

Response to NT EPA Direction to provide additional information

Australia-Asia Power Link Environmental Impact Statement



3 November 2023

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Appendices

Appendix A	Copy of NT EPA Direction to provide additional information
Appendix B	Stakeholder consultation report
Appendix C	Threatened flora survey report
Appendix D	Operational noise assessment
Appendix E	Assessment of EMF impacts on Marine fauna

ACRONYMS

BIA	Biologically Important Area
dB	decibel – unit used to measure sound power
dB(A)	estimated average sound power
DC	direct current
DCCEEW	Department of Climate Change, Energy, Environment and Water (Commonwealth)
DEPWS	Department of Environment, Parks and Water Security (NT Government)
DoE	Department of Environment (now DCCEEW)
EIS	Environmental Impact Statement
EMF	electromagnetic fields
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
HVDC	High Voltage Direct Current
KEF	Key Ecological Features
LAeq	LAeq is the equivalent continuous sound pressure level
MER	Metallic Earth Return
MNES	Matters of National Environmental Significance
NT EPA	Northern Territory Environmental Protection Authority
NT EPA Act	Environment Protection Act (NT)
NTG	Northern Territory Government
OHTL	Overhead Transmission Line
OSMP	Oceanic Shoals Marine Park (Commonwealth Marine Area)
SEF	static electric field
SEIS	Supplementary Environmental Impact Statement
SMF	static magnetic fields
SOCS	Sites of Conservation Significance
TPWC Act	<i>Territory Parks and Wildlife Conservation Act</i>

INTRODUCTION

On 11 January 2023, Sun Cable Pty Ltd made the difficult decision to enter Voluntary Administration. This process reached a successful conclusion on 7 September 2023 with all assets and shares in Sun Cable Pty Ltd. being acquired by Grok Ventures including AAPowerLink Australia Assets Pty Ltd. SunCable Pty Ltd (SunCable) is now established and moving forward with a renewed focus and robust plan to progress the Australia-Asia Power Link (“AAPowerLink”). The mission to deliver reliable, cost-competitive green electrons to customers in both Darwin and Singapore remains. SunCable is well-progressed and in a strong position to deliver the AAPowerLink Project and is committed to working collaboratively with all stakeholders to realise the potential of this opportunity that will deliver significant benefits for Australia, Indonesia and Singapore.

The AAPowerLink is being assessed under the *Environment Protection Act 2019* (EP Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) by Environmental Impact Statement (EIS). The Draft EIS was made available for public comment from 20 April to 15 July 2022 and 12 public submissions were received, in addition to government authority submissions. The Supplementary EIS (SEIS) was prepared to respond to the submissions and that document was made available for public comment from 7 December 2022 to 31 January 2023, with one public submission received. On 19 March 2023, the NT Environment Protection Authority (NT EPA) issued a direction to SunCable to provide additional information in relation to 15 specific items (see Appendix A).

This document responds to the Direction to provide additional information. It references and/or builds on information already provided in the Draft EIS and SEIS. It is intended that this document is read in conjunction with those documents which are available online ([Link to NTEPA website](#)).

It is noted that SunCable continued to engage with stakeholders in preparation of the SEIS including while it was on public exhibition and during the period of Voluntary Administration. Appendix B provides a summary of consultation undertaken in this time as an update to the consultation report provided as Appendix F of the Draft EIS.

1 EXTENT OF PROPOSED ACTION

1.1 Context provided by the NT EPA

There is no succinct summary of estimated limitations and extent of the proposed action e.g., maximum extent of land clearing (for the entire proposed action).

1.2 Additional information required by the NT EPA

1. Provide a table summarising the maximum extent of each element of the proposed action and the total maximum extent of the whole proposed action.
2. In the case that there is uncertainty about the need for, or aerial extent of, key physical elements of the Project, provide the maximum development envelope and footprint as a worst-case scenario for the maximum likely impact.

1.3 Response

Table 1 below provides the extent of the 'disturbance footprint' for each of the key Project components, including details of the following:

- Construction footprints – areas cleared to facilitate construction of the Project infrastructure.
- Reinstatement footprints – components of the construction footprint that will be reinstated post-construction so that the ground is stabilised, and native vegetation can regrow over time.
- Operational footprints – areas of cleared ground and infrastructure, plus the OHTL vegetation management corridor where ongoing management of vegetation will be undertaken in accordance with the *OHTL Corridor Vegetation Management Framework* (refer SEIS Appendix 5.4).

Table 2 then provides a breakdown of the footprint for each component and documents the assumptions used to derive the footprint. The footprints align with those presented in SEIS – refer *Chapter 2 Project Refinements* and Draft EIS – refer *Chapter 2 Project Description*, excepting for minor adjustments (which are identified and explained where relevant).

Table 1. Summary of the extent of the proposed action

Project Component	Construction footprints	Reinstatement ¹ footprints (post-construction)	Operations footprints	
			Cleared ground and infrastructure	Vegetation management
Powell Creek Solar Precinct	12,403 ha	124 ha	12,279 ha	-
Overhead Transmission Line	2,787 ha	2,246 ha	541 ha	2,436 ha
Darwin Converter Site	60 ha	-	60 ha	-
Cable Transition Facilities	45 ha	45 ha	-	17 ha ²
Total Land Disturbance Footprint	15,295 ha ³	2,415 ha	12,880 ha	2,453 ha
			15,333 ha	
Subsea Cable System	6,400 ha	6,400 ha	-	-
Total Sea Disturbance Footprint	6,400 ha	6,400 ha	0 ha	0 ha

Notes:

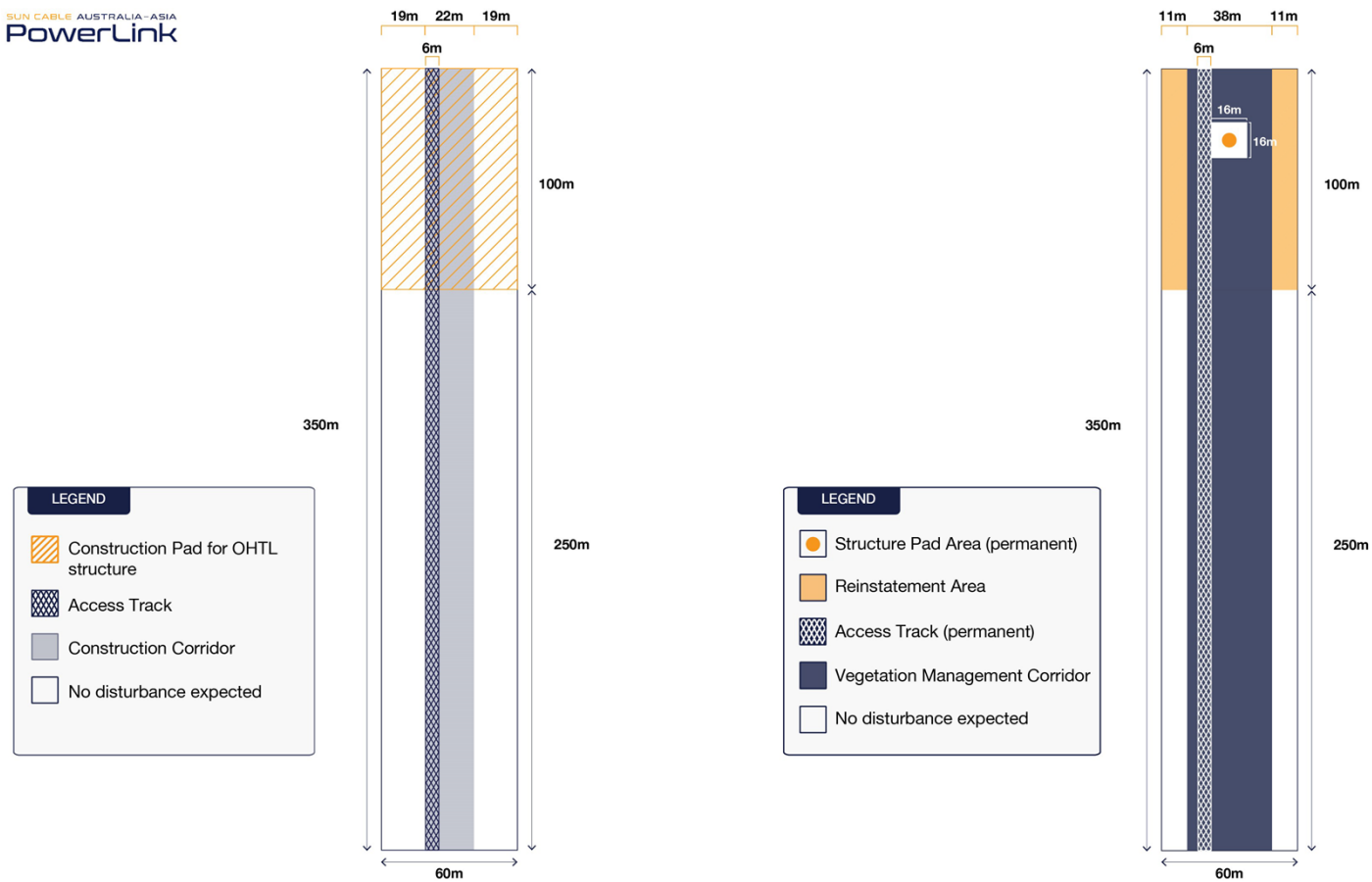
1. Reinstatement refers to leaving the land in a condition that allows for natural regeneration of vegetation (in the land footprint) and benthic habitats and communities (in the sea footprint). Most of the OHTL construction footprint will be reinstated; however, the vegetation communities will be different to the pre-construction communities due to the ongoing requirement for vegetation management to protect the infrastructure – refer OHTL Vegetation Management Framework (refer SEIS Appendix 5.4).
2. This figure relates to the Underground Cable Corridor footprint where vegetation will regenerate but ongoing vegetation management will be required.
3. The SEIS stated 15,238 ha. The increase of 57ha is due to increasing the OHTL construction footprint by 81ha to allow for the use of 60m wide construction pads for all structures as contingency, which was offset partially by the removal of the ground-based electrodes at Gunn Point and Powell Creek (-24ha). The increase in the OHTL construction footprint has no additional residual impacts. The original footprint calculation was based on 1,300 towers having a construction pad 60m x 100m, 409 towers having a construction pad 50 m x 100 m, and 13 towers having a construction pad 30m x 100m. The new footprint is based on all towers having a construction pad 60m x 100m, which equates to an additional 10m x 100m strip of vegetation being cleared at 409 towers and an additional 30m x 100m strip of vegetation being cleared at 13 towers. The construction pads are not located in sensitive or significant vegetation types and they are reinstated post construction, therefore the residual impact is minor.

Table 2. Basis of construction, reinstatement, and operational footprints for each component

Component	Footprint	Sub-component	Assumptions	Subtotal	Total
Solar Precinct	Construction	Solar Precinct	Solar arrays, Battery Energy Storage Systems (BESS), electrical and ancillary infrastructure, and access roads – as per Draft EIS Chapter 2 Table 2-2	12,269ha	12,403ha
		Ancillary infrastructure	10ha for landfill, water bores, access tracks – as per SEIS Chapter 2 Table 2-3	10ha	
		Temporary construction areas	124ha for laydown, accommodations, support areas, borrow pits – as per SEIS Chapter 2 Table 2-3	124ha	
	Reinstatement	Temporary construction areas	Temporary construction areas will be reinstated – as per SEIS Chapter 2 Table 2-3	124ha	124ha
	Operations	Solar Precinct Ancillary infrastructure	Construction footprint minus reinstatement footprint = operational footprint required for Solar Precinct infrastructure. Not stated in Draft EIS or SEIS.	12,279	12,279ha
OHTL	Construction	OHTL Construction Corridor	783km x 22m – as per SEIS Chapter 2 Table 2-3	1,723ha	2,787ha
		Construction pads for structures	Additional 38m x 100m alongside construction corridor for each structure = 0.38ha/structure x 2,785 structures. Note the footprint presented in the SEIS Chapter 2 Table 2-3 was 977ha – the minor increase to 1,058ha allows for the use of 60m wide construction pads for all structures as contingency.	1,058ha	
		Temporary construction areas	Areas outside the construction corridor required for laydown and OHTL mobile camps – as per SEIS Chapter 2 Table 2-3.	6ha	
	Reinstatement	Reinstatement footprint - complete	Approximately 19% or 533ha of the construction footprint can be completely reinstated, without requiring ongoing vegetation management. This is the area of the OHTL structure construction pads that lie outside of the vegetation management corridor. These areas will be allowed to naturally regenerate over time and will be monitored. As per SEIS Chapter 2 Table 2-3.	533ha	2,246ha
		Reinstatement footprint - partial	A further 61% of the construction footprint can be partially reinstated post construction. These areas will regrow grasses, shrubs and trees <6m tall, but may need to be subject to vegetation management to protect the OHTL infrastructure – see vegetation management corridor below. This was described in the SEIS but footprints weren't provided - refer OHTL Vegetation Management Framework (refer SEIS Appendix 5.4).	1,713ha	

Component	Footprint	Sub-component	Assumptions	Subtotal	Total
	Operations	Permanent access track and structure pads	This is the construction footprint minus area reinstated. The cleared footprint required for operations will comprise a 6m wide access track and 2,785 permanent structure pads, each 16m x 16m wide around the base of the structures - as per SEIS Chapter 2 Table 2-3.	541ha	2,977ha
		Vegetation management corridor	Vegetation in a 38m wide corridor around the OHTL will be managed in accordance with the OHTL Vegetation Management Framework (refer SEIS Appendix 5.4) to protect the infrastructure. The corridor footprint is 2,436ha as per SEIS Chapter 2 Table 2-3.	2,436ha	
Darwin Converter Site	Construction	Converter site	All construction activities can be accommodated within the 60ha footprint required for the facility infrastructure and operations. No additional land required for laydown etc. The 60ha footprint is as per SEIS Chapter 2 Table 2-3.	60ha	60ha
	Reinstatement	Converter site	No reinstatement will occur. The construction footprint is inside the operational footprint.	-	
	Operations	Converter site	60ha site to accommodate up to 4 x Voltage Source Converters, batteries, AC substations and ancillary infrastructure. The 60ha footprint is as per SEIS Chapter 2 Table 2-3.	60ha	
Cable Transition Facilities	Construction	Underground Cable Corridor	63 m wide 2.7 km corridor required to accommodate installation of six cables plus bundled fibre optic cable connection from DCS to Land Sea Joint Station. The 17ha is less than the 18.5ha footprint stated in SEIS Chapter 2 Table 2-3. The decrease is due to the corridor width decreasing to 63m wide.	17 ha	43.5ha
		Land Sea Joint Station	1.5ha required to accommodate six bays. The 1.5ha footprint is as per SEIS Chapter 2 Table 2-3.	1.5 ha	
		Shore Crossing Site	500m x 500m area within which cables will be laid in open trenches crossing the intertidal zone and beach, and then back filled. The 25ha footprint is as per SEIS Chapter 2 Table 2-3.	25 ha	
	Reinstatement	Underground Cable Corridor Land Sea Joint Station Shore Crossing Site	Vegetation will be allowed to regrow in the reinstated underground cable corridor and land sea joint station. The Shore Crossing Site will be reinstated and left to naturally recolonise.	45ha	45ha
	Operations	Underground Cable Corridor Land Sea Joint Station Shore Crossing Site	There is no requirement to maintain above-ground clearing or infrastructure for the Cable Transition Facilities.	0ha	0ha

Component	Footprint	Sub-component	Assumptions	Subtotal	Total
Subsea Cable System	Construction	Subsea cables	Approximately 895km of the Subsea Cable System is in the Australian jurisdiction. Up to 6 cables will be installed, spaced 50-200 m apart. Cable installation will disturb a 12m wide area of seabed around each cable.	6,400ha	6,400 ha
	Reinstatement	Subsea cables	The seabed will be left to naturally recolonise with benthic habitats/communities over time. As per Draft EIS.	6,400ha	6,400 ha
	Operations	Subsea cables	There is no requirement to maintain a cleared footprint for operation of the Subsea Cable System. In the event of a failure, the seabed in the vicinity of the affected cable/s will be disturbed and reinstated.	0ha	0ha



OHTL Construction Footprint

Conceptual example for one structure and adjoining conductor wires

OHTL Operations / Reinstatement Footprint

Conceptual example for one structure and adjoining conductor wires

Figure 1. Schematic of OHTL construction and operations/reinstatement footprints

2 PROPOSED ACTION

2.1 Context provided by the NT EPA

The NT EPA Direction to include additional information in the supplement to the draft environmental impact statement (Supplement) (herein referred to as Supplement Direction), Table 1 item #1 specified that uncertainties about key elements of the proposed action should be resolved in the Supplement.

