmentation, Southern Connection and Cannington Connection sections of the corridor selection. These sections are mostly mapped as having a medium potential bushfire intensity, with some small areas of high and very-high potential bushfire intensity. The CopperString Core and Phosphate Hill Connection are generally not in bushfire prone areas; there are some small areas that are mapped as medium potential bushfire intensity however these are associated with riparian zones. Identified bushfire prone areas are illustrated in Figure 3-28.

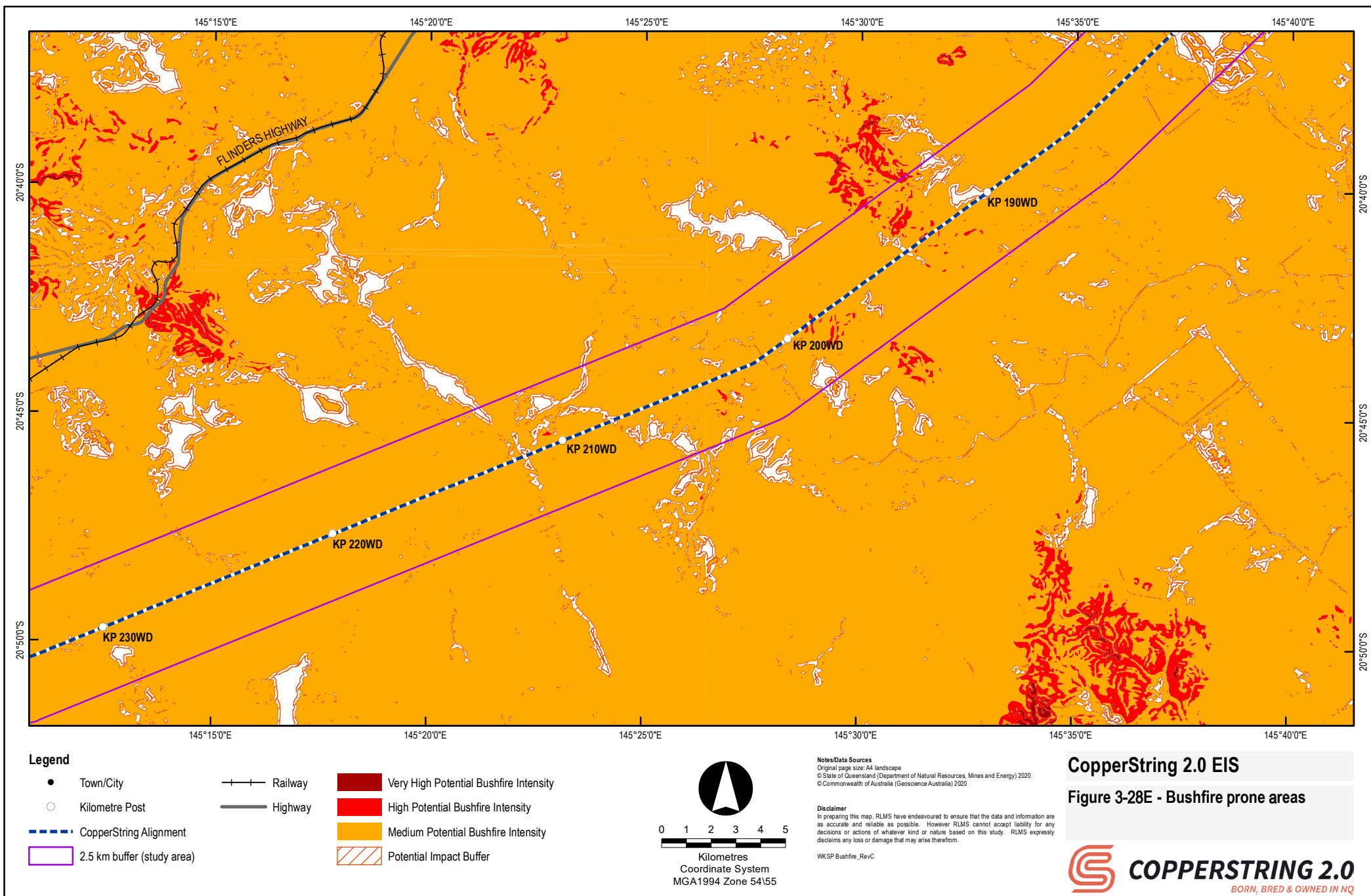


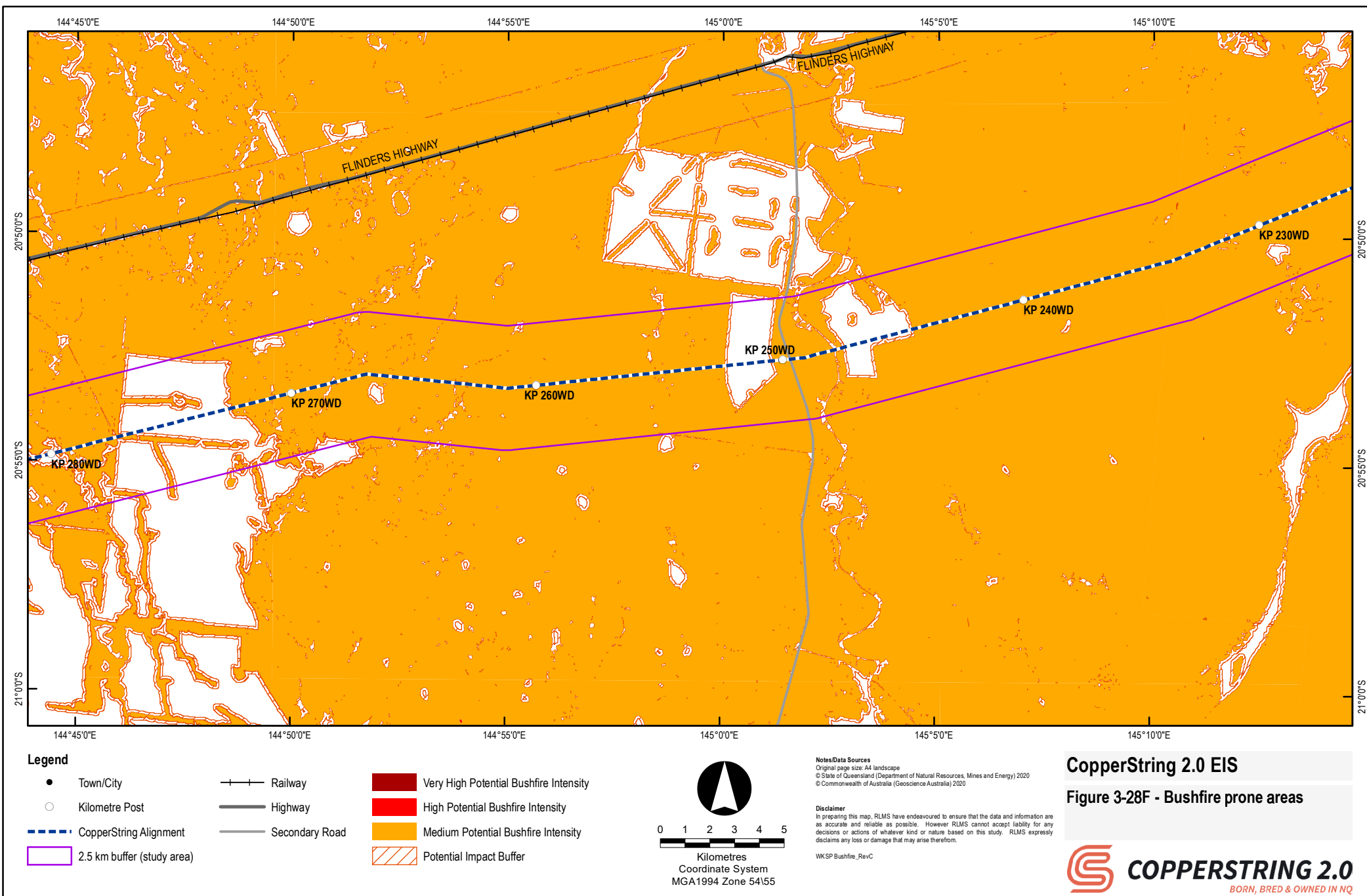


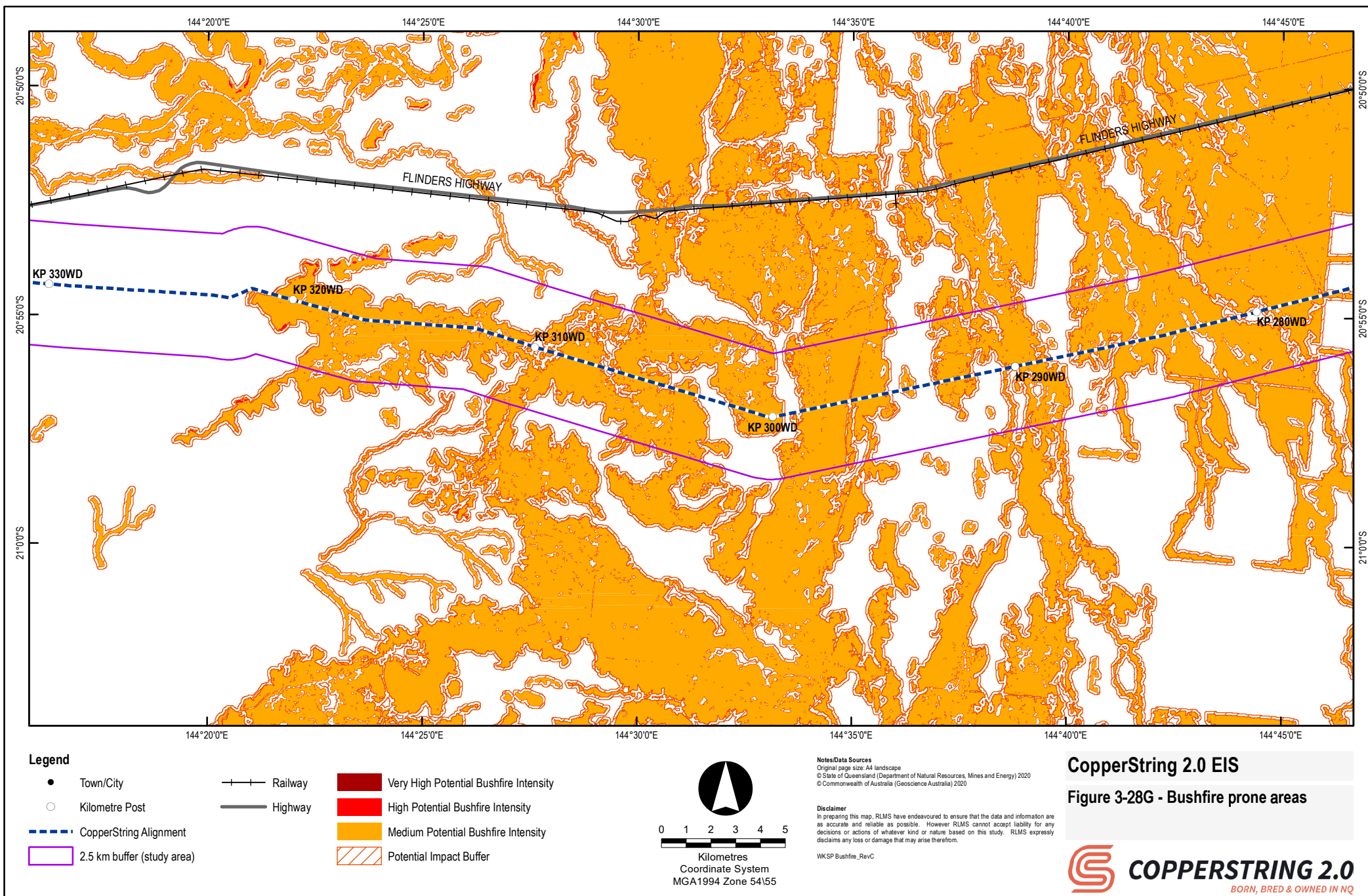


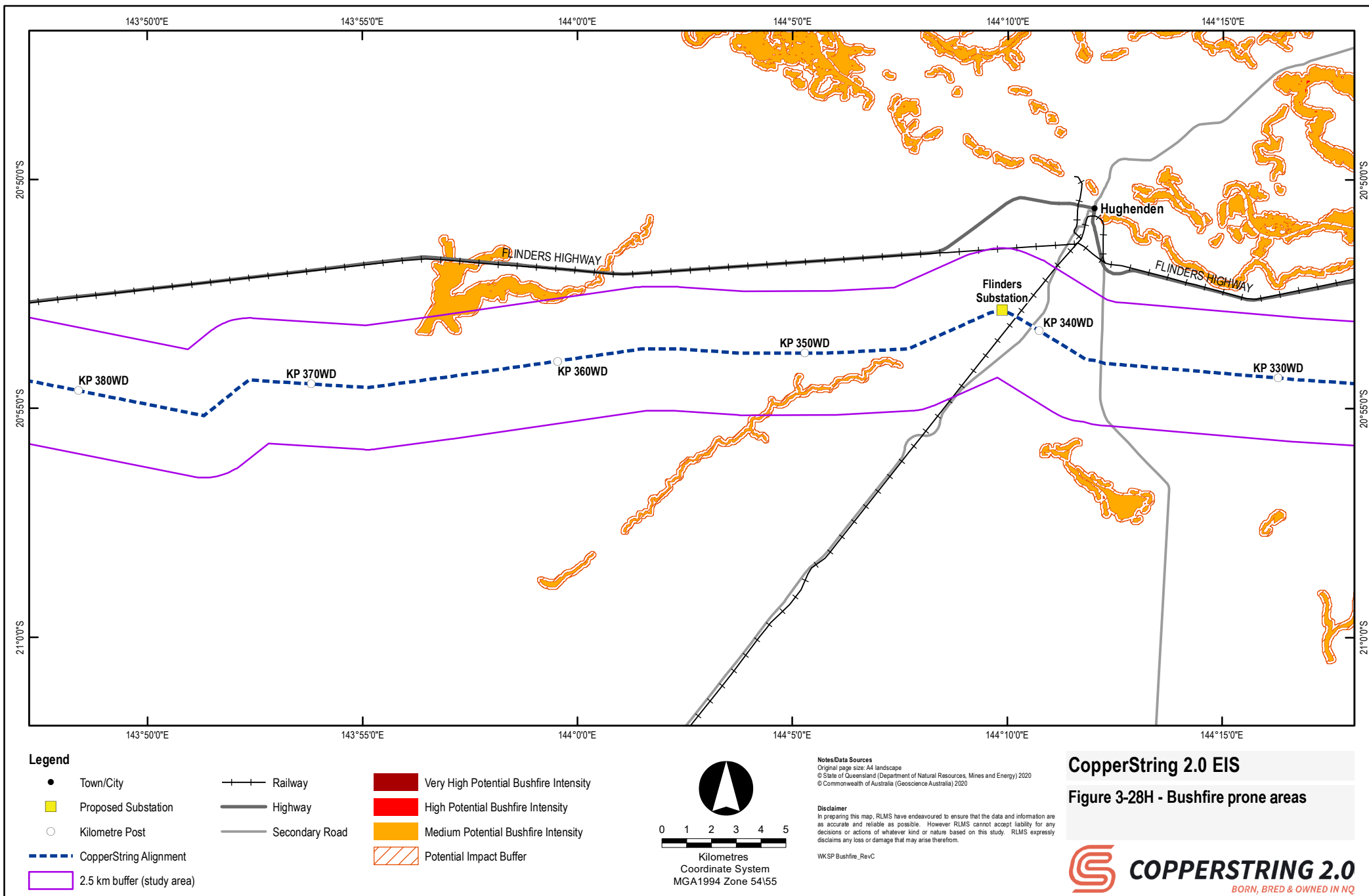


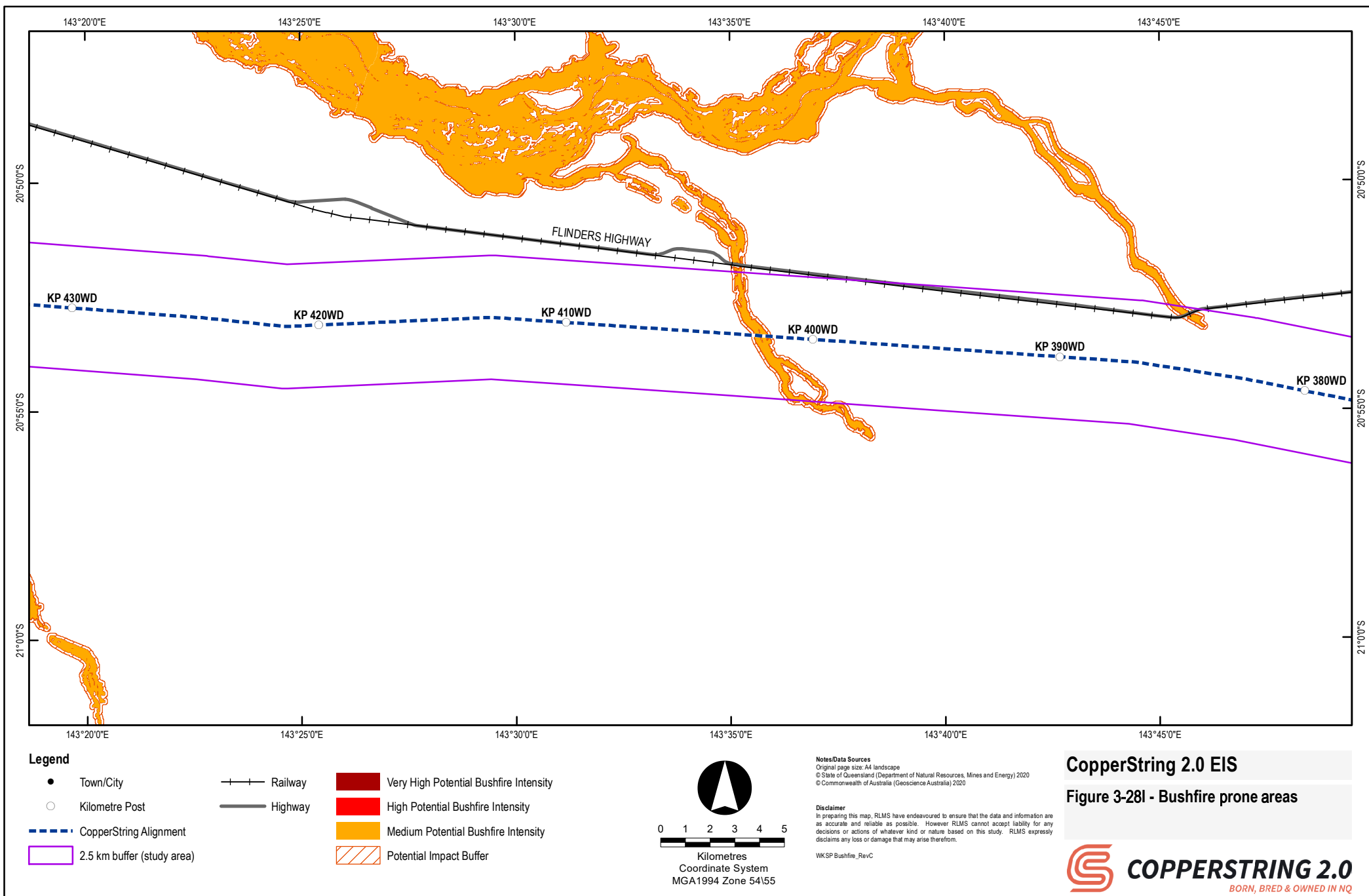


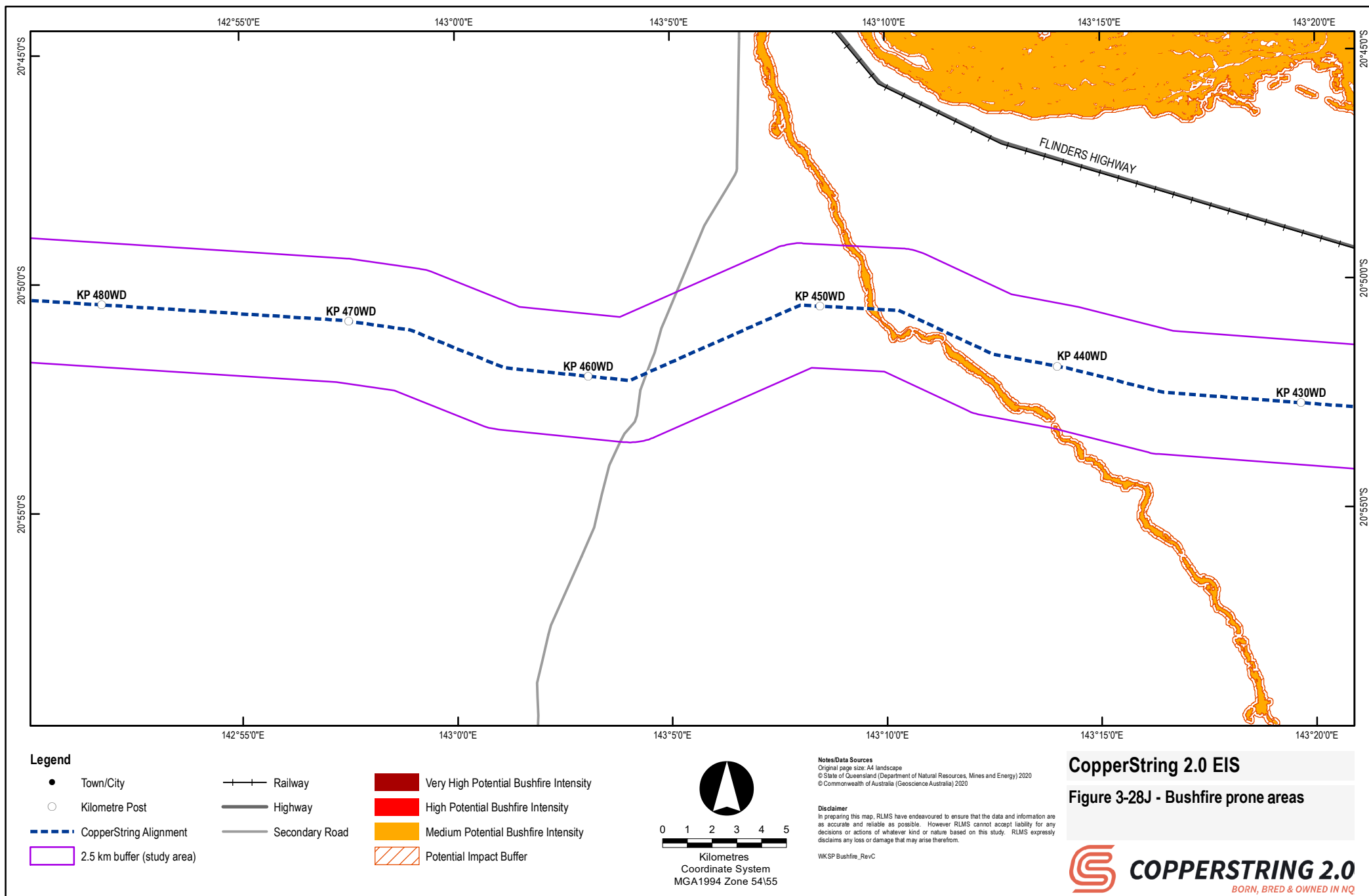


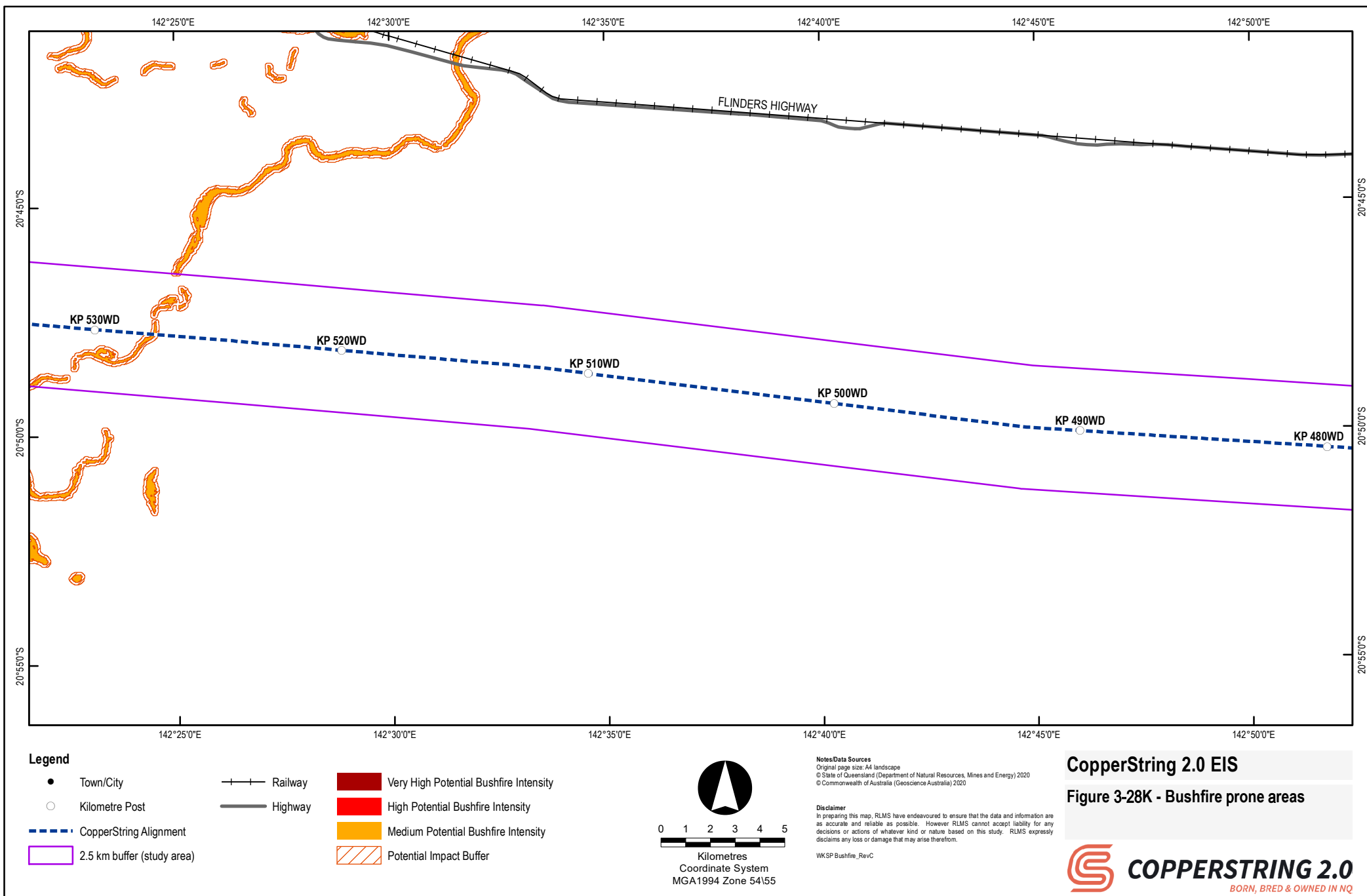


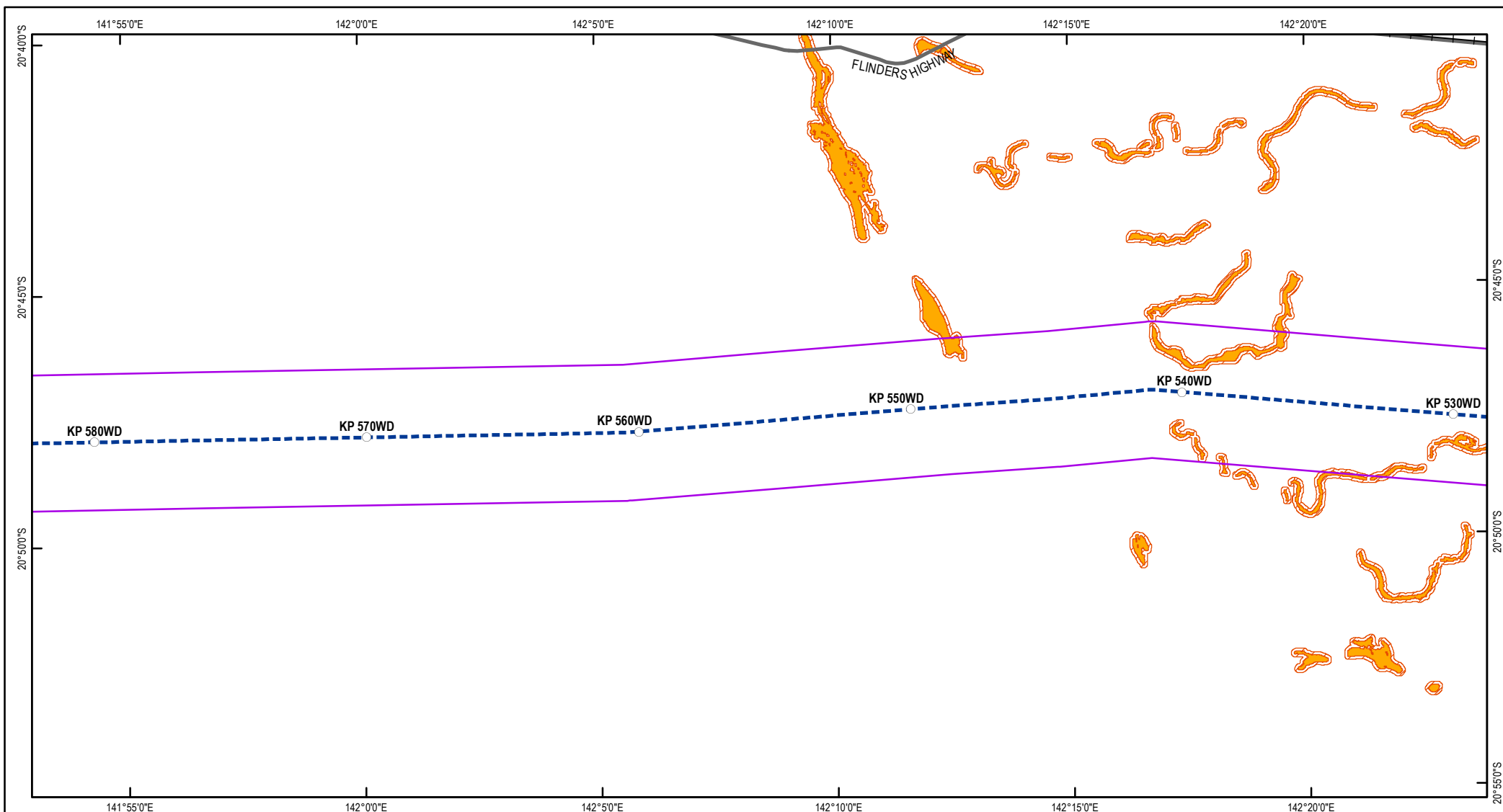






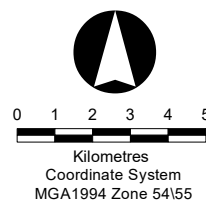






Legend

- Town/City
- Kilometre Post
- CopperString Alignment
- 2.5 km buffer (study area)
- Railway
- Highway
- Very High Potential Bushfire Intensity
- High Potential Bushfire Intensity
- Medium Potential Bushfire Intensity
- ▨ Potential Impact Buffer



Notes/Data Sources
 Original page size: A4 landscape
 © State of Queensland (Department of Natural Resources, Mines and Energy) 2020
 © Commonwealth of Australia (Geoscience Australia) 2020