The Supplement retains the following options for grounded electrical current return via either:

- a. a dedicated metallic earth return; or
- b. two ground electrodes.

2.2 Additional information required by the NT EPA

Specify which current return option is proposed. Describe the impacts of the specified current return option on other physical and operational elements of the Project e.g., higher towers, larger foundations, additional cable. If ground electrodes are proposed, refer to item 3 below.

2.3 Response

SunCable has identified a dedicated Metallic Earth Return (MER) as the current preferred option for the system configuration. The MER is a proven technology with well understood technical/industry precedence. The preference for a MER is underpinned by the ongoing engineering and detailed site investigations to identify an acceptable electrode solution at Powell Creek and Murrumujuk. These studies are anticipated to be completed in the first half of 2024 and will continue in parallel with other Project activities. Once further engineering and site investigations are completed, SunCable will determine whether the optimal transmission system configuration should incorporate electrode(s) or retain the MER. It is acknowledged that further statutory approvals would be required to support a change to the optimal transmission system configuration to incorporate electrodes.

The MER are shown in Figure 2-6 of the SEIS, which is reproduced below as Figure 2 for reference. The MER are the wires second from top of the OHTL structures shown. Two MERs are to be utilised approximately 41 mm in diameter and predominantly comprised of aluminium.

The basic function of the MER conductors is to carry small compensation currents to absorb voltage fluctuations in the converter systems during normal operations. The MER, as currently conceived, also provides system redundancy by ensuring that if one pole is offline, they have the capacity to carry the other pole's current capacity.

MER conductors carry only low levels of current during normal bi-pole operations. However, MER can carry full load during mono-pole operations if required. This is why two MERs are proposed to provide further redundancy and ensure consistent transmission capacity.

The MER was part of the OHTL design presented in the Draft EIS and SEIS and therefore selecting this option does not alter any other physical elements of the Project. The MER is also not relevant to any considerations of Electromagnetic Fields (EMF) and interaction studies with other assets due its separation distance from the ground and reduced voltage. The MER will operate at 132kV Direct Current (DC) (not 525kV HVDC) and therefore has lower electric field influence than the HVDC bi-poles.

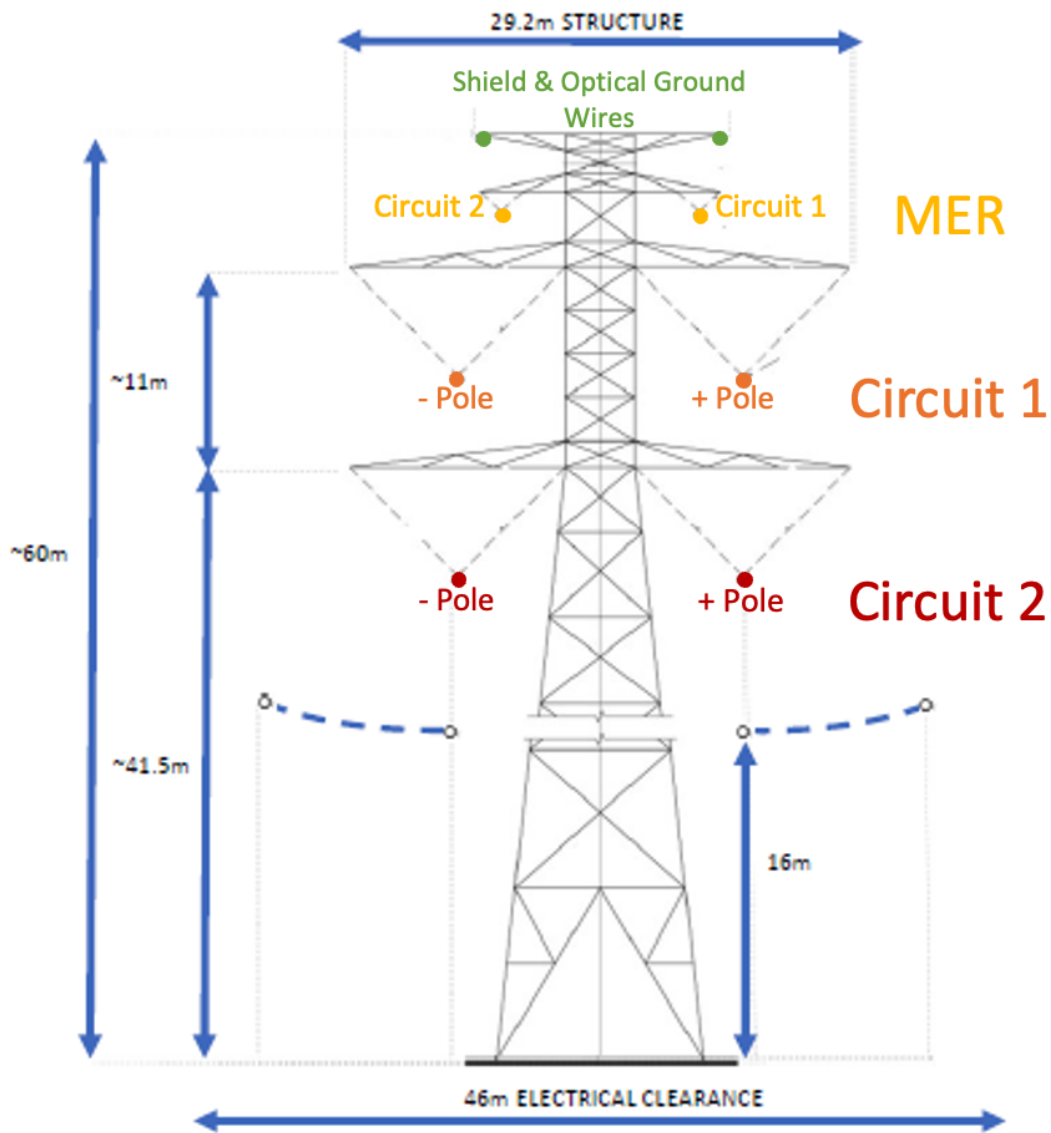


Figure 2. Typical OHTL structure conductor configuration

3 GROUND ELECTRODE DESIGN DETAILS

3.1 Context provided by the NT EPA

Ground electrode systems can cause corrosion of adjacent infrastructure through electromagnetic coupling, or health effects to people and animals through high step, transfer and touch potentials close to the electrode site. The appropriate buffer to avoid or mitigate these impacts is dependent on the magnitude of ground current, electrode design and geological characteristics of the site.

3.2 Additional information required by the NT EPA

If ground electrodes are proposed, provide evidence-based design and dimensions of the exclusion zone for corrosion sensitive infrastructure and mitigation that will be applied to reduce the potential impact on community and economy receptors. Include a list of any assumptions used about the electrode design and effectiveness of mitigation.

3.3 Response

As discussed in Section 2 above, ground electrodes are not proposed through this submission. Instead, the OHTL will adopt the MER configuration as originally proposed in the Draft EIS. SunCable acknowledges that further statutory approvals would be required if the optimal transmission system configuration were to change to incorporate electrodes.

4 IMPACTS TO SANDSHEET HEATH HABITATS

4.1 Context provided by the NT EPA

Section 10 of the EP Act requires consideration of the environmental impacts of the proposed action including those that are an indirect consequence of the action.

The northern overhead transmission line (OHTL) footprint is mapped as crossing habitats including sandsheet heath, which support highly habitat-specific listed threatened species including:

- Howard River Toadlet (*Uperoleia daviesae*) – Vulnerable under the *Territory Parks and Wildlife Conservation Act 1976* (TPWC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Typhonium taylori* – Vulnerable under the TPWC Act
- *Utricularia dunstaniae* – Endangered under the TPWC Act and EPBC Act.

The direct impacts on these species have been addressed; however, further information is required on the avoidance of indirect impacts on habitat values.

4.2 Additional information required by the NT EPA

1. Provide an evidence-based strategy for determining appropriate buffers for sensitive and significant sandsheet heath vegetation. In particular, demonstrate that hydrological characteristics (such as

sheet flow) would not be impacted. Consideration should be given to indirect impacts including impacts of tracks and drainage infrastructure on sheet flow.

2. Describe the measures that would be implemented to ensure that the proposed action causes no or minimal impacts on surface hydrology, including the quantity, distribution and movement of surface water in suitable habitat adjacent to the corridor and within the buffer determine by the above.
3. Confirm that measures to avoid and buffer these vegetation communities are in line with the NT Land Clearing Guidelines.

4.3 Response

A field-based assessment of the habitat quality of the ten sandsheet heath patches intersected by the NT Government (NTG) Utilities Corridor, where the OHTL is located, was undertaken. The patch locations are shown in Figure 3 and Figure 4. The habitat quality assessment method described below was adopted on the advice of the NT Government Department of Environment, Parks and Water Security (DEPWS) because it aligns with the methods previously developed for sandsheet heath assessments (Hill 2020). The habitat quality results were used to determine the recommended buffers for each patch in accordance with the NT Land Clearing Guidelines (DEPWS 2021). An assessment was undertaken to identify locations where the NTG Utilities Corridor encroaches on the recommended sandsheet heath patch buffers, and where this occurs to identify specific measures that can feasibly be implemented to minimise impacts to hydrological characteristics. The assessment methods and results are provided below.

4.3.1 Method

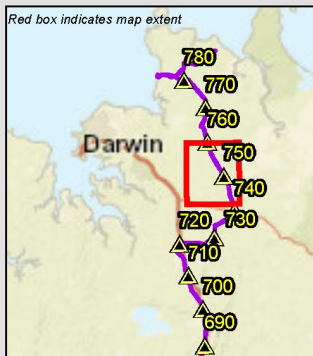
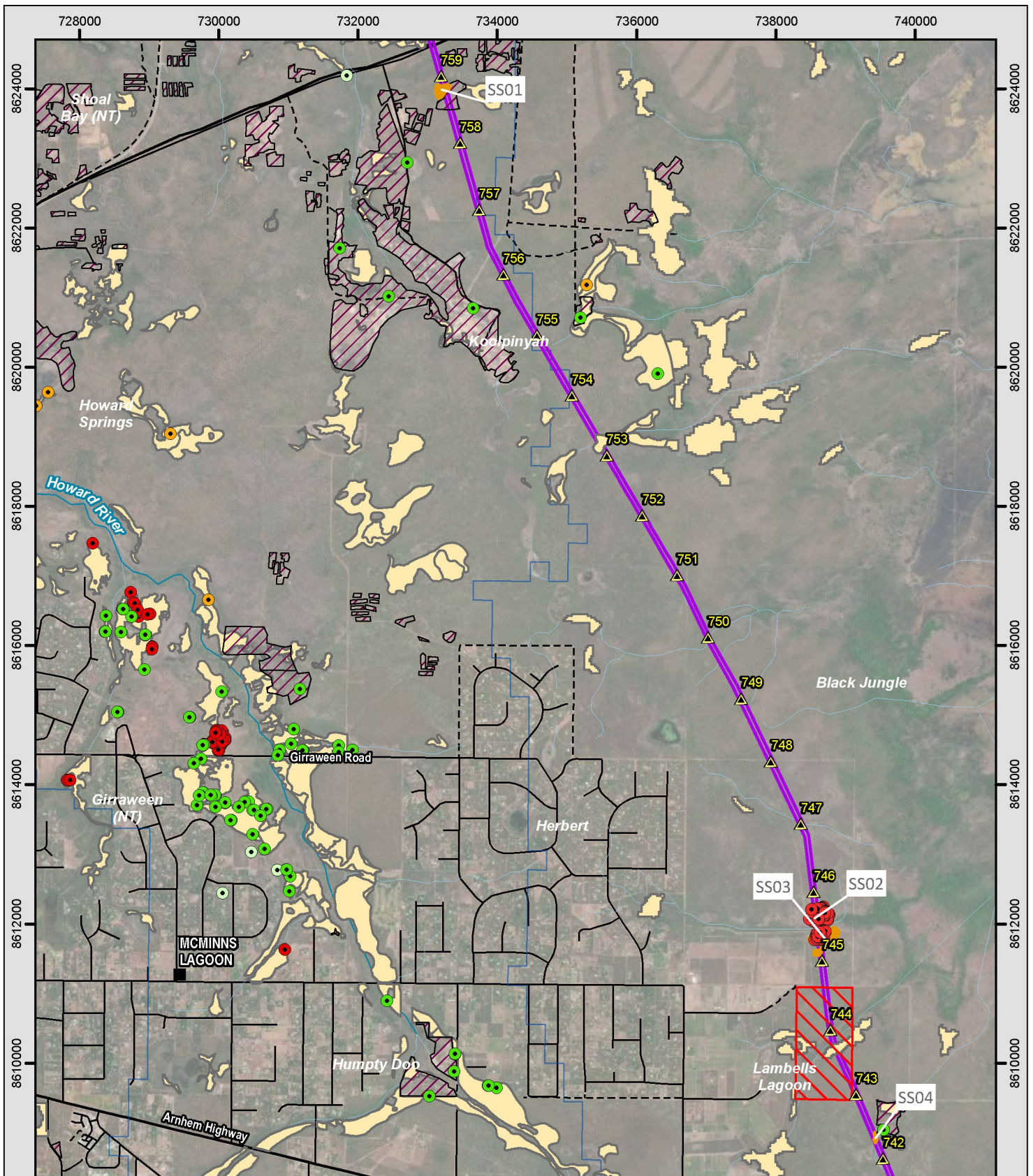
Habitat quality assessments in the sandsheet heath patches were undertaken in March 2022 by EcOz botanist Anna Lemon and sandsheet heath flora expert Dr David Liddle. Survey data have been collated from the ten patches of sandsheet heath identified within, or immediately adjacent to, the NTG Utilities Corridor. The data collected were landform; soil type (surface examination only); vegetation structure; vegetation description; dominant flora species within each stratum; and estimated height ranges. The presence of surface water, Utricularia species, and nearby Eucalyptus woodland were also documented, because these are typical features of sandsheet heath vegetation. Threatening processes were also documented – namely presence of weeds and feral animals – and other disturbances such as nearby sand mining and roads.

To determine the presence of threatened species habitat, each site was assigned a ‘map unit’, based on similarities in vegetation structure and species composition to the sandsheet heath vegetation communities outlined in Liddle et al. (2013). Sandsheet habitat quality was then determined for each patch based on:

- Diversity of Utricularia species
- Weed presence and level of disturbance
- Presence of threatened flora and/or fauna species (or individuals).

The number of Utricularia species observed at individual sites was collated for each patch and assigned a diversity rank according to those described in Liddle et al. (2013). These are very high (seven or more species), high (five to six species), moderate (three to four species), low (one to two species) or none.

Using all this information, each patch was assigned a measure of habitat quality – very high, high, moderate or low.



Legend

- ▲ Kilometre Point (KP)
- *Typhonium taylorii*
- *Utricularia dunstaniana*

Howard River toadlet

- Pre 2010 record
- Post 2010 record

Project footprint

- ▭ Section 572 - not accessed
- ▭ Historic mining
- ▭ Sandsheet Heath (NTG mapped)
- ▭ Sandsheet Heath (EcOz verified)

Roads

- Secondary road
- Minor road
- - - Track
- Streams
- Major Drainage
- ▭ Sub-catchments

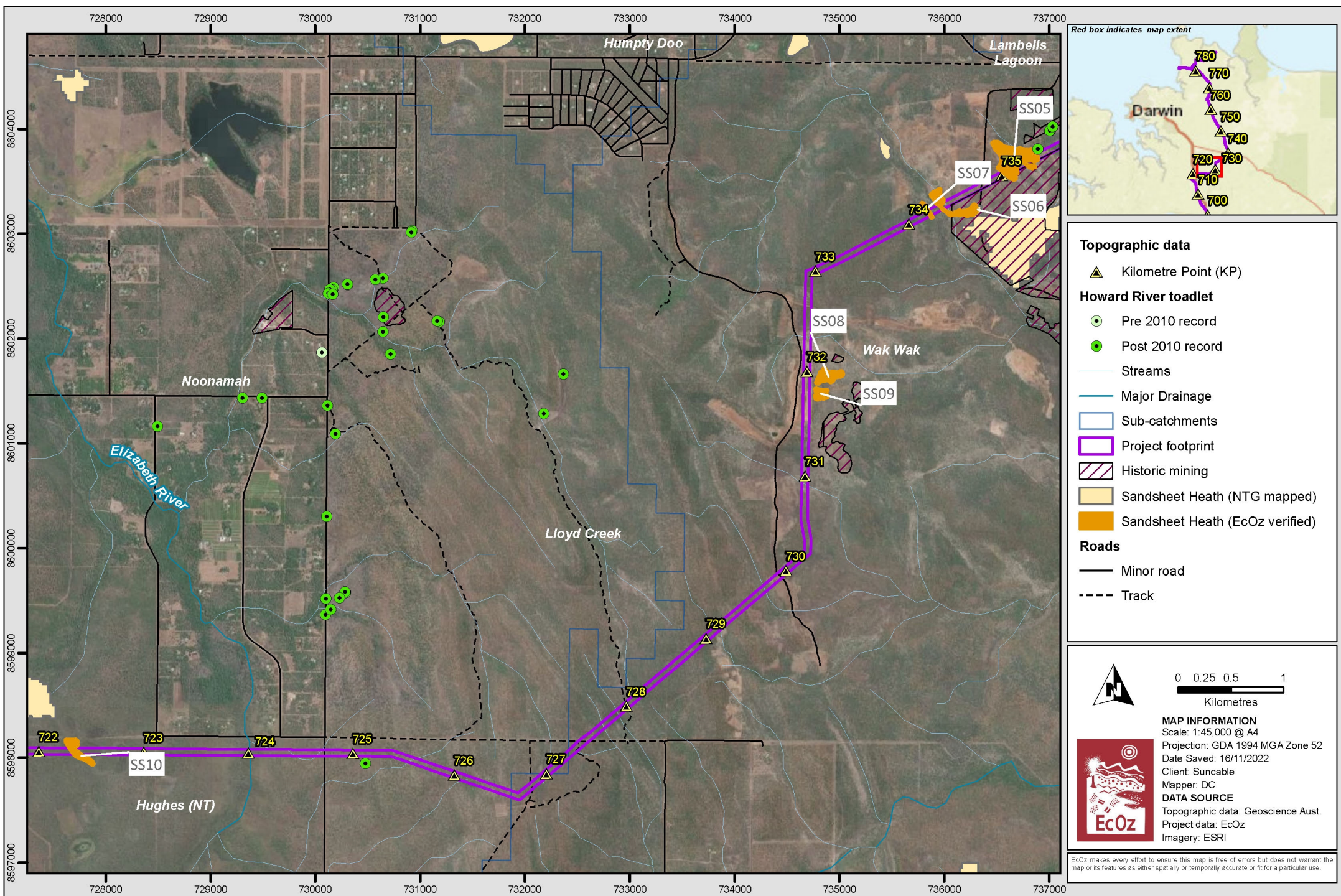
MAP INFORMATION

Scale: 1:75,000 @ A4
 Projection: GDA 1994 MGA Zone 52
 Date Saved: 16/11/2022
 Client: Suncable
 Mapper: DC

DATA SOURCE

Topographic data: Geoscience Aust.
 Project data: EcOz
 Imagery: ESRI

Figure 3. Map of sandsheet heath patches within the northern extent of the NTG Utilities Corridor



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ20220 - Australian ASEAN Power Link Ecology\01 Project Files\Ecology\Threatened species surveys\Fig 4-2 Sandsheet heath habitat SS05 - SS10.mxd

Figure 4. Map of sandsheet heath patches within the northern extent of the NTG Utilities Corridor

4.3.2 Results

Habitat quality

The quality assessment indicates that five patches are considered very high value, one patch as high value, and the remaining four patches are low value. By default, patches supporting threatened fauna or flora species are categorised as very high value as shown in Table 3.

Habitat types

Field data indicate that there are three habitat types occurring within sandsheet heath patches throughout the study area:

- 3a – *Melaleuca nervosa* +/- *Pandanus spiralis* low open woodland with a *Sorghum intrans*, *Eriachne trisetata* mid tussock grassland understorey.
- 3b – *Melaleuca nervosa* and *Grevillea pteridifolia* low open woodland with *Dapsilanthus spathaceus* low open sedgeland ground layer.
- 4a – *Verticordia cunninghamii* and *Banksia dentata* mid open heathland with an emergent *Melaleuca nervosa* and *Grevillea pteridifolia* low open woodland, over *Dapsilanthus spathaceus* mid open sedgeland ground layer.

As detailed in Table 3, vegetation community 3b was the most widespread, occurring across six patches and covering approximately 19.0 ha. This is followed by 3a which occurs across two patches (11.6 ha) and 4a which occurs at one patch (2.5 ha). One patch occurs near disturbed sandsheet vegetation and comprises vegetation with similar elements to sandsheet heath, but which could not be comfortably assigned to a particular vegetation community (0.5 ha).

Disturbance

Six of the surveyed patches showed signs of previous disturbance. Three patches (SS1, SS5 and SS6 – totalling 15.9 ha) are highly modified from sand mining. Other threatening processes observed across patches were feral pig damage and occasional extractive test pits. Those patches that were undisturbed were the two Crocodile Creek sites (SS2 and SS3), one site within Koolpinyah (SS7), and one site along Alverly Road in Noonamah (SS10).

Threatened species

Two patches support a very high (SS10) and high (SS5) diversity of *Utricularia* species. SS6 supports a moderate diversity, and SS9 a low diversity. No *Utricularia* species were observed at the remaining six patches. Of note, SS10 supports two Near Threatened species – *Utricularia holtzei* and *U. subulate*.

Four patches support the Endangered plants *Typhonium taylori* (patches SS2 and SS3) and *Stylidium ensatum* (SS4 and SS10).

Two patches, SS4 and SS5, have historic records of Howard River Toadlet (*Uperoleia daviesae*) in the patch, and there are records downstream of SS1. Additionally, SS1 and SS10 have been identified as having habitat with a high likelihood of supporting Howard River Toadlet but have not been surveyed for that species. Adopting the precautionary principle, the species is assumed to occur in these patches and therefore they are assigned a High or Very High habitat quality rating.

Table 3. Summary of sandsheet heath communities within the study area

Patch ID	Vegetation community	Indicative size (ha)	Length crossed by the NTG Utilities Corridor**	Threatened species recorded	Utricularia diversity	Disturbance	Habitat quality
SS 1	3a	3.08	105 m	Howard River Toadlet (downstream only)	0	High	High
SS 2	3a/3b	1.23	100 m	<i>Typhonium taylori</i>	0	Low	Very High
SS 3	3a	8.51	320 m	<i>Typhonium taylori</i>	0	Low	Very High
SS 4	*	0.51	65 m	<i>Stylidium ensatum</i> Howard River Toadlet	0	Moderate	Very High
SS 5	3b	9.14	370 m	Howard River Toadlet	5	High	Very High
SS 6	3b	3.68	25 m	-	4	High	Low
SS 7	3b	0.94	45 m	-	0	Moderate	Low
SS 8	3b	2.59	Adjacent only	-	0	Moderate	Low
SS 9	3b	1.37	Adjacent only	-	2	Moderate	Low
SS 10	4a	2.46	75 m	<i>Stylidium ensatum</i>	11	None	Very High

* The vegetation of SS4 contained elements of sandsheet heath but could not be comfortably assigned to a particular vegetation community. ** Measured down the centre of the NTG Utilities Corridor.

4.3.3 Information gaps and uncertainties

For reasons explained below, there has not been adequate survey effort for the Howard River Toadlet (*Uperoleia daviesae*), which is the only threatened fauna species relevant to sandsheet heath. Notwithstanding that surveys for the Howard River Toadlet are incomplete, a precautionary approach has been adopted that assumes the species is present where there is highly suitable habitat and/or previous records within or downstream of the patch.

The draft *Survey Methodology for Uperoleia daviesae* (DEPWS, in prep) is based upon nocturnal surveys. According to the methodology, each survey site should be 1 ha. The number of sites required depends on the size of the project footprint and the size, suitability and configuration of the habitat patch. Surveys should be planned to coincide with the onset of wet season monsoonal rains, and surveys should only take place after a sufficient rainfall event during the species' peak activity period.

The survey methodology stipulates that:

... to ensure rainfall and conditions are appropriate for Uperoleia daviesae detection, a local reference site is required. The reference site should be visited each night immediately prior to surveys to verify if Uperoleia daviesae are active and calling in the area. Site surveys should ONLY be undertaken if Uperoleia daviesae have been confirmed calling that night. Selection of the reference site should be based on a known reliable population, where local conditions are representative of the survey site.

As shown in Figure 3 and Figure 4, the patches of sandsheet which have the characteristics of high-quality Howard River Toadlet habitat (SS1, SS4, SS5 and SS10) are spread across a large area and safely accessing many of them at night during a rain event – having first visited a reference site – is not possible. Faced with such logistics, it was decided that employing the draft survey methodology was not feasible.

This prompted EcOz to develop a method of surveying for Howard River Toadlet using environmental DNA (eDNA). Living organisms constantly shed genetic material (DNA) such as skin, mucus, urine and faeces into the environment. Undertaking sampling for this eDNA is becoming an established tool for ecologists to detect species – particularly in aquatic systems – in situations where conventional methods may be ineffective, prohibitively labour- or time-intensive, or detrimental to the species. For the Howard River Toadlet, the method

involves collecting water samples from suitable habitat and undertaking laboratory analysis of the samples to detect whether there is DNA of the toadlet in the samples. For this to be possible, the laboratory needs to first develop species-specific genetic markers. Such an assay has been developed by a company called EnviroDNA using tissue samples from Howard River Toadlet that were previously collected by EcOz and DEPWS. This work has been undertaken in conjunction with Dr Renee Catullo from the University of Western Australia who is an expert on this genus of frog.

A trial of this survey method was undertaken in mid-April 2023. To confirm the veracity of the method, water samples were collected from reference sandsheet heath patches away from the NTG Utilities Corridor that are known to support a local occurrence of Howard River Toadlet. Samples were also collected from pooling water at patches SS1 and SS10 – the two sites identified as containing habitat with a high likelihood of supporting the Howard River Toadlet. The water sampling methods used were developed with EnviroDNA.

The results of this trial were mixed. Howard River Toadlet was detected at some of the reference sites, but not at others, indicating that refinement of the method is required. Toadlet DNA was not detected at SS1 or SS10 but given that there were also no detections at some sites known to support the species, this cannot be considered a confirmed absence. In consultation with the laboratory and other practitioners of this survey technique, the method will be revised in time for application during the 2023-24 wet season.

In 2023, EcOz has also started developing software that can automatically recognise Howard River Toadlet calls from acoustic recordings. Once refined, the intention is to deploy acoustic loggers at suspected Howard River Toadlet sites, collect call data over a suitable period, and then use the call recogniser to determine presence/absence of the species at that location. This methodology will be developed in conjunction with DEPWS to ensure it meets the level of rigour and accuracy required.

While SunCable is committed to employing suitable methods to verify the presence/absence of the Howard River Toadlet during the 2023-2024 wet season, for the purpose of this assessment it is assumed that the species could occur in and/or downstream of patches SS1, SS4, SS5 and SS10. The buffer widths and impact analysis presented in the sections below were determined on the basis that the species is present.

4.3.4 Recommended buffer widths

The quality of the sandsheet heath patches within the NTG Utilities Corridor was assessed to determine the level of protection each patch needs from potential indirect impacts from works associated with this project. Section 4.4.6 of the NT *Land Clearing Guidelines* (DEPWS 2021) describes how significant vegetation communities – which includes sandsheet heath – have:

...the potential to be impacted either directly or indirectly by a range of processes associated with clearing activities...