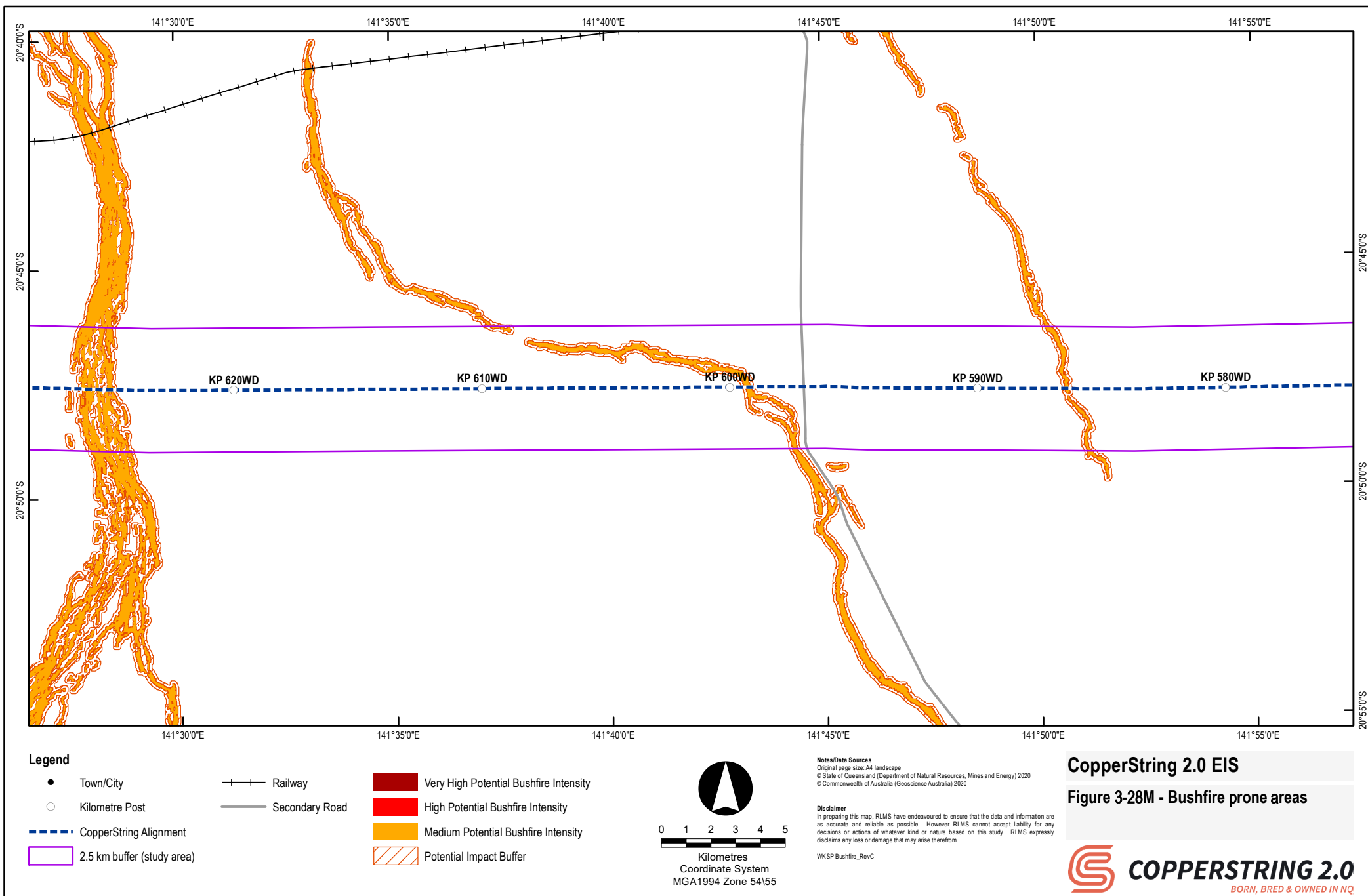
Disclaimer
 In preparing this map, RLMS have endeavoured to ensure that the data and information are as accurate and reliable as possible. However RLMS cannot accept liability for any decisions or actions of whatever kind or nature based on this study. RLMS expressly disclaims any loss or damage that may arise therefrom.

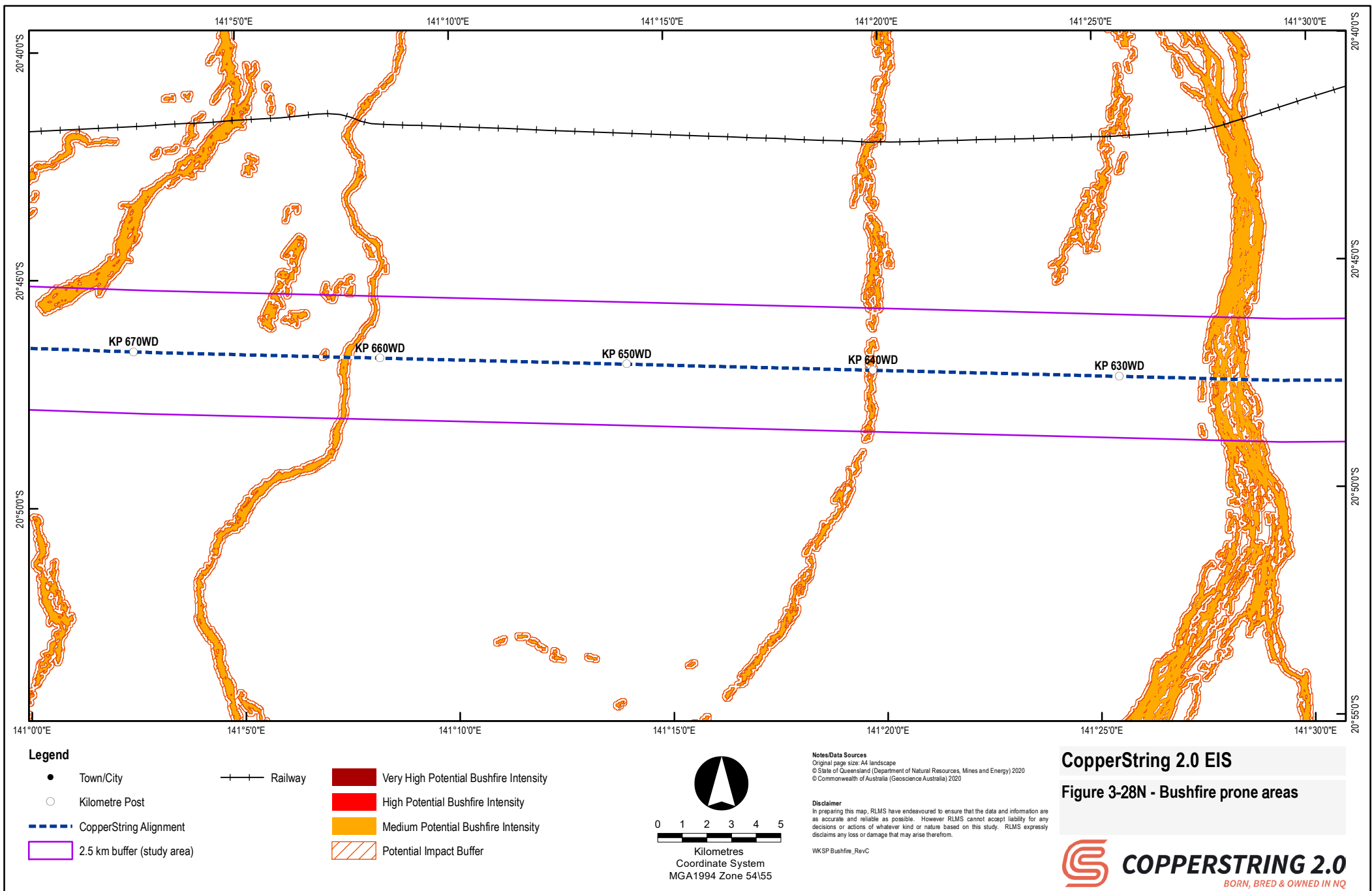
WKSP Bushfire_RevC

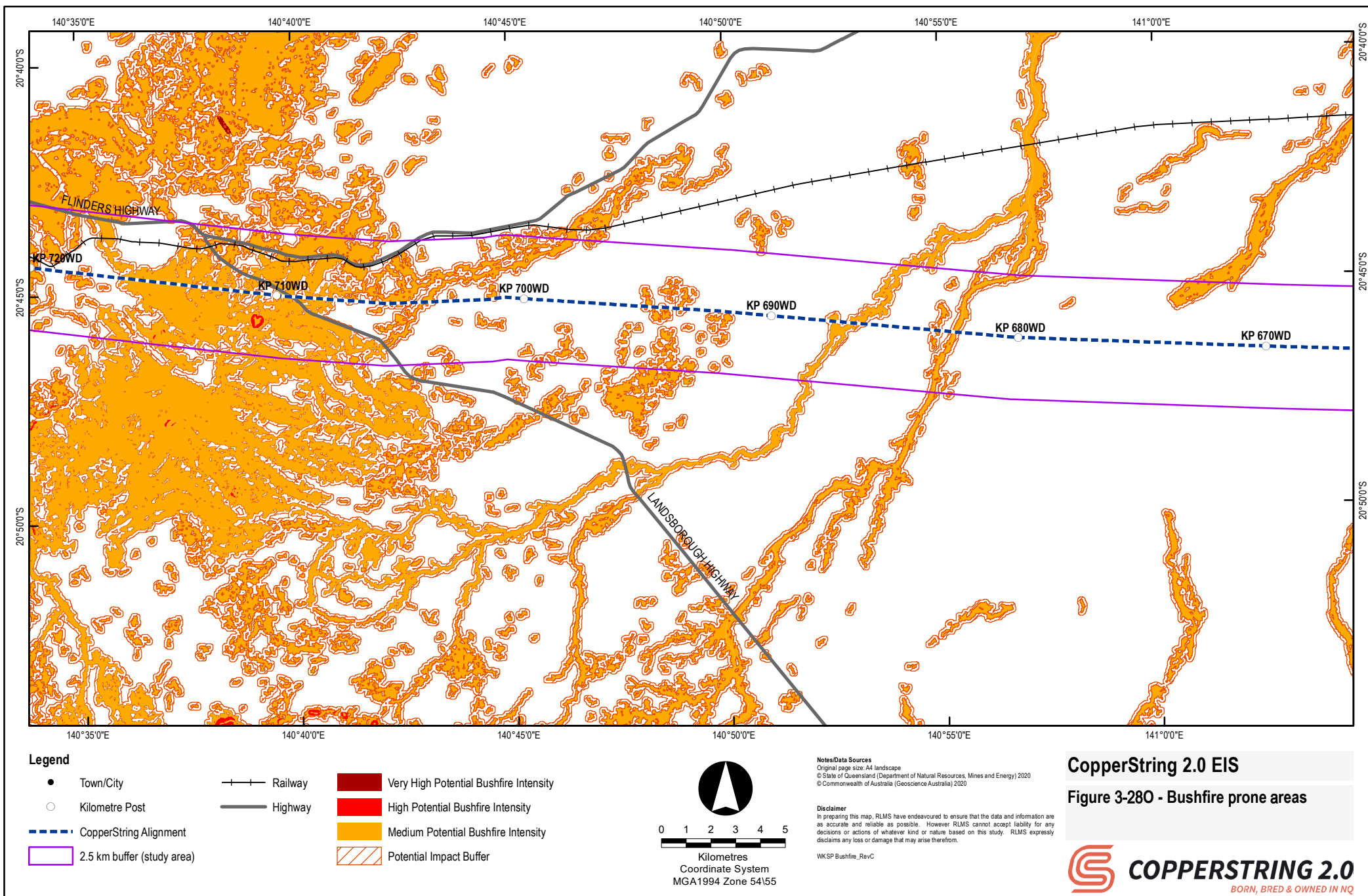
CopperString 2.0 EIS

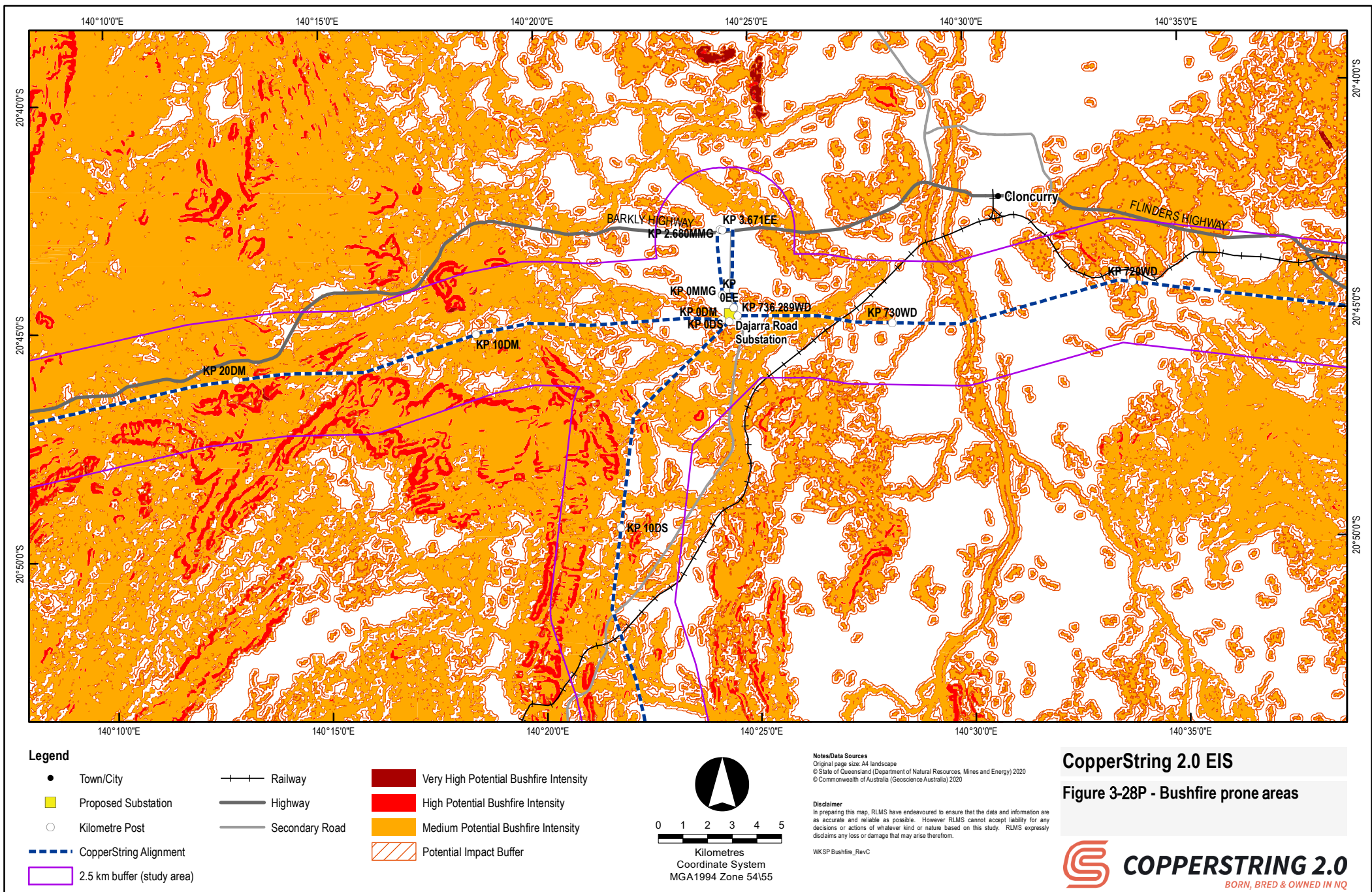
Figure 3-28L - Bushfire prone areas

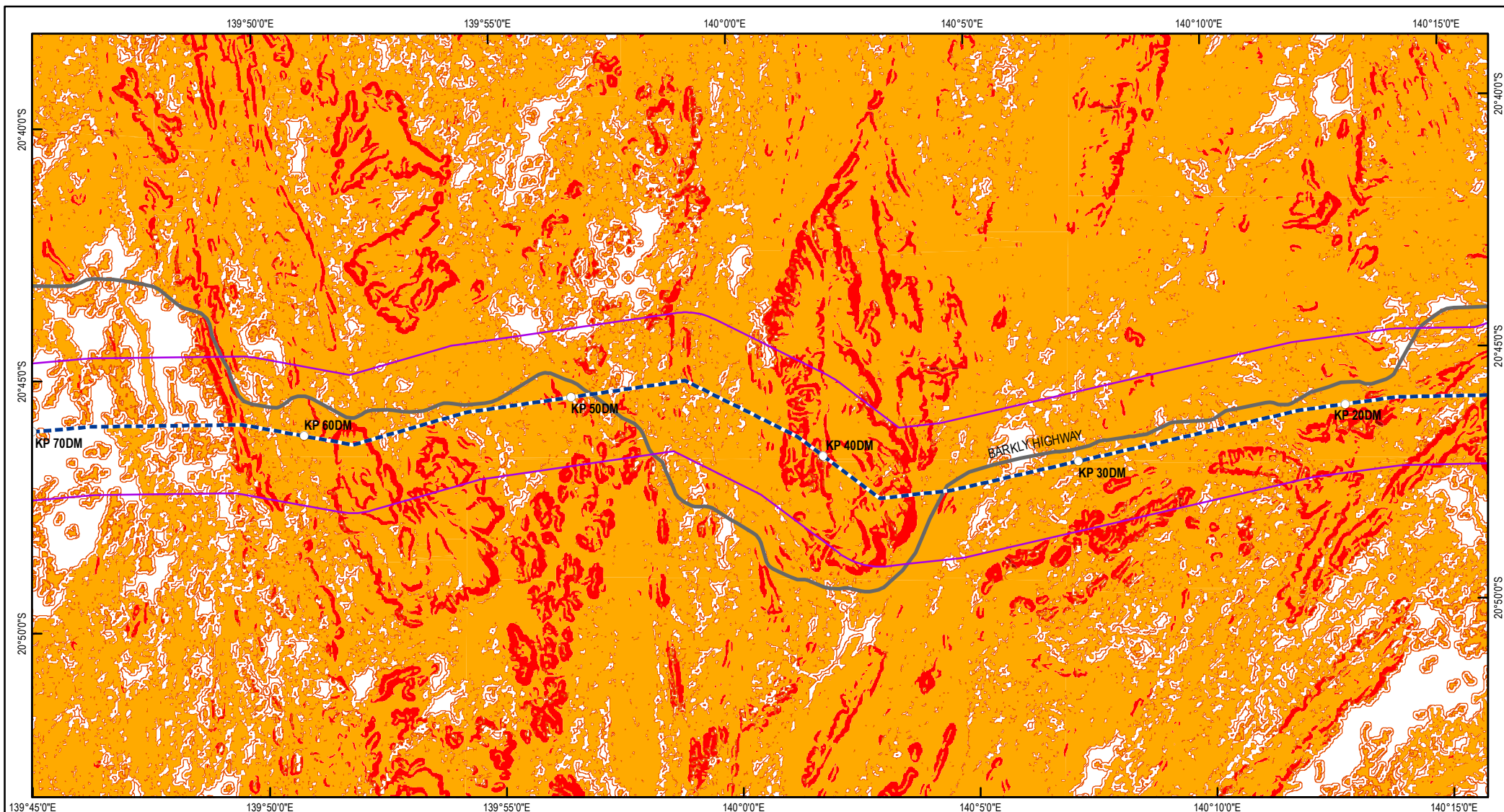






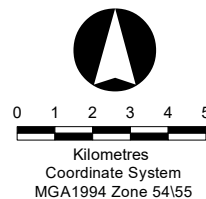






Legend

- Town/City
- Kilometre Post
- CopperString Alignment
- 2.5 km buffer (study area)
- Highway
- Very High Potential Bushfire Intensity
- High Potential Bushfire Intensity
- Medium Potential Bushfire Intensity
- Potential Impact Buffer



Notes/Data Sources

Original page size: A4 landscape
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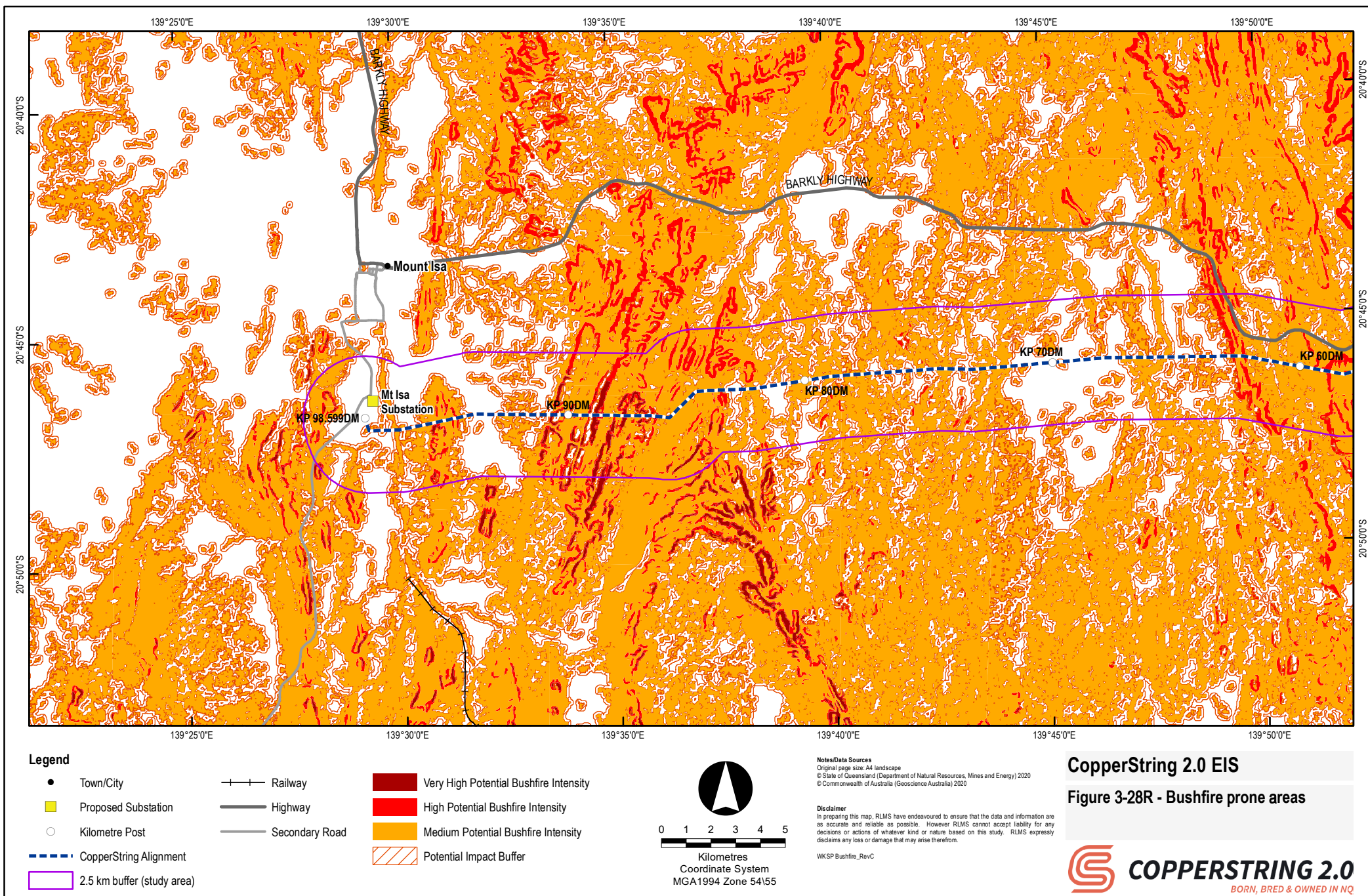
Disclaimer