Sensitive and significant vegetation types should be excluded from the proposed clearing footprint and appropriate native vegetation buffers retained to protect them. The appropriate buffer size depends on the value of the sensitive or significant vegetation community and recommended buffer widths are provided below (see Table 4). Where an application has not applied buffers in accordance with guidelines recommendations, justification must be provided, and alternative mitigation or management strategies must be identified to avoid impacts.

Table 4. NT Land Clearing Guidelines – recommended widths of significant vegetation buffers

Value	Buffer width (m)*
Low	50
Medium	100
High	250

* Buffers are measured from the outer edge of the significant vegetation

This analysis considers sandsheet patches within the NTG Utilities Corridor that were assessed above as being of high or very high quality as falling within the *Land Clearing Guidelines* category of 'high'. On this basis, a native vegetation buffer of 250 m is recommended for patches SS1 to SS5, and SS10, and a minimum 50 m native vegetation buffer is recommended for the other four patches. For sandsheet heath, maintaining a native vegetation buffer is most important to minimise impacts to the particular hydrological regime supporting a patch and the values there-in.

4.3.5 Avoidance and mitigation measures

It is possible to avoid direct impacts to sandsheet heath patches that are intersected by the NTG Utilities Corridor by placing the OHTL towers outside of the patch extent so that the transmission lines span over or re-route around the patch without any direct ground disturbance. The standard distance between towers is approximately 450 m, which can be increased up to approximately 550 m by increasing the tower height from 60m to 70m for specific span(s) over patches. Where the intent is to span a patch, options include using helicopters to string the cables between the tower structures, or avoiding so that an access track through the patch is not required.

In terms of minimising indirect impacts to sandsheet heath, the native vegetation buffer widths recommended in the *Land Clearing Guidelines* can be achieved at four patches (SS6, SS7, SS8 and SS9). However, because the greatest distance that can be spanned by powerlines is approximately 550 m, it is not possible to stay within the Utilities Corridor and meet the 250 m buffer recommended in the *Land Clearing Guidelines* for avoiding indirect impacts to five¹ high value sandsheet heath patches (SS1, SS2, SS3, SS5 and SS10) described in Table 3. Nevertheless, as explained below, for all these patches design outcomes can ensure that indirect impacts to sandsheet heath – particularly modified hydrology – are negligible.

The cleared footprint for each tower is a small area, approximately 16 x 16 m, upon which four 2 x 2 m concrete blocks are placed as the corner footings for the tower. A 6 m wide maintenance access track is required to each tower (see Figure 5). This constitutes a very small proportion of the catchment supplying each patch. As such, there is an inherently low likely of indirect impacts to sandsheet heath hydrology because. An additional 60 x 100 m cleared area is required for construction pads at each tower location; however, post-construction, these cleared areas will be re-instated such that the local surface hydrological regime is not disturbed and identified patches avoided.

Patch SS1 (Figure 6) and SS5 (Figure 8) – and, to a lesser, extent, patches SS02 and SS03 – are adjacent to land that is already disturbed by tracks and historic extractive activity which encroaches upon the recommended native vegetation buffers. To minimise indirect impacts, the intention is to preferentially locate OHTL infrastructure within those areas, maintaining at least a 100 m from the sandsheet heath patches.

For patches SS2 and SS3 (Figure 7), patch SS10 (Figure 9), and for the mapped values in Section 572 that are yet to be ground-truthed (see Section 5.3), the OHTL will be re-routed outside of the proposed project footprint for short sections to ensure that there is a 250 m buffer from these values (or at least 100 m if the location is already disturbed). As shown in the abovementioned figures, the OHTL footprint is within a wider Utilities Corridor, which is adjacent to a Proposed Main Roads Corridor. Consequently, in the first instance re-routing options that use the full extent of these two corridors will be investigated, in consultation with NT Government and relevant landholders. The preferred option for avoiding these values will be selected during detailed design and will depend on site-specific factors that determine engineering feasibility and availability of tenure.

Where the OHTL access track is required to deviate off the alignment to avoid impacts to a sandsheet heath patch, existing access tracks will be used where they exist. Where new permanent access tracks are required, the following principles will be adopted to avoid and mitigate indirect impacts to sandsheet heath:

¹ The remaining high value sandsheet patch SS4 (Figure 7) is crossed by 65 m of the OHTL, and so with a 550 m span, the buffer is just under 250 m either side – which is considered effective and therefore acceptable

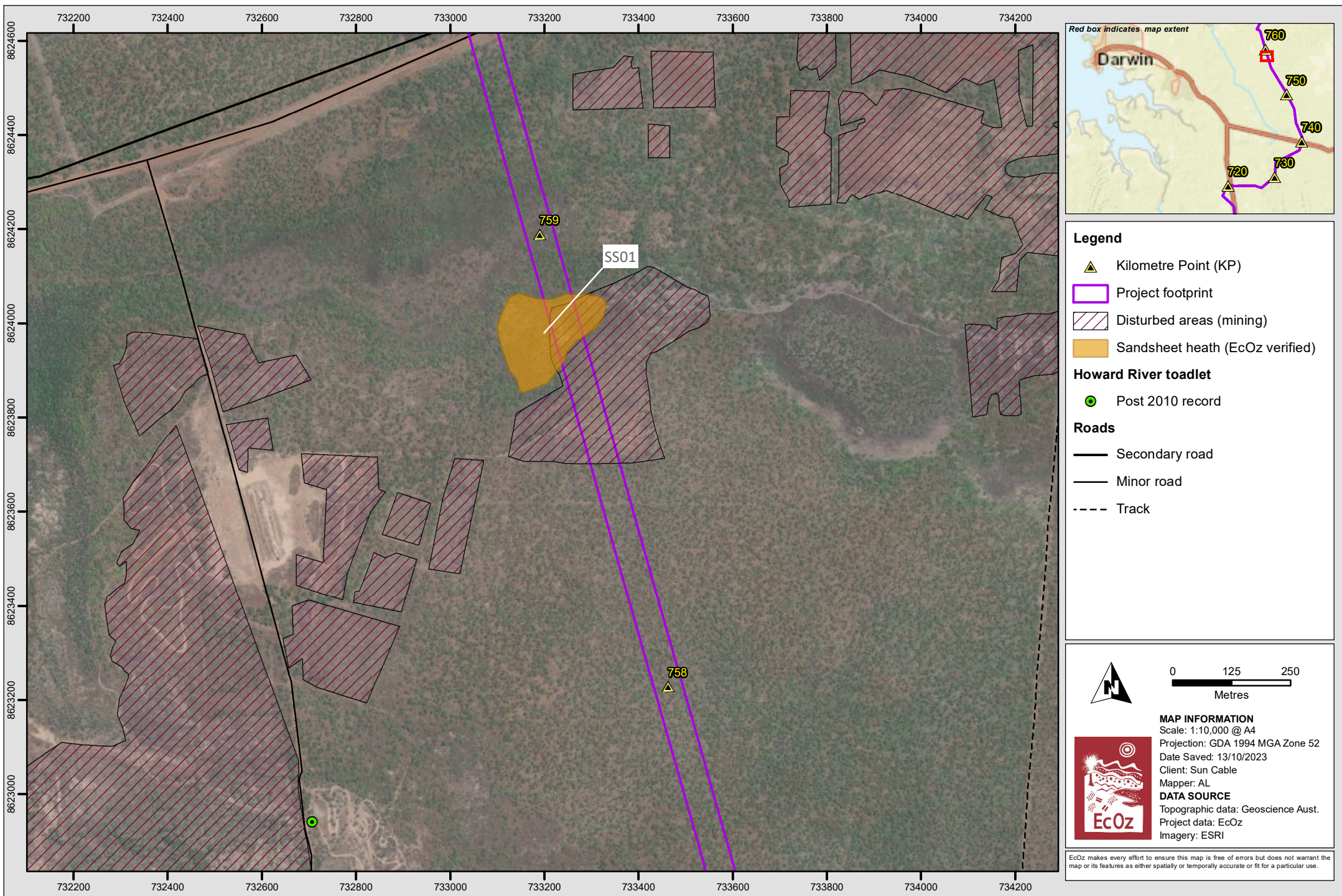
- Preferentially site permanent access tracks downstream of sandsheet heath patches and located at least 100 m away from the patch edge to avoid affecting surface water flow to the patch.
- Where access tracks must be sited upstream of a sandsheet heath patch, apply the 250 m buffer recommended in the *Land Clearing Guidelines*.
- Engineer and build the tracks to ensure there is adequate drainage, thereby maintaining existing hydrology.

SunCable is proposing to institute a procedure for working through location-specific constraints in the development of its infrastructure. The Constraints Planning and Field Development Procedure (the Micro Siting Procedure), as introduced through the SEIS (Appendix 4.1) proposes a refined process for the specific placement of Project infrastructure, such as OHTL tower structures, to minimise disturbance to the surrounding environment.

During operations, there will be no disturbance to these sandsheet heath patches because – unlike most of the OHTL where a Vegetation Management Corridor is required to ensure trees do not interfere with the transmission lines – such management is not required within sandsheet heath because the vegetation type does not support very tall trees. Selective vegetation management may be required in the native vegetation buffer zone if trees larger than 6 m are present; however, this can be achieved without causing significant ground disturbance.

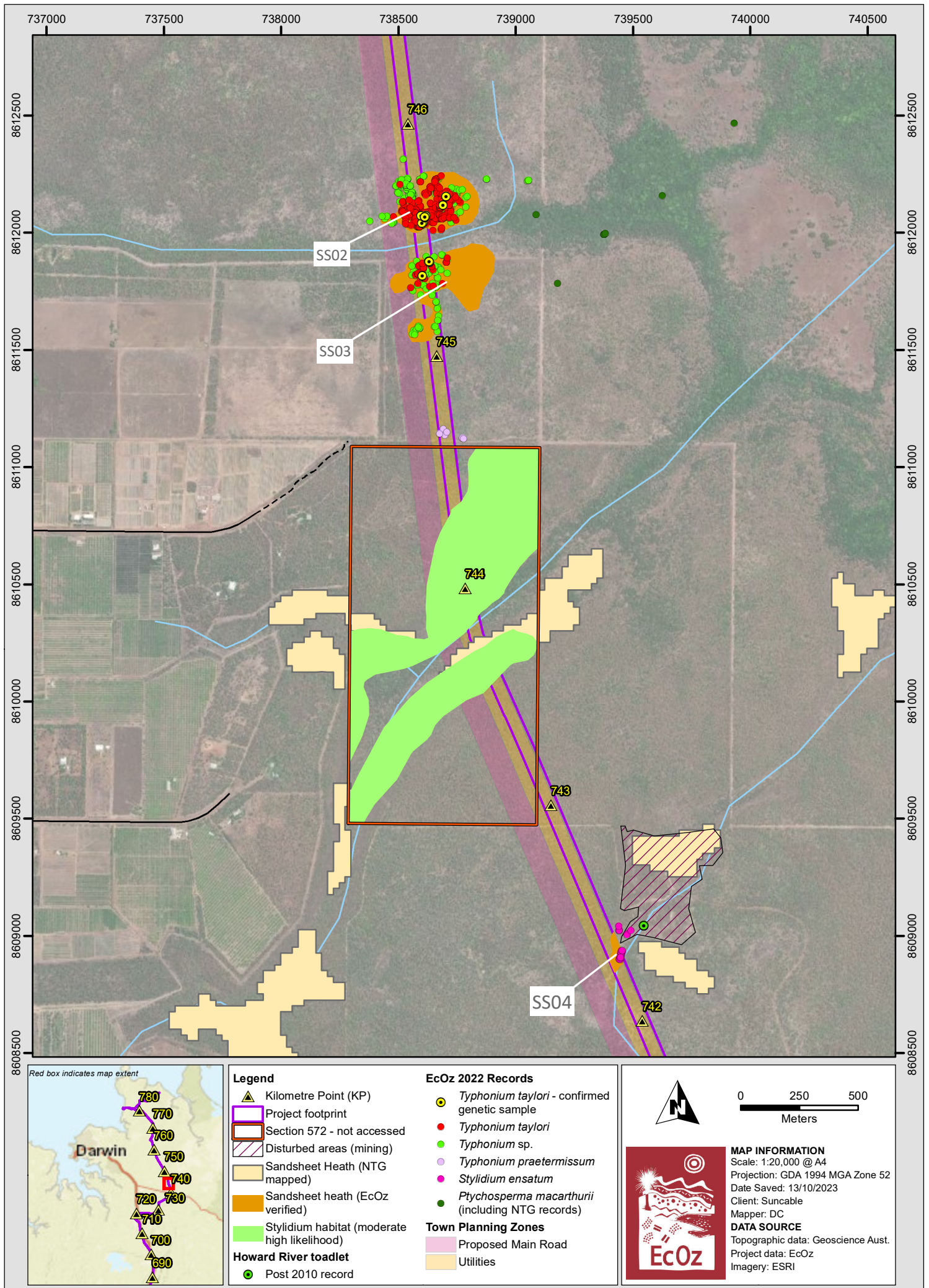


Figure 5. Photograph of an indicative tower pad



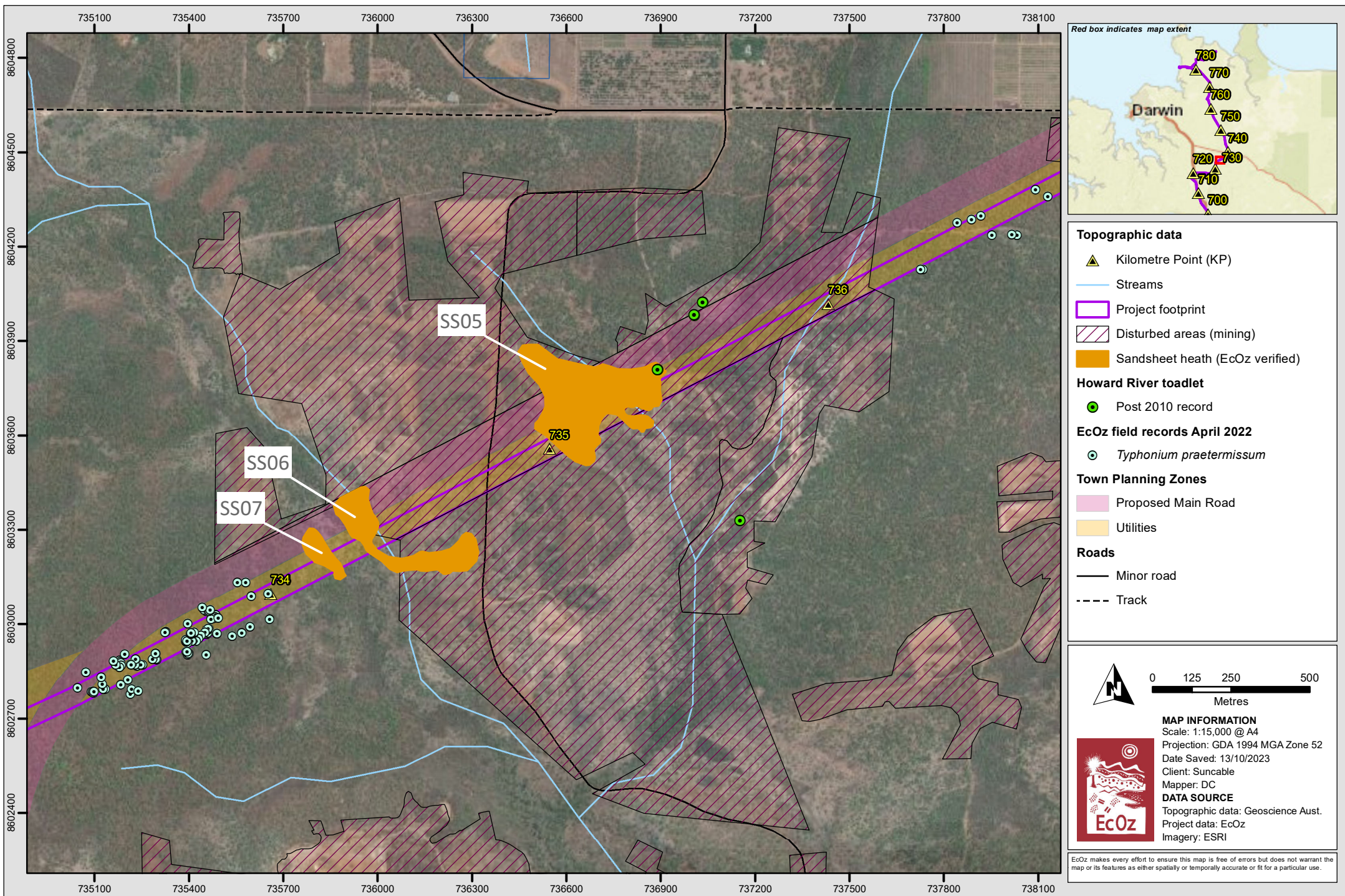
Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ23168 - Responding to NT EPA Direction to provide Additional Information\1. Project Files\2. Report Maps\Sandsheet heath patch SS1.mxd

Figure 6. Map of sandsheet heath habitat SS01 along the OHTL Utilities Corridor



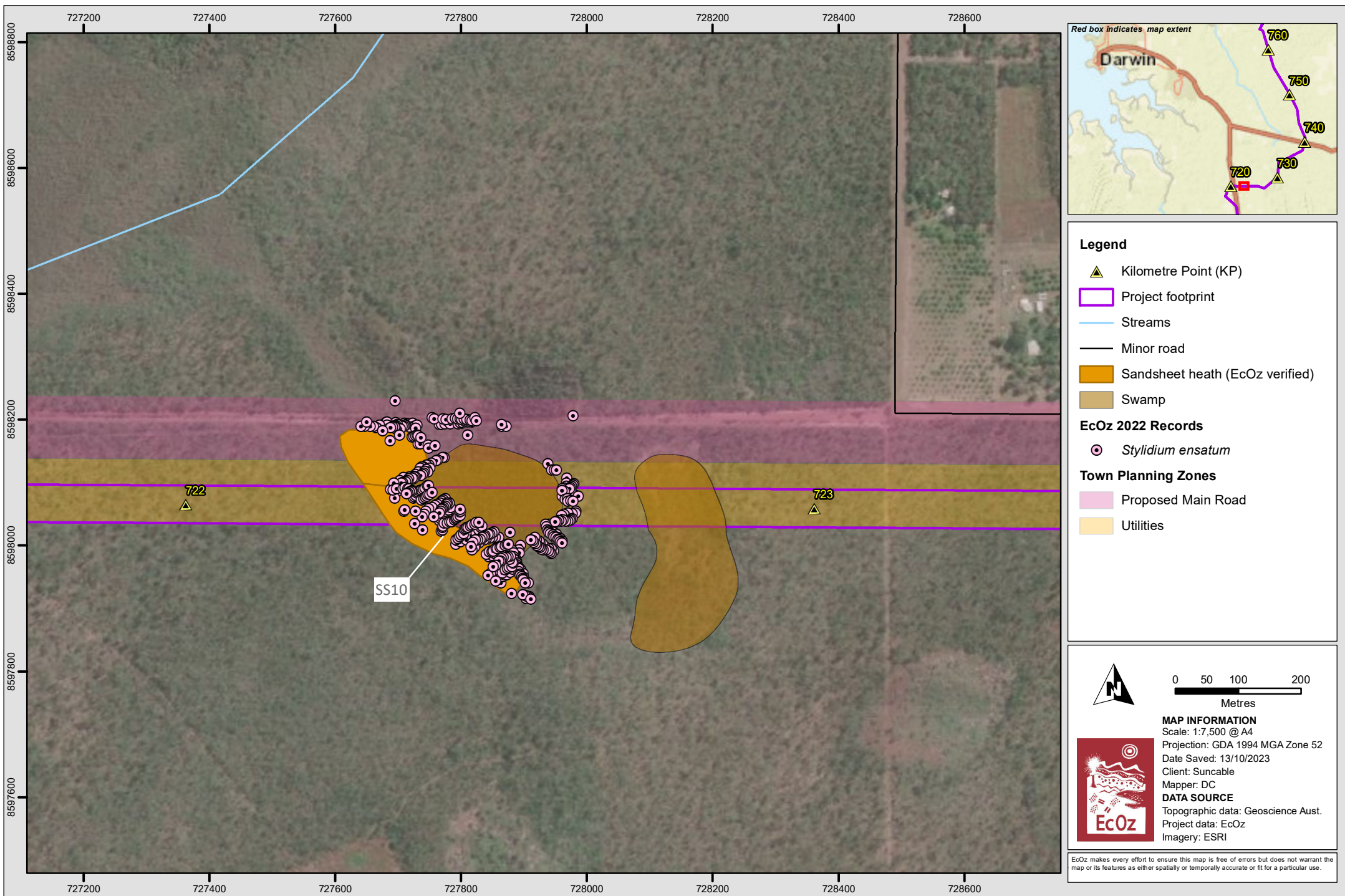
Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ23168 - Responding to NT EPA Direction to provide Additional Information\1. Project Files\2. Report Maps\Sandsheet heath patches SS2, SS3 and SS4.mxd

Figure 7. Map of sandsheet heath habitat SS2, SS3 and SS4 and Section 572 along the OHTL Utilities Corridor



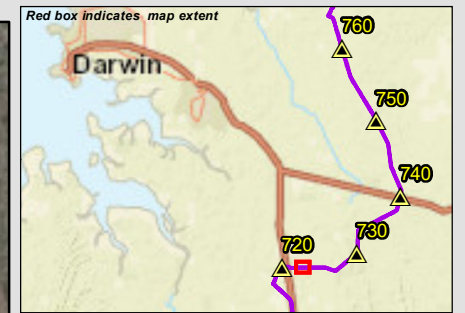
Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ23168 - Responding to NT EPA Direction to provide Additional Information\1. Project Files\2. Report Maps\Sandsheet heath patches SS5, SS6 and SS7.mxd

Figure 8. Map of sandsheet heath habitat SS5, SS6 and SS7 along the OHTL Utilities Corridor



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ23168 - Responding to NT EPA Direction to provide Additional Information\1. Project Files\2. Report Maps\Map of sandsheet heath patch 10.mxd

Figure 9. Map of sandsheet heath habitat SS10 along the OHTL Utilities Corridor



Legend

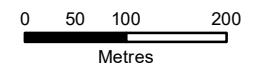
- Kilometre Point (KP)
- Project footprint
- Streams
- Minor road
- Sandsheet heath (EcOz verified)
- Swamp

EcOz 2022 Records

- Styliidium ensatum*

Town Planning Zones

- Proposed Main Road
- Utilities



MAP INFORMATION

Scale: 1:7,500 @ A4
 Projection: GDA 1994 MGA Zone 52
 Date Saved: 13/10/2023
 Client: Suncable
 Mapper: DC

DATA SOURCE

Topographic data: Geoscience Aust.
 Project data: EcOz
 Imagery: ESRI

EcOz makes every effort to ensure this map is free of errors but does not warrant the map or its features as either spatially or temporally accurate or fit for a particular use.

5 IMPACTS TO *STYLIDIUM ENSATUM*

5.1 Context provided by the NT EPA

As identified in the Supplement Direction (Table 2, item #8), DEPWS has mapped highly suitable habitat for *Stylidium ensatum* within the OHTL corridor and surveys for this species are required where the OHTL overlaps with the DEPWS modelling and Department of Climate Change, Energy, the Environment and Water (DCCEEW) species distribution information. Appropriate survey times are during the mid-late dry season (June to August) when the plant is flowering/fruitlet. The EIS states that potentially suitable habitat in Section 572 was not surveyed as access permission was not obtained. Refer to submission on the Supplement from DEPWS

5.2 Additional information required by the NT EPA

1. Provide the outcome of seasonally appropriate field surveys to identify how many hectares of *Stylidium ensatum* habitat and *Stylidium ensatum* suitable habitat would be cleared in NT Section 572 when access permission is obtained, and quantify the impact of proposed habitat loss on local and regional populations outside of the proposed action's footprint.
2. Identify the percentage of *Stylidium ensatum* habitat that will be cleared in relation to the local and regional *Stylidium ensatum* habitat and the area of suitable habitat available.
3. Identify a suitable buffer for species records that is suitable to avoid indirect impacts on local hydrology (see Item 4 above).
4. Propose offsets for any residual significant impacts (for habitat loss and removal of any plants).

5.3 Response

Despite concerted effort, it has not yet been possible to access Section 572 to survey for *Stylidium ensatum* (*S. ensatum*). Once access is granted, a habitat suitability survey will be undertaken and, if suitable habitat is present, there will be a subsequent targeted survey for the species. For now, it must be assumed that *S. ensatum* is present within the entire length of modelled high-likelihood habitat within the NTG Utilities Corridor (see Figure 7). This is ecologically unlikely, and therefore a very conservative assumption.

Within Section 572, the NTG Utilities Corridor transects approximately 760 m of *S. ensatum* habitat (including a wide riparian corridor that bisects that habitat). As explained in the response to Item 4, it is feasible to span the OHTL towers up to 550 m so the vegetation beneath the OHTL can be left uncleared if there are no trees taller than 6 m present. If *S. ensatum* is detected within Section 572 then – depending on the extent of its occurrence and/or whether *Cleome insolata* is also detected (see Section 9) – it may not be feasible to span. In such a scenario, the OHTL could be re-routed outside of the NTG Utilities Corridor, as explained in Section 4.3.5.

To avoid indirect impacts to this species associated with alterations to the local surface hydrology regime the same avoidance and mitigation measures proposed for high quality sandsheet heath patches – as discussed in the Section 4 above – will be applied. This involves placement of permanent disturbance footprints at least 100 m downstream or at least 250 m upstream of known occurrences (except if there is already disturbed land which can be used, in which case a buffer of at least 100 m will be applied), and re-instatement of the tower construction pads post-construction to minimise alteration of surface water flows.

The above measures are expected to provide for adequate protection of *S. ensatum* habitat should it occur in Section 572. While there is some uncertainty to be resolved, on balance it is unlikely that there will be significant impact to the species. Offsets would only be considered as the final option in the environmental management hierarchy if the species is found to be present, the occurrence cannot be adequately spanned, and tenure cannot be secured to reroute around the occurrence.

6 IMPACTS TO HELICTERES MACROTHRIX

6.1 Context provided by the NT EPA

As identified in Supplement Direction (Table 2, item #9), DEPWS has mapped highly suitable habitat for *Helicteres macrothrix* (Endangered under the TPWC and EPBC Acts) within the OHTL corridor deviation at Adelaide River. Surveys of the deviation have not been conducted, but are required. The TOR required assessment of the significance of residual impacts (Table 5). The significant residual impacts from removing *H. macrothrix* have not been discussed.

6.2 Additional information required by the NT EPA

1. Provide the outcome of seasonally appropriate field surveys for this species for the OHTL deviation at Adelaide River where it overlaps with DEPWS modelling and DCCEEW species distribution information.
2. Identify:
 - a. the maximum area (hectares) of *Helicteres macrothrix* known and suitable habitat that would be cleared.
 - b. the location of any plants within the area to be cleared.
3. Identify the percentage of *Helicteres macrothrix* habitat that will be cleared in relation to the local and regional *Helicteres macrothrix* habitat and suitable habitat availability.
4. Provide details of the avoidance and mitigation measures for this species such as determining a suitable buffer where plants are identified.
5. Discuss any potential significant residual impacts (e.g., habitat loss and removal of any plants) that cannot be avoided or mitigated and proposed offsets.

6.3 Response

High likelihood *Helicteres macrothrix* habitat has been modelled as present in the OHTL Adelaide River diversion. All the high likelihood habitat in the northern section of the diversion has been surveyed for *H. macrothrix* using an approved methodology and an appropriate time of the year – see 0. No *H. macrothrix* plants were detected.

High likelihood *H. macrothrix* habitat modelled as present in the southern section of the diversion has not yet been surveyed due to access restrictions. A survey will be undertaken at an appropriate time once access is viable. The habitat modelling is coarse, and the likelihood of this species being present in this section of the diversion (compared to the northern section) is lower due to the distance from known records (and possibly because of cattle grazing in that area). If *H. macrothrix* is found in the southern section of the OHTL diversion, then – depending on the extent of its occurrence – it will either be spanned or the OHTL corridor will be locally realigned around the occurrence (applying a disturbance buffer of at least 50 m).

Whilst there are still some information gaps in relation to the occurrence of *H. macrothrix*, SunCable commits to apply the above avoidance and mitigation measures during detailed design and construction planning should the species occur. On this basis the proposed activities are considered unlikely to significantly impact on *H. macrothrix*. Offsets would only be considered as the final option in the environmental management hierarchy if the species is found to be present and for some reason tenure cannot be secured to reroute around the occurrence.

7 IMPACTS TO GOULDIAN FINCH

7.1 Context provided by the NT EPA

As identified in Supplement Direction (Table 2, item #12), the NT EPA require that the assessment of significant impact for Gouldian Finches incorporates all potential Gouldian Finch habitat, including core foraging and breeding habitat within 20 km of the proposed action. The supplement did not include consideration of breeding habitat including Salmon Gum (*Eucalyptus tintinnans*) and termite mounds. Refer to comment #5 of the submission on the Supplement from DCCEEW.

7.2 Additional information required by the NT EPA

1. Address DCCEEW comment #5.
2. Provide details of the avoidance and mitigation measures for Gouldian Finch breeding habitat, including consideration of Salmon Gum (*Eucalyptus tintinnans*) and termite mounds.