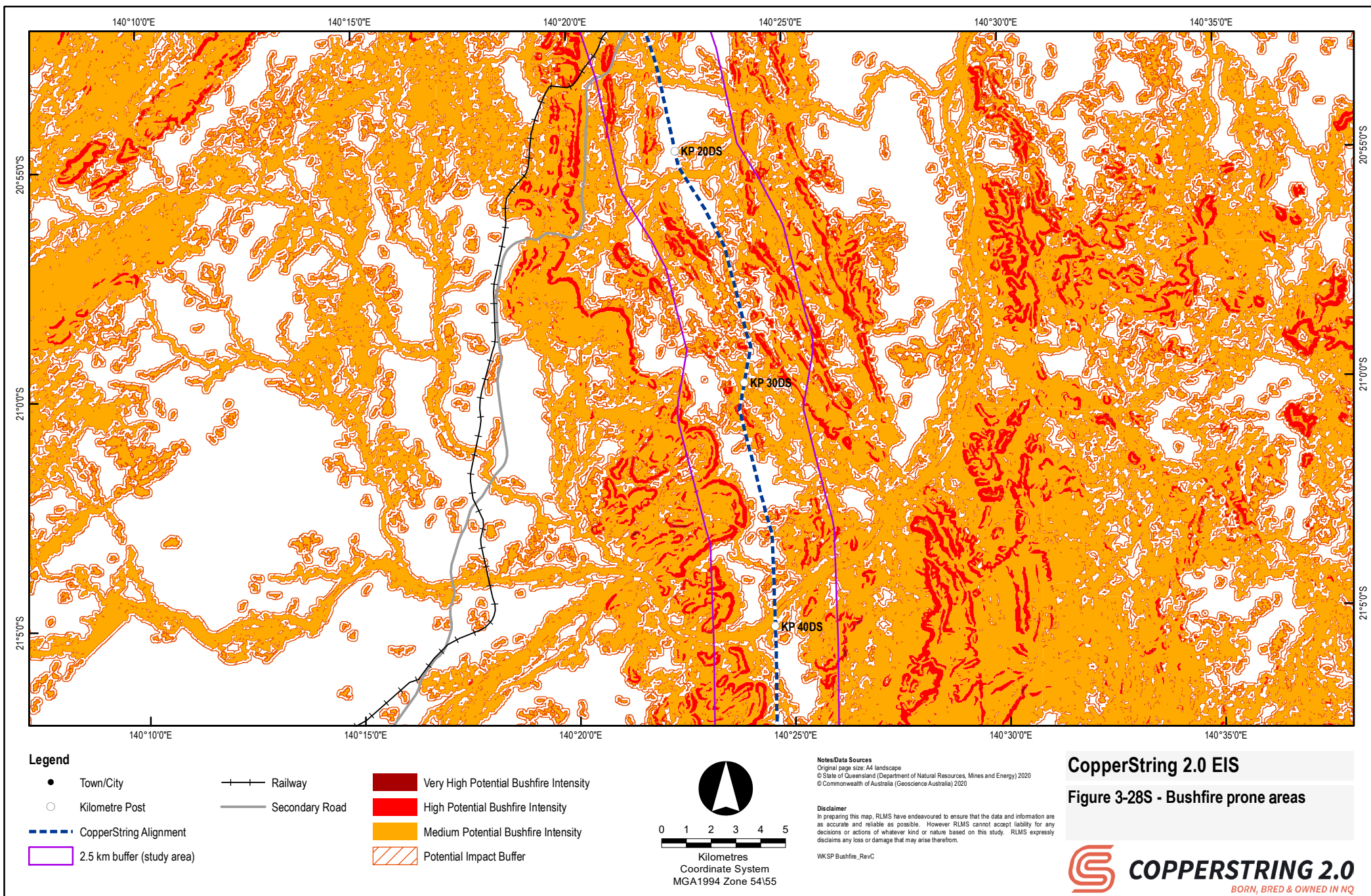
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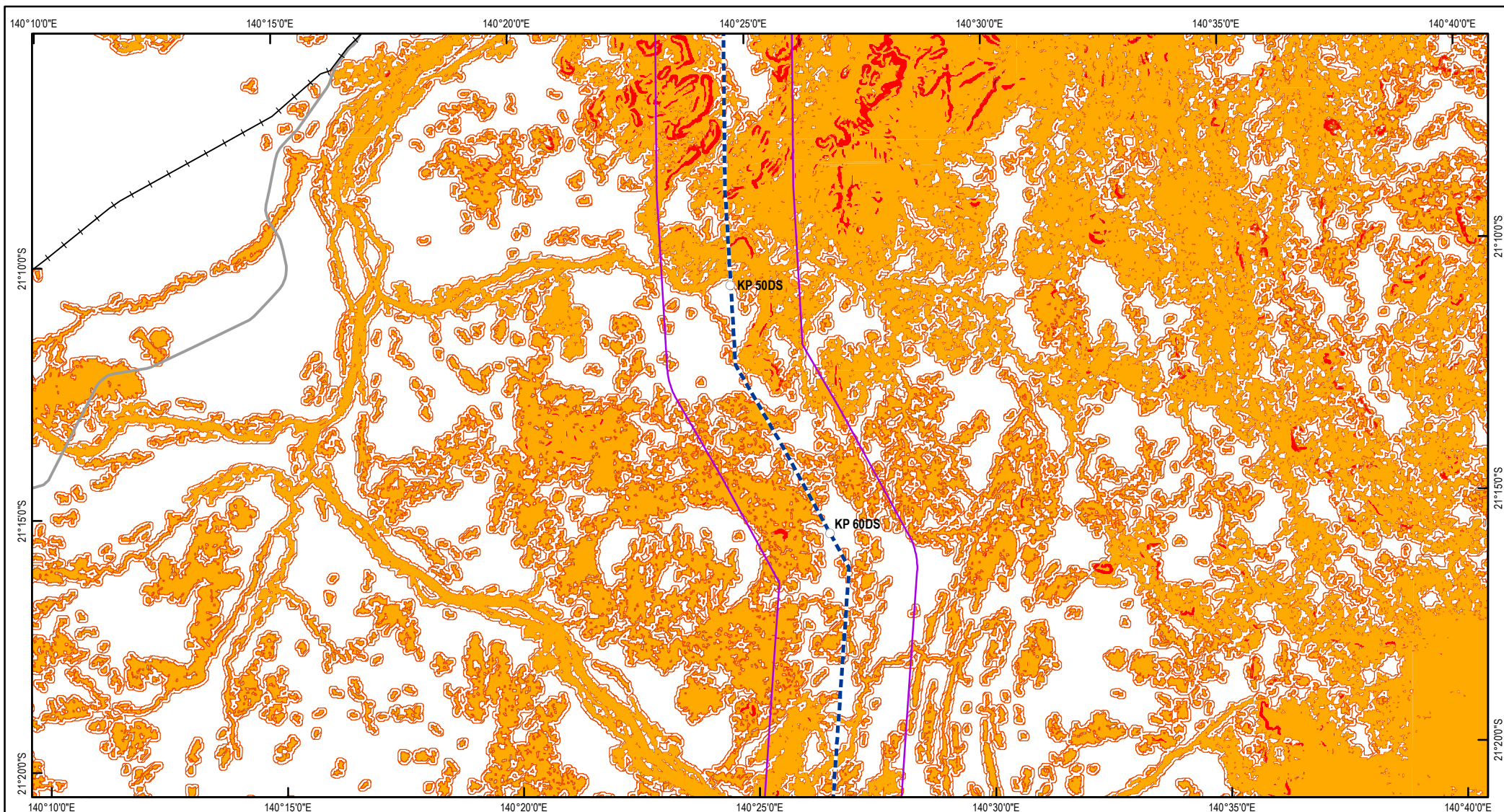
WKSP Bushfire_RevC

CopperString 2.0 EIS

Figure 3-28Q - Bushfire prone areas

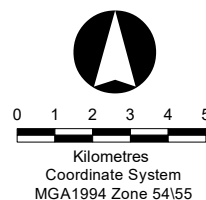






Legend

- Town/City
- Kilometre Post
- CopperString Alignment
- 2.5 km buffer (study area)
- Railway
- Secondary Road
- Very High Potential Bushfire Intensity
- High Potential Bushfire Intensity
- Medium Potential Bushfire Intensity
- ▨ Potential Impact Buffer