7.3 Response

7.3.1 Context

Table 5-23 of the SEIS contained an error. Instead of presenting the proportion of area of vegetation within the OHTL and surrounding 20 km that contained key foraging and breeding plant species (e.g. 1.0 % of the area of vegetation within the OHTL contains *Eucalyptus tintinnans*), it showed the proportion of each key plant species within the vegetation communities that contain breeding or foraging habitat (e.g. of all the vegetation communities that contain breeding habitat relevant to the project, 89.62 % support *Eucalyptus tintinnans*).

That table has been revised as Table 5 below to show the proportion of area of vegetation within the OHTL corridor (and surrounding 20 km) that support the key foraging and breeding plant species. It shows that none of the important tree and grass species are over-represented in the OHTL Corridor compared to surrounding areas. Most pertinently, Salmon Gum (*Eucalyptus tintinnans*) is only present within 1% of the OHTL.

The results of that analysis are that the regional proportion of vegetation types that support breeding tree species within the OHTL is, at most, 0.02 %. For foraging grass species, the proportion is 0.11 %. These are conservative estimates of actual habitat loss because only a proportion of the entire OHTL corridor will be maintained cleared for operational and maintenance access; and the remainder will not be disturbed.

That these values, and some others presented in this section, differ slightly from those in the SEIS is a consequence of slight changes to the route and footprint of the OHTL.

Table 5. Proportion of native vegetation with Gouldian Finch breeding and foraging plant species within the OHTL corridor

Species	% of regional* occurrence within the OHTL footprint	Proportion of area of vegetation with breeding / foraging plant species**	
		Within 20 km	Within the OHTL footprint
Foraging grass species			
<i>Sorghum intrans</i>	0.09%	17.3%	19.5%
<i>Alloteropsis semialata</i>	-	0.1%	0.0%
<i>Chrysopogon fallax</i>	0.11%	41.9%	59.2%
<i>Triodia bitextura</i>	0.01%	2.8%	0.3%
<i>Heteropogon triticeus</i>	0.11%	34.4%	48.0%
Breeding tree species			
<i>Eucalyptus tintinnans</i>	0.02%	3.9%	1.0%
<i>Eucalyptus leucophloia</i>	-	0.7%	-
<i>Eucalyptus brevifolia</i>	-	-	-

* Within 20 km of the OHTL; ** Some key species occur together, and so the columns are not supposed to add to 100%

Core and critical habitat

The EIS and SEIS refer to core foraging and breeding habitat but did not provide an explicit explanation as to what these are. The terms core habitat or critical habitat are not defined for Gouldian Finch (O'Malley 2006). For this purpose, these terms have been defined as consisting of habitat containing the most limited of resources required by Gouldian Finch – namely breeding habitat and foraging habitat of the less abundant grass species that Gouldian Finch are dependent on at certain times of the year.

Using the vegetation datasets from NVIS 6.0 and the Vegetation of the Daly River Catchment (Cuff 2011), an analysis has been undertaken for this project of the available foraging and breeding habitat within the OHTL, in comparison to that available within 20 km of the OHTL (a search area suggested by DEPWS).

The results were that:

- Along the 783 km OHTL, there are 29,285 km² of Gouldian Finch foraging habitat mapped within the 20 km buffer. Of this, 31 km² (0.11%) is within the project footprint. This may be an overestimate because some of that habitat may have been cleared for the railway and associated infrastructure. Moreover, post-construction up to 80% of the OHTL clearance footprint will be re-instated, which should lead to re-establishment of foraging grasses.
- There are 1,400 km² of Gouldian Finch breeding habitat mapped within the 20 km buffer. Of this, 0.3 km² (0.02%) is within the project footprint. As above, this may be an overestimate.

The Yinberrie Hills region north of Katherine is a known breeding hot-spot for Gouldian Finch and is the region crossed by the OHTL with the most records of the species. The Yinberrie Hills are within the Vegetation of the Daly River Catchment map extent (Cuff 2011) which covers 5,257,620 ha, of which 49,756 ha contains vegetation types that support trees used by Gouldian Finches for breeding, and 97,573 ha contains vegetation types that support one or more of the core grass species that Gouldian Finches feed upon. The OHTL crosses the catchment map extent for approximately 200 km – from KP 350 to KP 550. Over this distance, the OHTL corridor equates to 1,200 ha or 0.0228 % of the vegetation within the map extent.

Across the 200 km section of the OHTL corridor that traverses the Yinberrie Hills, four patches of Gouldian Finch breeding habitat are intersected. Those patches total 134.44 ha, of which only 5.74 ha (4.3%) are within the OHTL corridor – as shown in Figure 10, and presented in Table 6. There are additional areas of breeding habitat in the surrounding landscape. These values – and those for breeding habitat – differ slightly

from those presented in the EIS due to subsequent modifications in the OHTL route and including more breeding tree species in this analysis.

Across the 200 km section of the OHTL corridor within Yinberrie Hills, three patches of Gouldian Finch breeding habitat are intersected. Those patches total 1,057.3 ha, of which only 13.04 ha (1.2%) are within the OHTL corridor – as shown in Figure 10, and presented in Table 6. There are additional areas of foraging habitat in the surrounding landscape.

There are also numerous large patches of suitable breeding and foraging habitat within 20 km of the OHTL corridor – as shown in Figure 5-17 of the EIS.

Incorporating all the information presented in this section, the significant impact assessment presented in Section 7.4.4 of this response concludes that the loss of such small proportions of Gouldian Finch habitat along a linear corridor does not constitute a significant impact to this species.

Table 6. Lengths and areas of the OHTL corridor that intersect Gouldian Finch habitat

Length (KP's)	Patch size (ha)	Area within OHTL (ha)	% of patch in OHTL
Foraging habitat			
483 – 481	23.82	1.61	6.8 %
472 – 473	7.81	0.31	4.0 %
425 – 427	91.38	2.09	2.3 %
399 – 401	11.43	1.73	15.1 %
Breeding habitat			
527 – 528	94.25	0.07	0.1 %
416 – 417	153.50	4.47	2.9 %
404 – 407	809.55	8.51	1.1 %

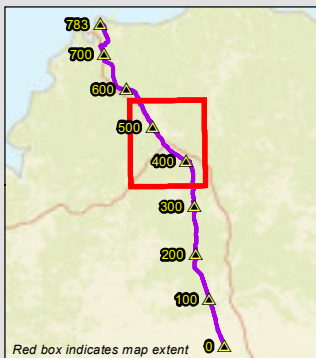
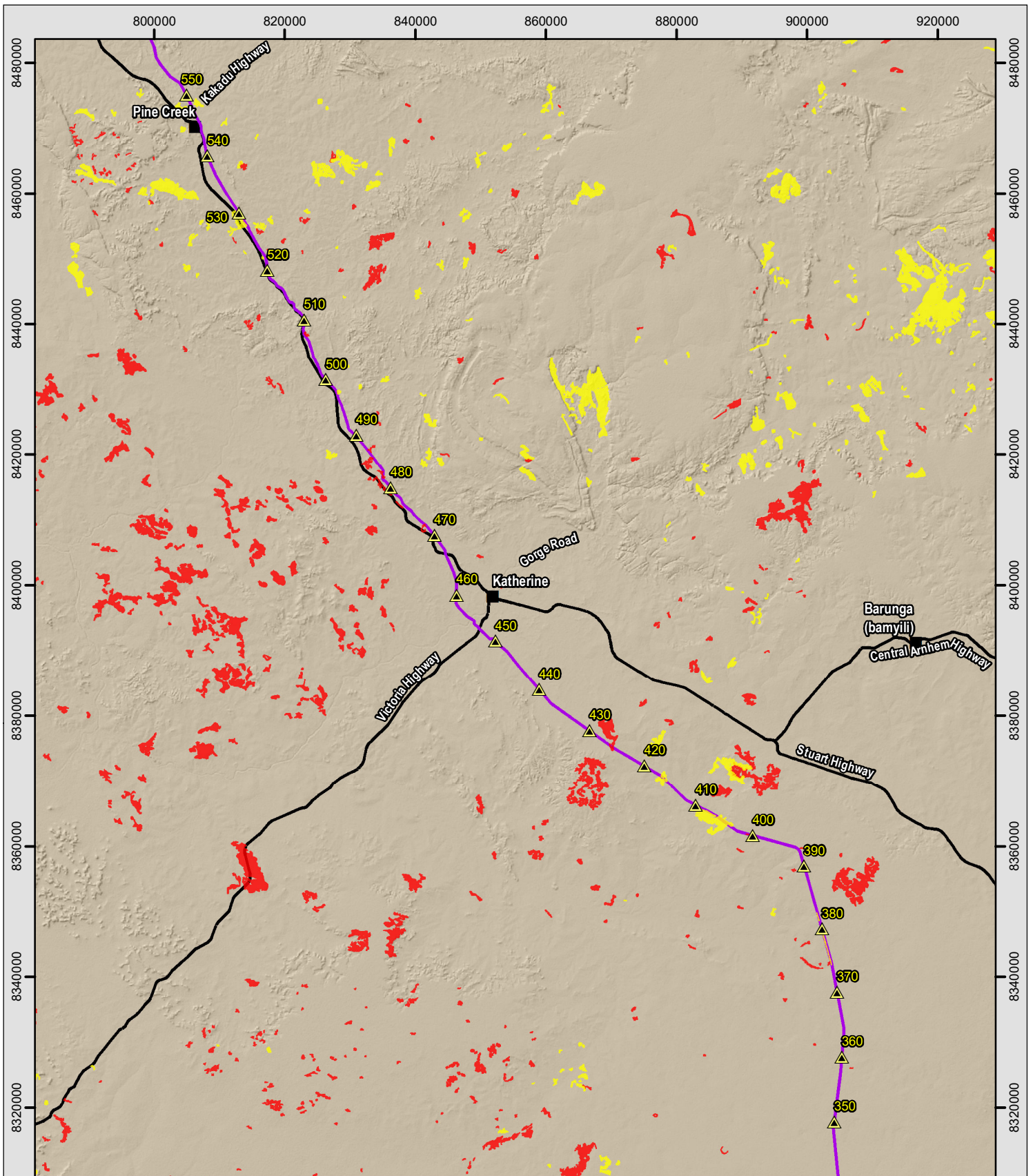
7.3.2 Breeding habitat surveys

The SEIS clearly states that an aerial survey of breeding habitat was carried out over the Project's components within Powell Creek Station only. That survey did not include Salmon Gum (*Eucalyptus tintinnans*) because that species only occurs between about KP 465 to 653, which is outside the survey area.

The reference to Gouldian Finches using termite mounds for breeding comes from the *Background Information to the National Recovery Plan for the Gouldian Finch* (O'Malley 2006) which states that 'there are also a few records from both the Northern Territory and Western Australia of Gouldian Finch nests built in hollows within termite mounds (e.g. N. Kolichis in WA Museum records)'. Neither the actual National Recovery Plan nor the Conservation Advice for this species refer to termite mounds. After a thorough review of the literature on Gouldian Finches, it appears that this assertion maybe based on unconfirmed reports from the 1960's of the species using termite mounds that have not been observed since. Whether or not Gouldian Finches use termite mounds for nesting makes no difference to the impact assessment as suitable termite mounds are abundant in the savannah woodlands of the Northern Territory and are not a limiting habitat feature for this species.

For the entire OHTL corridor, identification of potential breeding and foraging habitat was undertaken using vegetation mapping only, with the explanation in the SEIS that:

Any mapped suitable habitat will be assigned a high constraint rating and managed in accordance with the Constraints Planning and Field Development Procedure (Appendix 4.1). The intention will be to minimise disturbance to foraging, but especially the more limited breeding habitat, by minimising placement of OHTL structure pads within such habitat as it is identified on the ground.



Topographic data

- Kilometre Point (KP)
- OHTL Project footprint
- Gouldian Finch breeding habitat
- Gouldian Finch foraging habitat
- Town
- Principal road

MAP INFORMATION

Scale: 1:800,000 @ A4
 Projection: GDA 1994 MGA Zone 52
 Date Saved: 29/09/2023
 Client: AAPowerLink Australia Assets
 Mapper: DC

DATA SOURCE

Topographic data: OSM
 Project data: Client, EcOz
 Imagery: Shaded relief, Landsat

Figure 10. Map contextualising the intersection of the OHTL Corridor between KP 350 and KP 550 with mapped Gouldian Finch habitat in the Yinberrie Hills region

7.3.3 Avoidance and mitigation

Notwithstanding the small proportion of Gouldian Finch habitat that will be disturbed by the construction of the OHTL, this section discusses the avoidance and mitigation measures that will be employed to minimise impacts to that habitat, and therefore to the Gouldian Finch. As noted above, the Constraints Planning and Field Development Procedure mandates ground-truthing of areas mapped as having a high constraint rating. This includes Gouldian Finch breeding or foraging habitat as mapped within the Daly River catchment.

Where foraging habitat is confirmed as being present, towers will be placed to ensure it will be spanned as much as possible. Whilst no active revegetation measures are proposed, any temporarily disturbed topsoil will be stored in such a way as to maintain seed viability when it is re-spread, and follow-up weed control will be undertaken. This will maximise the likelihood that the foraging grass species that were present will return.

Where breeding habitat is confirmed as being present, towers will be placed to ensure it is also spanned as much as possible. Tower pads that cannot avoid breeding habitat, will be constructed such that laydowns are located outside of the breeding habitat, where feasible. In the few instances where potential breeding habitat is unavoidably located within a tower pad disturbance footprint, it will be checked prior to construction to determine whether it is currently in use by Gouldian Finches. Likewise, although none is mapped, any habitat that is confirmed in the field as suitable for breeding within the Yinberrie Hills Site of Conservation Significance will be surveyed during the species' breeding season to ascertain whether it is in use. Any breeding habitat confirmed as being in use by Gouldian Finches will be avoided, buffered by 200 m, and disturbance will only commence once breeding has finished.

7.3.4 Revised significant impact assessment

The Gouldian Finch's status as Endangered means that any occurrence constitutes an important population. Table 7 presents an assessment of whether Project activities are likely to have a significant impact on the Gouldian Finch, using the criteria contained within the EPBC Significant Impact Guidelines 1.1 (DoE 2013). It concludes that the Project is unlikely to have a significant impact on Gouldian Finch and an offset is not required.

Table 7. Significant impact assessment for Gouldian Finch

Criterion	Summary of mitigation measures and significant impact assessment
Lead to a long-term decrease in the size of a population	Given the mobile nature of the species, there is unlikely to be any direct mortality of individual Gouldian Finches because of interactions with construction machinery. The only other way in which this development could potentially lead to a long-term decrease in the size of the Gouldian Finch population is through substantial loss of critical habitat – which is considered unlikely as discussed below.
Reduce the area of occupancy (AOO) of the species	Garnett et al. (2021) estimates the AOO for Gouldian Finches to be between 2,000 and 20,000 km ² based on the IUCN 2 x 2 km grid cell method. Where Gouldian Finch habitat occurs within the OHTL (or Non-Process Infrastructure – including Solar Precinct access road footprints) – and its loss cannot be avoided – the only way that loss can lead to a reduced AOO is if it is entirely confined to within the footprint. In other words, if the breeding/foraging resources lost constitute the entire local occurrence of those resources, and there are no other nearby occurrences, then this could lead to a reduced AOO. There is no reason to suspect that these resources will only occur within the narrow project footprints in question, and so it is very unlikely that this scenario will eventuate.
Fragment an existing population into two or more populations	The Gouldian Finch is a mobile animal capable of travelling long distances. A narrow, cleared area adjacent to a railway line will not represent a barrier for dispersal of this species.
Adversely affect habitat critical to the survival of the species	Critical habitat for the Gouldian Finch is not defined (O'Malley 2006), and so for this purpose has been defined as consisting of habitat containing the most limited of resources required by Gouldian Finch – namely breeding habitat and foraging habitat of the less abundant grass species that Gouldian Finch are dependent on at certain times of the year.

Criterion	Summary of mitigation measures and significant impact assessment
	<p>Using the vegetation datasets from NVIS 6.0 and Cuff (2011), an analysis has been undertaken for this project of the available foraging and breeding habitat within the OHTL, in comparison to that available within 20 km of the OHTL (a search area suggested by DEPWS).</p> <p>The results were that:</p> <ul style="list-style-type: none"> • Along the 783 km OHTL, there are 29,285 km² of Gouldian Finch foraging habitat mapped within the 20 km buffer. Of this, 31 km² (0.11%) is within the project footprint. This may be an overestimate because some of that habitat may have been cleared for the railway and associated infrastructure. Moreover, post-construction up to 80% of the OHTL clearance footprint will be re-instated, which should lead to re-establishment of foraging grasses. • There are 1,400 km² of Gouldian Finch breeding habitat mapped within the 20 km buffer. Of this, 0.3 km² (0.02%) is within the project footprint. As above, this may be an overestimate. <p>The loss of such small proportions of this important habitat cannot be considered likely to have an adverse effect on the survival of the species.</p>
Disrupt the breeding cycle of a population	<p>Clearing of breeding habitat that is in use by Gouldian Finches could disrupt the breeding cycle of the Gouldian Finch. Given the very small proportion of locally available breeding habitat within the disturbance footprint, the inherent likelihood of this occurring is very low. Moreover, the Constraints Planning and Field Development Procedure will further minimise the area of breeding habitat that is disturbed.</p> <p>Any breeding habitat within the OHTL footprint that is confirmed as being in use by Gouldian Finches will be avoided, buffered by 200 m, and disturbance will only commence once breeding has finished.</p>
Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent the species is likely to decline	<p>Given the large area of breeding and foraging habitat in the region, the clearing of such a small (and narrow) proportion of it for the Project is unlikely to result in a loss, or decrease in quality, of habitat to the extent that it will cause a decline in the species.</p>
Result in invasive species, that are harmful to the species, becoming established in the species' habitat	<p>Heavy grazing by cattle and horses, and habitat disturbance by Feral Pigs are the only threats to Gouldian Finches listed by TSSC (2016a) that relate to invasive fauna species. Activities associated with the construction and operation of the Project will not result in these threats manifesting.</p> <p>Although not considered in TSSC (2016a), proliferation of weeds could plausibly lead to a reduction of foraging grass species and/or a detrimental change in fire regimes. The Weed Management Plan presented in Appendix 5.3 has been developed to minimise introduction and proliferation of weeds within the project area of influence for the life of the Project.</p>
Introduce disease that may cause the species to decline	<p>Disease is not listed as a threatening process for Gouldian Finch. The author is not aware of any literature on diseases that could be introduced by the Project and that would detrimentally affect this species.</p>
Interfere with the recovery of a species	<p>The National Recovery Plan for Gouldian Finch (O'Malley 2006) contains a large number of conservation and management actions, none of which will be interfered with by development of the Project.</p>

8 IMPACTS TO GHOST BAT

8.1 Context provided by the NT EPA

The TOR required the proponent to outline measures for avoiding, mitigating, or offsetting impacts including impacts to the Ghost Bat (*Macroderma gigas*). Refer to submission on the Supplement from DEPWS and the submission on the Supplement from DCCEEW.

8.2 Additional information required by the NT EPA

1. Address DCCEEW comments #9 and #10.
2. Review, analyse and summarise available information on how the OHTL may affect Ghost bat behaviour.
3. Determine the distance from the cable at which the static magnetic field is likely to be indistinguishable from the background.
4. Subject to the findings of points 2 and 3 above – provide avoidance/ mitigation approaches including discussion about the effectiveness and confidence in the measures and any residual significant impacts (and proposed offsets).
5. Demonstrate how the precautionary principle has been applied to the assessment of potential significant impacts and application of protection measures (Part 2 of the EP Act).

8.3 Response

8.3.1 Direct disturbance

The preferred OHTL route presented in the SEIS (see Figure 2-18 in Chapter 2) traverses approximately 395 m away from the known Ghost Bat adit, referred to as the Kohoonir adit. Given that towers are placed >400 m apart, the nearest tower to the adit will be about 600 m away. In addition, a buffer of at least 250 m around the adit will be designated as a ‘no-go zone’ for all personnel working on OHTL construction, to ensure no direct disturbance of the adit by machinery or personnel.

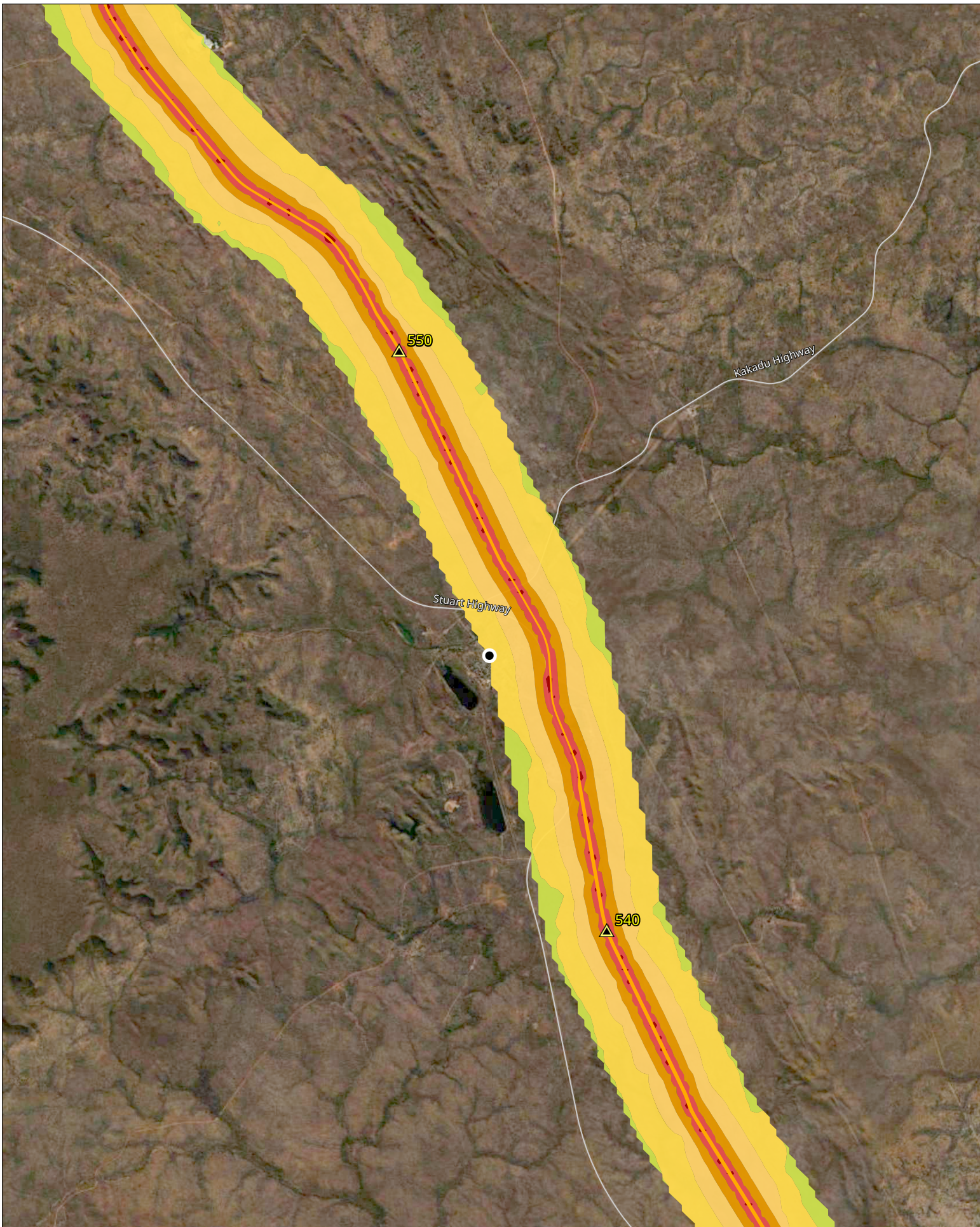
8.3.2 Sound and vibration

Both construction and operational noise modelling has been undertaken for the OHTL and the results relevant to the Pine Creek area where the Kohinoor adit² is located are shown on Figure 11 and Figure 12.

The resultant construction noise contours indicate that sound pressure at the adit entrance will be between 50 and 55 dB, which is well below the best-practice threshold of 70 dB (Bat Call WA 2021). In addition, the use of helicopters for stringing the transmission lines is not required for the sections of the OHTL that are proximate to the Kohinoor adit. On this basis, none of the proposed construction activities are likely to affect the Ghost Bat.

Operational noise contours indicate that at the adit entrance, maximum worst-case sound pressure will be approximately 30 dB – see 0. At the powerlines, the sound pressure will be approximately 50 db. This is also well below the best-practice threshold of 70 dB.

² Note the adit location is not shown on the maps because it is sensitive to disturbance and should not be accessed.



Legend		
Kilometre Points	OHTL Daytime Construction Decibels	45-50
OHTL Corridor		50-55
Roads	30-35	55-60
	35-40	60-65
	40-45	65-70
		70-75



Figure 11. Map showing construction noise contours near Pine Creek

Project: Australia-Asia PowerLink		Reference #: AAPL_GNR_CTA_GEN_MAP_357	
0 0.5 1 1.5 2 2.5 Kilometres		Date: 23/10/2023	Figure: 1 of 1
Scale: 1:55,000	Datum: GDA2020	Revision: B	
Coordinate System: MGA53		A3	



Source: Earthstar Geographics, Northern Territory Government, Esri, HERE, Garmin, FAO, NOAA, USGS



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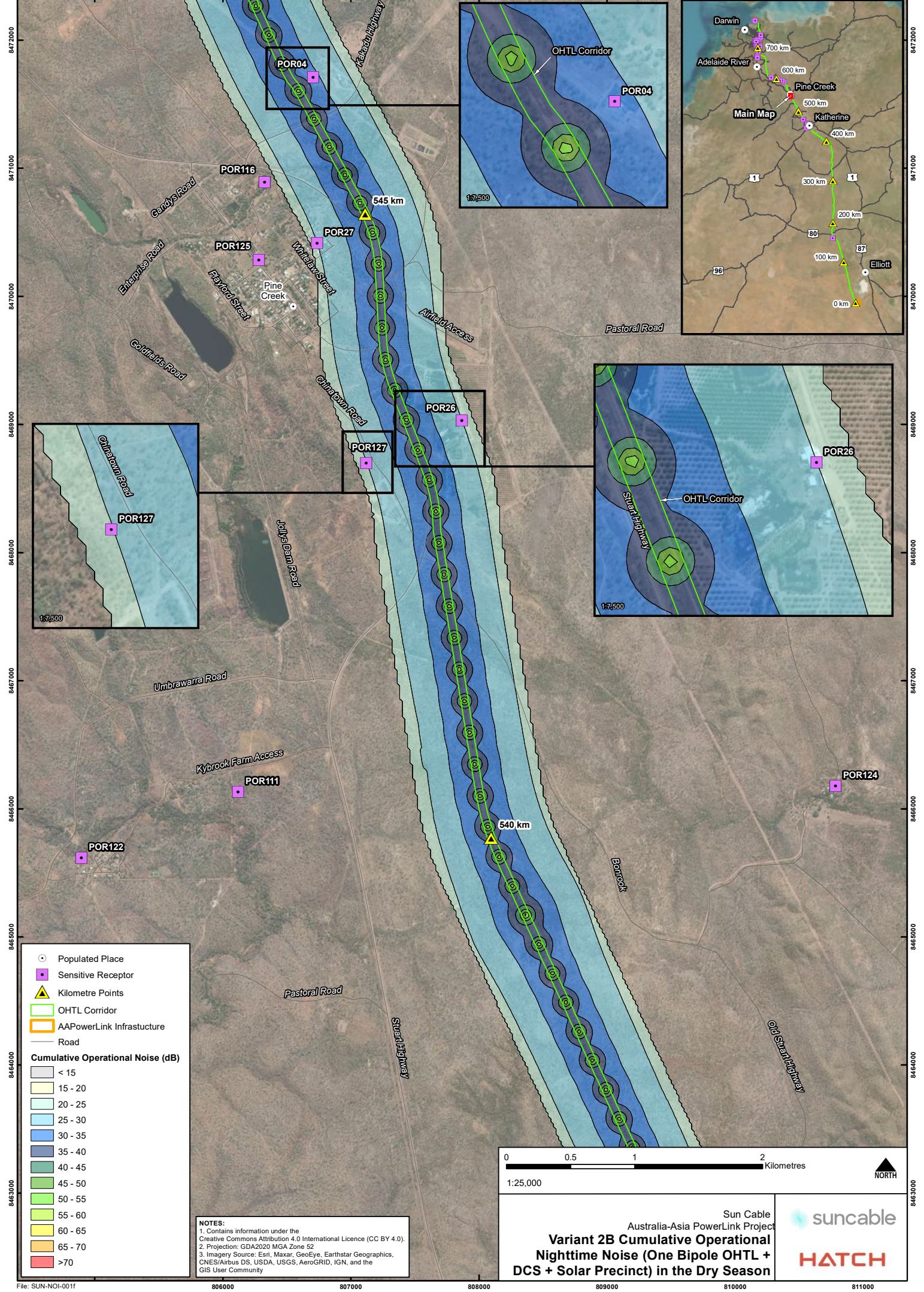


Figure 12. Map showing operational noise contours near Pine Creek

NOTES:
 1. Contains information under the Creative Commons Attribution 4.0 International License (CC BY 4.0).
 2. Projection: GDA2020 MGA Zone 52
 3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 0.5 1 2 Kilometres
 1:25,000
 NORTH

Sun Cable
 Australia-Asia PowerLink Project
**Variant 2B Cumulative Operational
 Nighttime Noise (One Bipole OHTL +
 DCS + Solar Precinct) in the Dry Season**

suncable
HATCH

8.3.3 Electric and magnetic fields

The AAPowerLink 525 kV High Voltage Direct Current (HVDC) powerlines will emit low-level static electric and magnetic fields (EMF). Static EMF are stationary fields that do not change over time; hence they do not have a frequency. These fields do not induce currents in conductors, but they can still interact with charged particles – such as electrons – causing them to move or become polarized. Static EMF does not produce any radiation or electromagnetic waves that could impact the Ghost Bat.