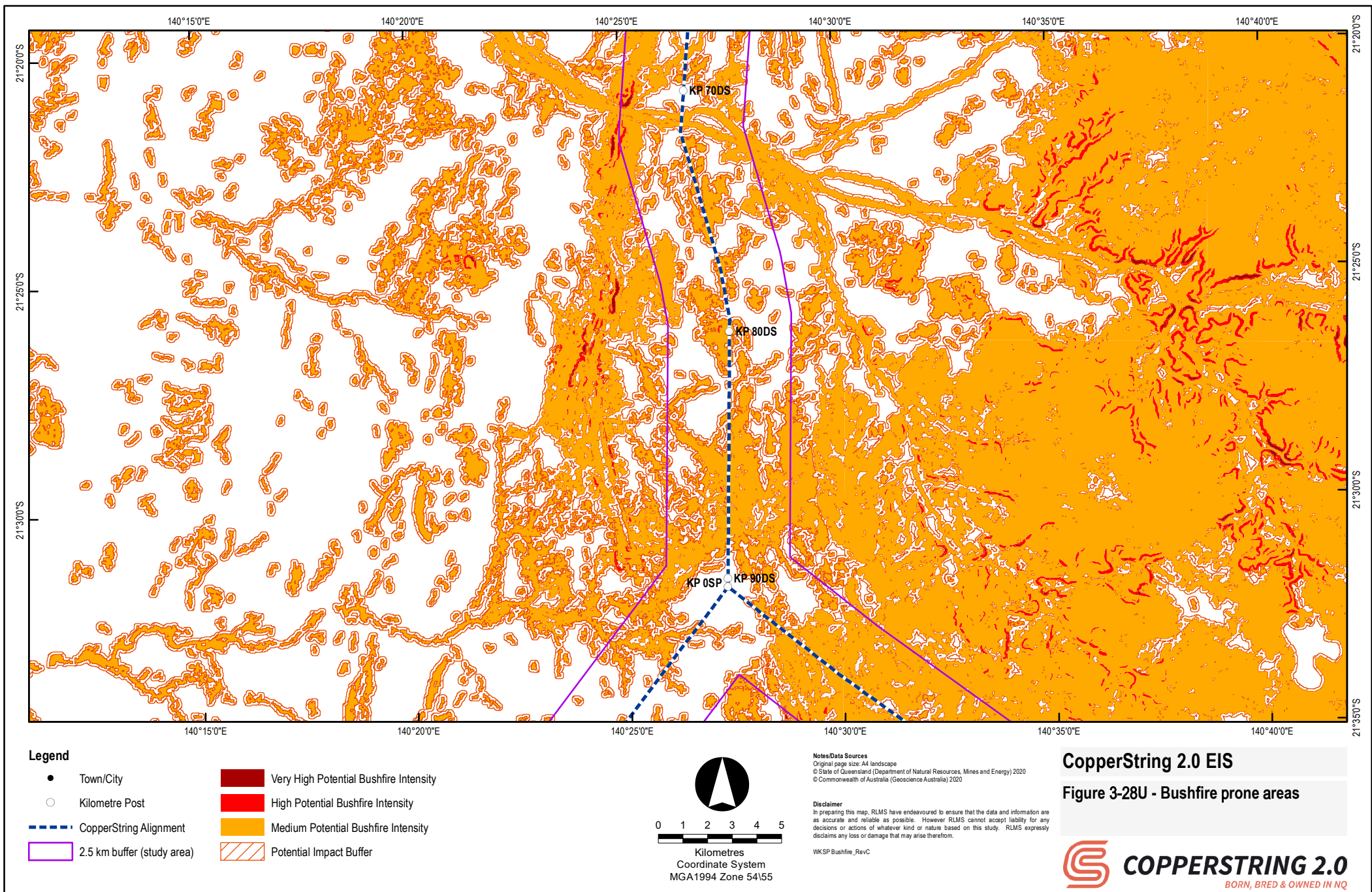
Notes/Data Sources
 Original page size: A4 landscape
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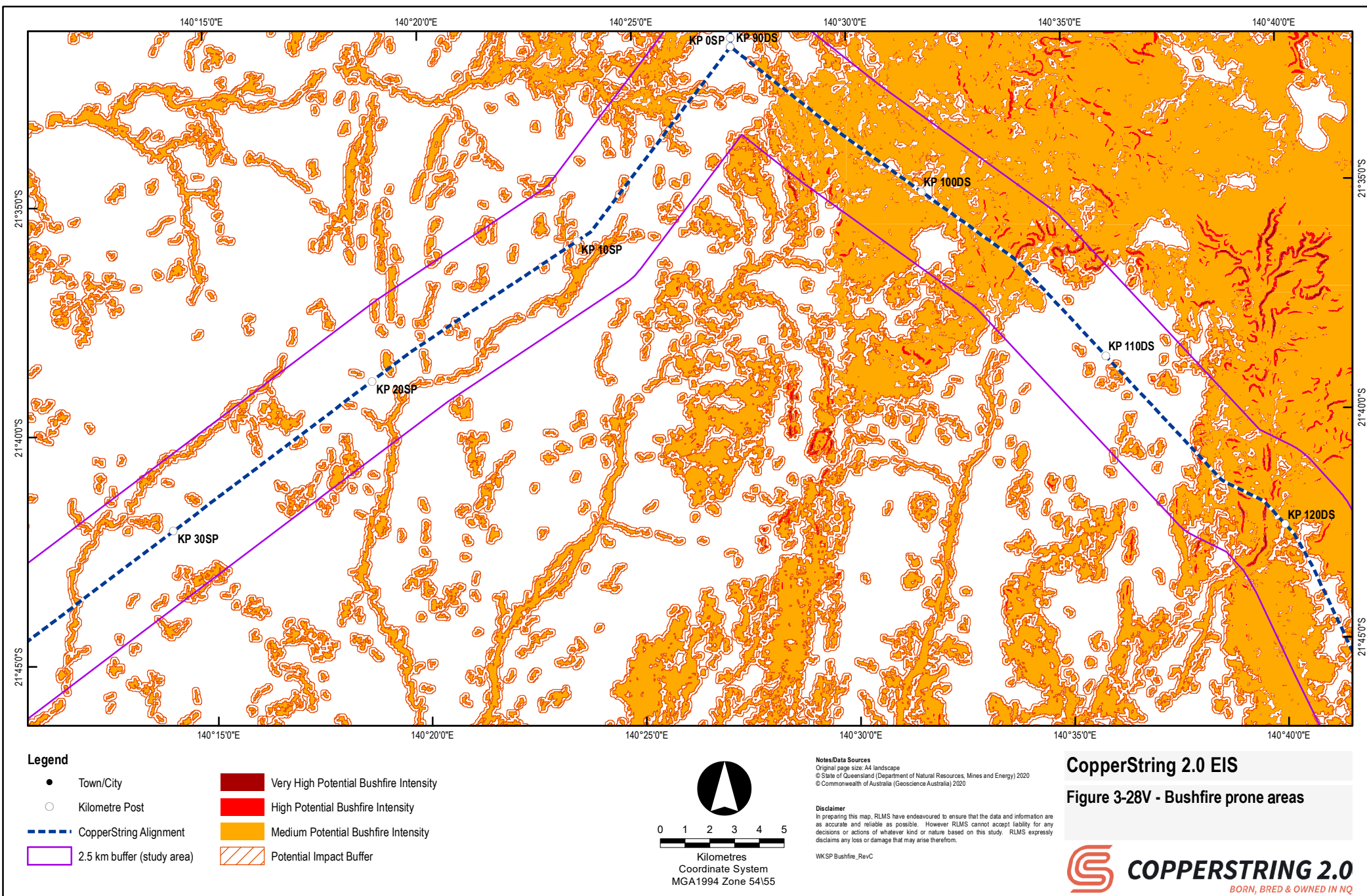
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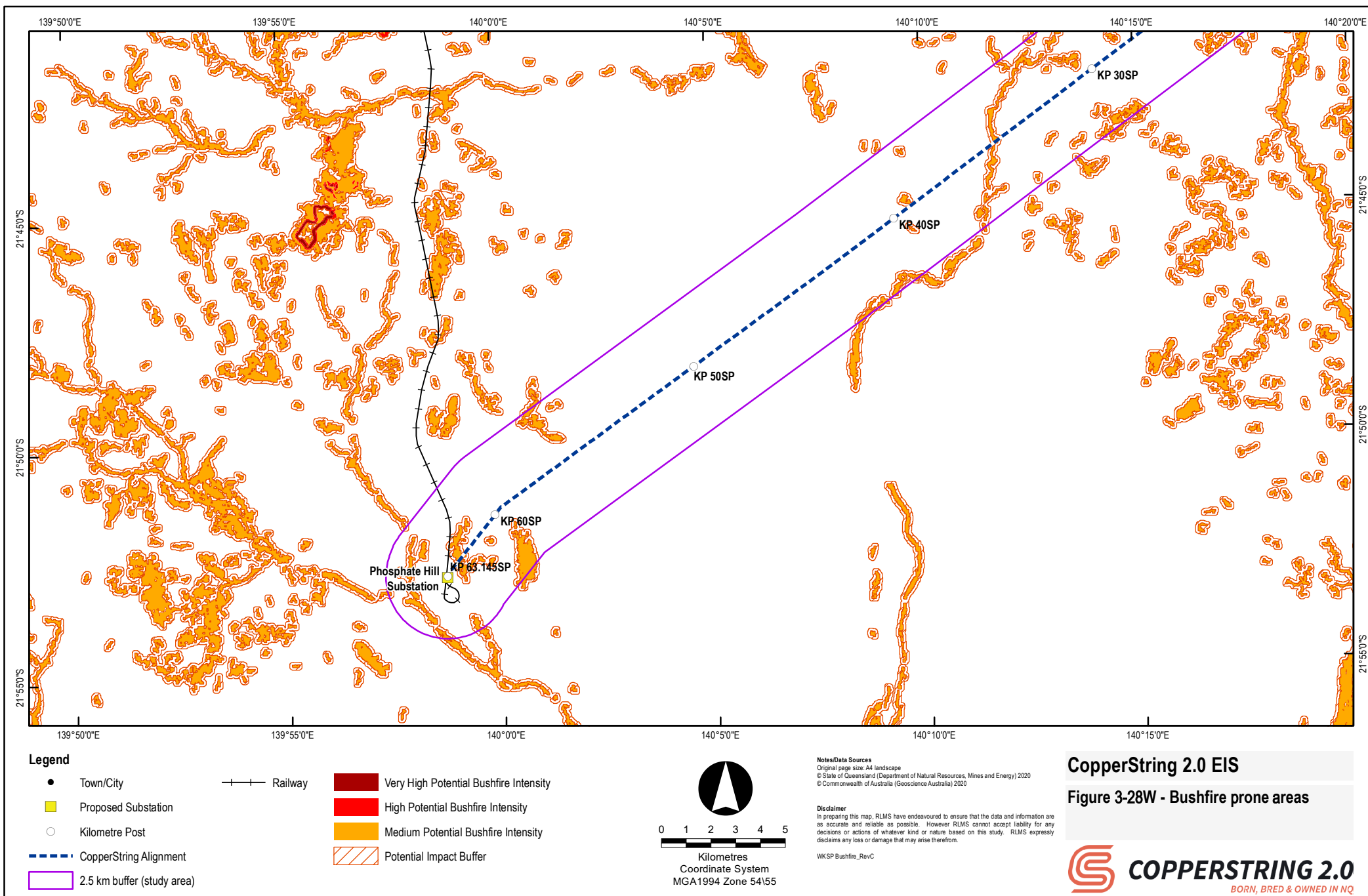
WKSP Bushfire_RevC

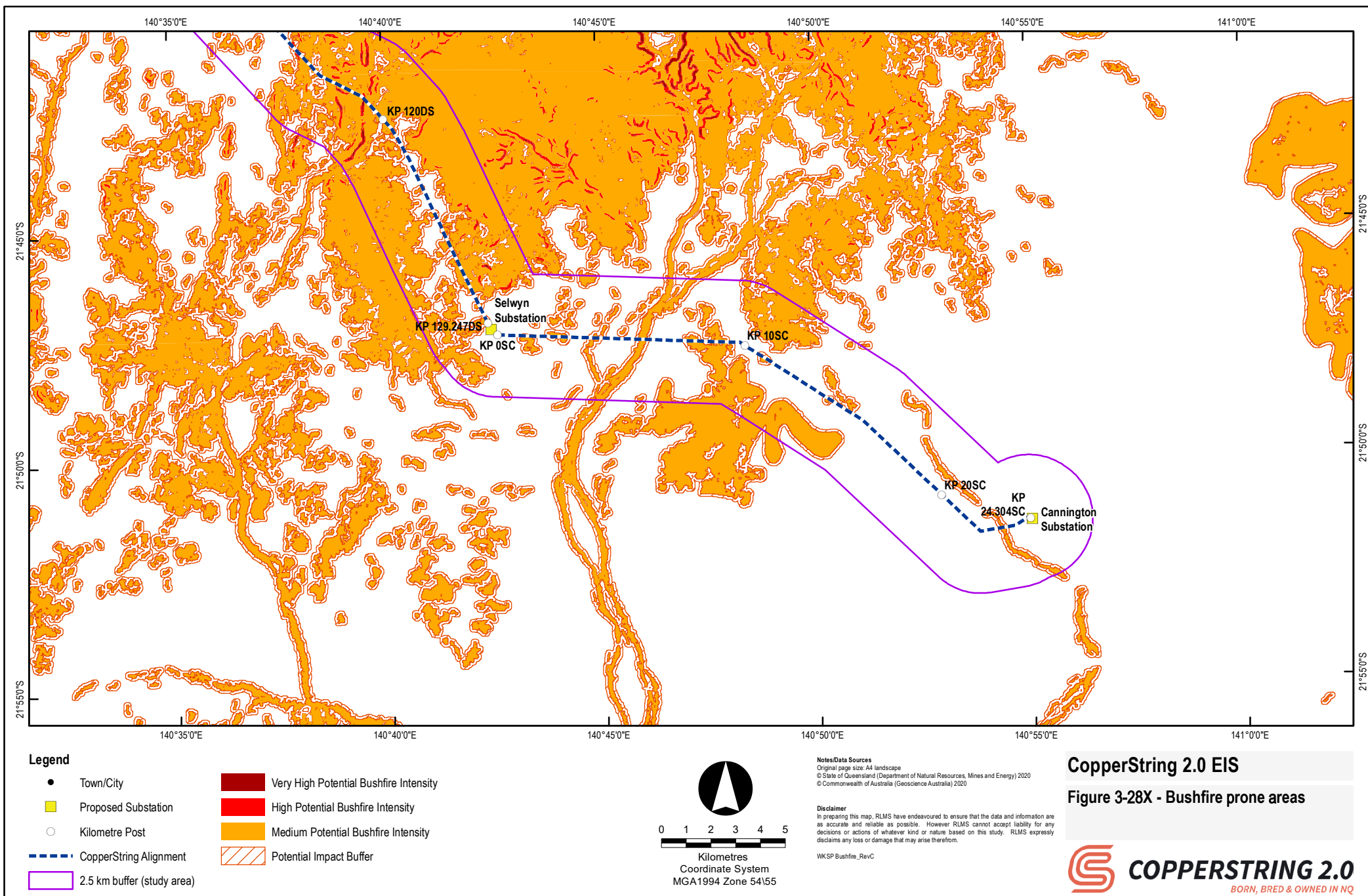
CopperString 2.0 EIS

Figure 3-28T - Bushfire prone areas









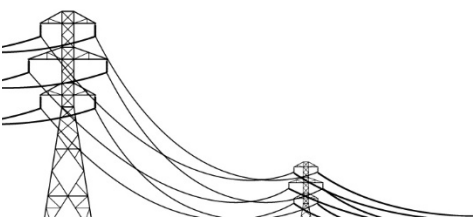
Earthquakes

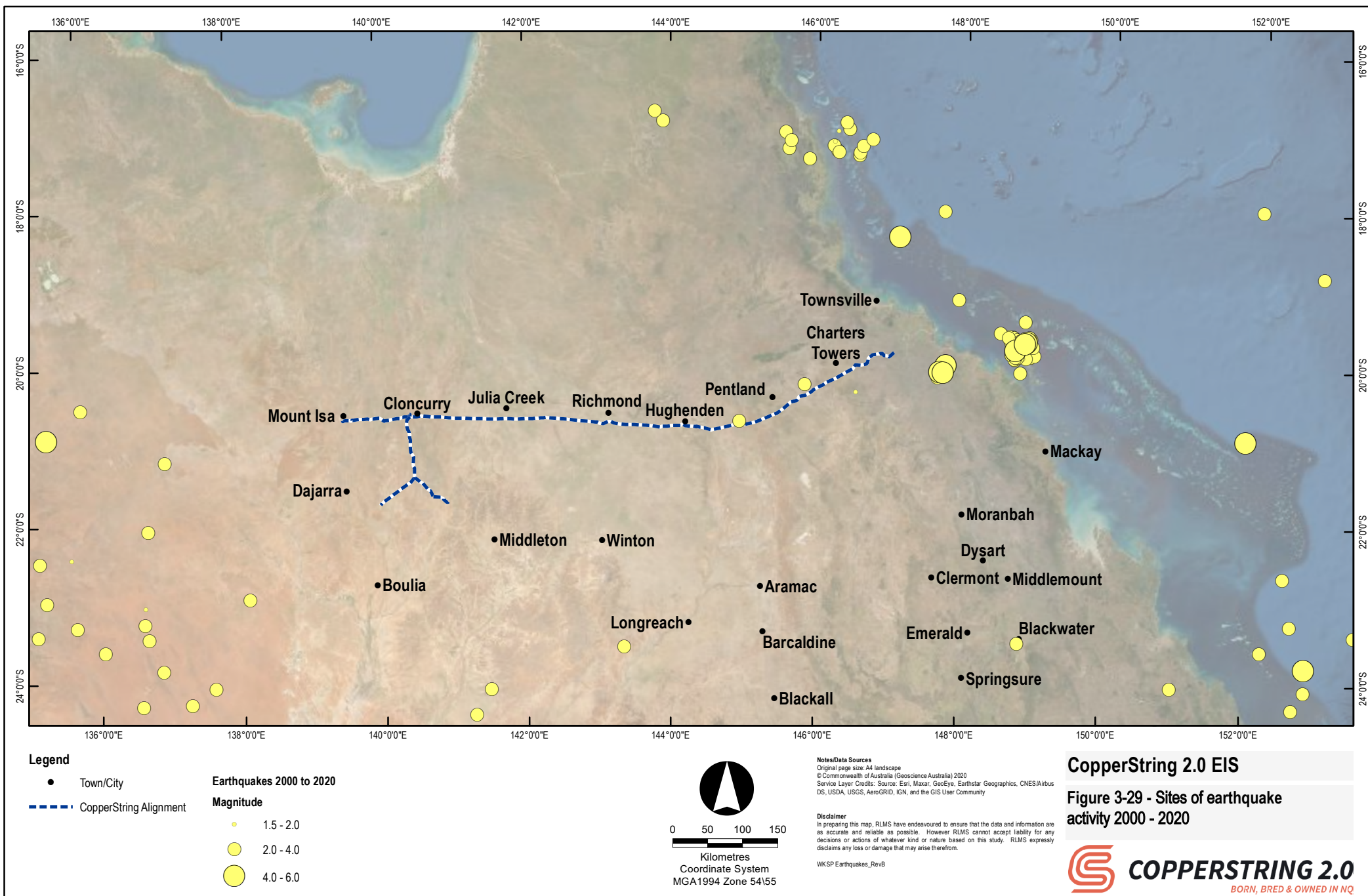
Earthquakes are sudden movements within geographical faults and can cause strong and destructive ground shaking up to tens or even hundreds of kilometres from an earthquake epicentre.

The University of Queensland Seismological Observatory has undertaken mapping of earthquakes in Queensland with Richter magnitudes greater than two for the period 1866 to June 2000. Most data has been collected since 1977, when seismographs were installed around the state's largest dams. The data indicates that the areas of highest seismicity in Queensland are along the east coast and inshore areas, particularly between Brisbane and Gladstone and between Mackay and Cairns.

Few earthquakes have been recorded in the vicinity of the corridor selection with most earthquakes occurring around the Burdekin Falls Dam area and off the coast. Recorded seismic events within the region during the period of 2000 to 2020 are presented in Figure 3-29. Two earthquakes of between 2.0 and 4.0 magnitude were recorded in proximity of the corridor selection. Older historical earthquake data from Geosciences Australia (2020) shows 10 earthquakes within 50 km of the corridor selection, including a 5.7 magnitude event in 1913, and two earthquakes of <3 magnitude within 50 km of Mount Isa. Seismic activity is rare in the inland region.

Fewer seismographs and lower population density in Queensland means that the true seismicity in Queensland may be higher than what is mapped in comparison to other eastern states of Australia (University of Queensland, 2020). Predicting earthquakes with a level of certainty is not possible. While the risk of earthquake in the corridor selection is low, it cannot be dismissed.





Climate change

Climate change is influencing the frequency and severity of hazardous climate-related events such as cyclones, storms and bushfires in Australia, including influencing temperature, environmental moisture, weather patterns and fuel conditions.

There have been significant changes observed in recent decades towards more dangerous bushfire weather conditions for various regions of Australia, in particular more extreme conditions during summer in Eastern areas and an earlier start to the bushfire season, with dangerous weather conditions occurring earlier in spring than they did in previous years.

Recently a number of devastating fire events have occurred in Australia associated with extreme pyroconvection (where bushfires cause their own storms, including thunderstorm development within a fire plume). Research indicates that over the past 40 years, south-eastern Australia has experienced an increase in the number of high pyroconvection risk days in summer (Earth Systems and Climate Change Hub, 2019). Whilst the data for north Queensland and north-west Queensland indicates that high pyroconvection risk days have generally remained the same or decreased over the past 40 years, there are some areas around the CopperString Core and Renewable Energy Hub sections that have experienced an increase in the number of high pyroconvection risk days.

There is some indication that climate change could influence the risk of ignition from dry-lightning (i.e. Lightning that occurs without significant rainfall) however the modelling of this phenomenon is presently uncertain.

General bushfire weather conditions are projected to increase in severity in future years for many regions of Australia, due to more extreme heat events.

Climate change is also influencing extreme rainfall events. The warmer atmosphere holds more moisture, which increases the risk of heavier downpours. It is predicted that extreme rainfall events are likely to worsen (Climate Council, 2019).