8.4.3.1 Static magnetic field

Static magnetic fields (SMF) arise naturally in the environment, such as the Earth's magnetic field which is caused by the motion of molten iron in the planet's core. SMF are measured in micro-Telsa (μT) – the Earth's SMF ranges between 23 μT (at the equator) and 66 μT (at the poles). According to the magnetic field calculator developed by the National Center for Environmental Information, at Pine Creek – where the Kohinoor adit is located – the SMF is 47 μT .

SMF can be artificially generated, including by the flow of DC in a conductor, hence they are emitted from DC powerlines. Table 8 shows the modelled strength of the SMF generated by the OHTL as measured over various distances. SMF is cumulative – at 50 m, the additional SMF emitted from the OHTL is 10 μT , meaning the cumulative SMF is 57 μT . This is within the Earth's SMF range and is a maximum of approximately 20% higher than the natural background magnetic field. By 200 m, the additional SMF is <1 μT , and the maximum SMF is less than 2% above background.

Table 8. Modelled strength of the SMF generated by the OHTL as measured over various distances

Distance	SMF (μT)	% of background
Directly below (ground level)	60 to 70	200
50 m	10	21
100 m	<5	<11
200 m	<1	<2

SMF are not identified as a potential threat to Ghost Bats in *either A Review of Ghost Bat Ecology, Threats and Survey Requirements* (Bat Call WA 2021 for DCCEE) or the Conservation Advice for the species (TSSC 2016b). Based on a review of relevant studies, there are two ways in which SMF could impact Ghost Bats – as discussed below:

- **Physiological.** It is known that SMF can penetrate living systems and directly interact with moving electric charges (e.g. ions) inside the body – even weak SMF (over relatively long exposures). However, a review of studies on the effect of this by Petri et al. (2017) indicated that it is unlikely that the reported effects of exposure to weak SMF (such as those generated by HVDC powerlines) pose a serious risk for health. That review found that eight of the eleven reviewed studies reported effects on mammals of exposure to weak SMF. However, even at exposures of 1000 μT over long time periods, it remained largely unclear from the interpretation of the results whether the reported effects in the evaluated studies were beneficial or detrimental for health.
- **Behaviour.** It is thought possible that strong SMF could impact fauna species who use magneto-reception for orientation or migration. Ghost Bats do not migrate; however, studies of some bat species strongly suggest that bats use magnetic compass for orientation (Wang et al. 2007). Whether this assumption can extend to the Ghost Bat is unknown. Applying the precautionary principle, it is assumed that the species uses magneto-reception.

The OHTL is, at its closest, approximately 395 m from the Kohinoor adit entrance. It is therefore assumed that because Ghost Bats will – at most – only briefly fly past the powerlines, they will not be close enough for

long enough to experience any physiological effects from the SMF of the OHTL. Moreover, studies to date have only shown that exposure to weak SMF can result in some physiological effects, and not that those effects have a negative impact on the receptor.

If Ghost Bats use magneto-reception for orientation, it is plausible that in the vicinity of the SMF – i.e. within 200 m of the OHTL – individuals could experience some degree of disorientation, which could result in a change in foraging behaviour. The likelihood of this being significant; however, is reduced by the fact that the strength of the SMF quickly dissipates to a level that is well within the range of the Earth's natural background SMF.

8.4.3.2 Static electric field

The Earth generates a natural background static electric field (SEF) of approximately 0.1 to 0.3 kV/m at ground level, depending on the season, weather, and any atmospheric charge (Bering III et al. 1998). An approaching storm can increase that up to 3 KV/m. SEF are emitted from DC powerlines. The modelled strength of the SEF generated by the OHTL is 20 Kv/m directly below the powerlines, decreasing rapidly to 1 Kv/m at 100 m from the powerline (i.e. similar to background).

Unlike SMF, SEF do not enter the body. However, they can cause effects on living organisms via changes in the distribution of electric charges on the surface of the body (WHO 2006). The perception of this is a superficial sensory stimulation of the hair and skin, dependant on the level of the SEF (Petri et al. 2017).

SEF are not identified as a potential threat to Ghost Bats in either Bat Call WA (2021) or TSSC (2016b). Based on a review of relevant studies, it seems that the only potential impact that SEF could have on Ghost Bats is on biological functioning.

Petri et al. (2017) carried out a systematic literature review of 40 fauna studies (mainly mice and rats) that documented the biological effects of long exposure to SEF. The review included experimental and epidemiological studies, of which 30 studies used SEF comparable to that of HVDC transmission lines at varying distances, and four studies investigated the effects of a HVDC transmission line or simulated environment. All exposures were for an hour or longer. The results indicated that whilst fauna is able to perceive an SEF on the bodies surface, there is strong evidence that fauna do not experience any adverse direct health impacts. Given these findings, and that the strength of the SEF from the OHTL dissipates very rapidly within a short distance of the powerlines, it is unlikely that SEF will have a significant impact on Ghost Bats.

8.3.4 Application of the precautionary principle

Under Section 19 of the EP Act, the precautionary principle should be applied such that:

If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

The information presented above provide a high level of certainty that the Ghost Bat will not be directly impacted, and that indirect impacts from noise and vibration are unlikely due to the distance between the Project activities and the Kohinoor adit.

Whilst there are no studies that assessed the impacts of EMF on Ghost Bats, the studies discussed above indicate that the only potential impacts of EMF will be in individuals that fly very close to the powerlines. These individuals may experience some mild discomfort and/or disorientation. This is unlikely to cause 'serious or irreversible' damage. On this basis, it is not considered that any additional measures are needed to protect the Ghost Bat.

9 IMPACTS TO CLEOME INSOLATA

9.1 Context provided by the NT EPA

The TOR required targeted surveys for *Cleome insolata* conducted in the appropriate fruiting/seeding season (i.e. March-April) (Supplement Direction, Table 2 item #5), However, surveys were conducted in the OHTL corridor (excluding NT Section 572, which is private land in Lambells Lagoon) in September 2021, and surveys of the DCS were conducted in February 2022. Refer to submission on the Supplement from DEPWS.

9.2 Additional information required by the NT EPA

1. Provide the outcome of seasonally appropriate field surveys to identify how many hectares of *Cleome insolata* known and suitable habitat would be cleared.
2. Identify the percentage of *Cleome insolata* habitat that will be cleared in relation to the local and regional *Cleome insolata* habitat and the area of suitable habitat available.
3. Identify a suitable buffer for species records.
4. Propose offsets for residual significant impacts (for habitat loss and removal of any plants).

9.3 Response

It is common for targeted surveys for threatened flora to be preceded by a survey assessing the suitability of habitat present. That assessment is undertaken by botanists experienced with the habitat requirements of the target species, who use a conservative approach to ensure that all potential habitat is identified for the targeted survey. For many species – including *Cleome insolata* – the habitat suitability assessment can be undertaken any time of the year.

There is no modelled habitat for *Cleome insolata*; however, it is a species that is closely-affiliated with sandsheet heath. As detailed in Section 4, all sandsheet heath patches within, or adjacent to, the OHTL in the NTG Utilities Corridor were assessed by EcOz botanist Anna Lemon (who has found new populations of *Cleome insolata* for other projects) and sandsheet heath flora expert Dr David Liddle. None of them were considered likely to support *Cleome insolata*. The only marginally-suitable habitat for *Cleome insolata* identified within the entire project footprint was a *Melaleuca* swamp in the DCS footprint. That swamp was surveyed at the appropriate time of the year (as per the *Northern Territory guidelines for targeted surveys of threatened and significant plant species* (Cuff et al. 2020), and the species was not detected.

As explained in the response to Item 5, the only part of the NTG Utilities Corridor not yet surveyed is Section 572. Applying the precautionary principle, the impact assessment has been prepared assuming that *Cleome insolata* is present within the entire length of sandsheet heath mapped (but not field-verified) by the NT Government (Hempel 2003) as being present within the NTG Utilities Corridor (Figure 7). This is ecologically unlikely, and therefore a very conservative assumption.

In Section 572, the NTG Utilities Corridor transects approximately 140 m of sandsheet heath, which is immediately adjacent to an approximately 160 m wide riparian corridor. As explained in Section 4, the OHTL can be designed and constructed such that gaps of up to 550 m can be left uncleared. That results in a 50 m buffer (at least) to the modelled *Cleome insolata* habitat within Section 572 – which is considered adequate for conserving a patch of this species. This situation becomes problematic if, as discussed in Section 5, both *Cleome insolata* and *Styloidium ensatum* are detected within Section 572. This is because suitable habitat for those species overlap each other, and the abovementioned riparian corridor. In such a worst-case scenario, the OHTL may have to be diverted outside of the NTG Utilities Corridor to avoid impacting threatened flora

species. As explained in Section 4.3.5, this is a possibility given the flexibility in mast arrangement; however, any changes in this regard will be discussed with the relevant stakeholders.

To avoid indirect impacts to this species associated with alterations to the local surface hydrology regime the same avoidance and mitigation measures proposed for high quality sandsheet heath patches – as discussed in the Section 4 above – will be applied. This involves placement of permanent disturbance footprints at least 100 m downstream or at least 250 m upstream of known occurrences (except if there is already disturbed land which can be used, in which case a buffer of at least 100 m will be applied), and re-instatement of the tower construction pads post-construction to minimise alteration of surface water flows.

The above measures are expected to provide for adequate protection of *Cleome insolata* should it occur in Section 572. While there is some uncertainty to be resolved, on balance it is unlikely that there will be significant impact to the species. Offsets would only be considered as the final option in the environmental management hierarchy if the species is found to be present, the occurrence cannot be spanned, and tenure cannot be secured to reroute around the occurrence.

10 IMPACTS TO MIGRATORY SHOREBIRDS

10.1 Context provided by the NT EPA

Item #8 of the DCCEEW submission on the EIS required scientific information and/or examples of successful intertidal habitat recovery and detail recovery timing.

Temporary disturbance of approximately 25 ha of important intertidal habitat for migratory shorebirds from construction of the Cable Transition Facility at Gunn Point Beach is likely to have significant impacts on migratory shorebirds.

10.2 Additional information required by the NT EPA

1. Provide scientific evidence/examples of successful intertidal habitat recovery and recovery timing to support the statement in the EIS that the method is successful.
2. Provide evidence for predicted recovery time for foraging habitat and prey abundance for migratory shorebirds following construction of the shore crossing.
3. Demonstrate that habitat and prey availability will recover in time for the following migratory shorebird peak period.

10.3 Response

10.3.1 Context

Disturbance footprint

The comments received from DCCEEW and DEPWS relating to impacts to migratory shorebirds are based, in part, on some misinterpretations of the information provided in the SEIS. For instance, as explained in the text below taken from the SEIS, the proposed Shore Crossing Site impact footprints is not 25 ha, but 1.9 ha:

...the Subsea Cabling Systems will be installed through Gunn Point Beach and into Shoal Bay. This will include the excavation of two trenches, one for each cable system, and consist of an approximate construction corridor footprint width of 63 m. The preferred configuration for each of the two cable systems is a Bipole with Metallic Return, which involves three cables laid parallel: Positive

pole (Pole 1), Negative pole (Pole 2) and a Metallic Return. Lateral spacing between the cables in each trench will be approximately 4 m, within an approximate trench width of 13.5 m. Based on this specification, and a beach width of up to 300 m (relative to tidal state), the total construction footprint is approximately 1.9 ha, within the identified shoreline crossing location of 25 ha as shown on Figure 2-3. While there may be some disturbance-related impacts from construction activities at the shoreline crossing location – i.e. aversion to the use of intertidal foraging area – no direct impacts to migratory shorebird species or their habitats are likely to occur outside of the 1.9 ha construction footprint.

The 500 x 500 m (25 ha) area presented in the SEIS is the maximum area within which some Project construction activity may occur in the inter-tidal area (e.g. machinery operating, temporary laydowns, spoil stock-piling etc).

At the beach, trenches will likely be dug with an excavator, cable installed, and the trenches backfilled to their previous surface condition. Within the intertidal area, trenches will likely be dug and backfilled once the cables are installed with a long reach excavator. These can be used until water depths of approximately 1 to 1.5 m.

Shorebird distribution

Comments received from DCCEEW and DEPWS suggest a misapprehension of the contrast between the importance of the broader North Darwin Shorebird Area (SBA), and the location of the shoreline crossing, which is shown in Figure 13 and explained in the following text taken from the SEIS:

While Gunn Point beach is identified as Important Habitat for a range of migratory shorebird species, it is the southern extent of the beach which is of the most importance as a critical high tide roosting location – the majority of the high counts of the species noted above have come from this location. A range of migratory shorebird species can be reasonably expected to utilise intertidal foraging habitat along the extent of Gunn Point Beach, where they will be seeking various types of invertebrate species within the sediment. Numbers of these shorebird species are likely to be dispersed along the intertidal parts of the complete beach extent at low tide, such that any individual species would be unlikely to occur within or in proximity to the shoreline crossing location in numbers exceeding its respective significance threshold.

The area surrounding the Project has high recreation use which also likely impacts on shorebird presence, as they would be regularly disturbed by recreational users when foraging or roosting (Palmer and Smit 2020). Observations during field investigations for Project Sea Dragon found few shorebirds using the intertidal zone along the adjacent beach, potentially due to a lower abundance of invertebrates due to coarse sandy substrates, and high levels of disturbance by vehicles, people and pets along the beach.

... Habitat for listed migratory shorebird species is limited to Gunn Point Beach and intertidal zone. Gunn Point Beach is accessible by vehicle and is subject to various types of chronic anthropogenic disturbance. The location of the shoreline crossing is also situated between two existing primary beach access points and approximately 2 km south of Gunn Point Beach campground, and as such is subject to heightened levels of disturbance than other parts of the beach.

The comments from DCCEEW and DEPWS indicate a perception that the location of Project works is a shorebird roost site, when it is actually only foraging habitat. As detailed in Section 5.12.1.12 of the SEIS, the intertidal areas of Gunn Point Beach and their immediate surrounds, which fall within the Shore Crossing Site, do not support what constitutes critical habitat for any threatened shorebird species according to the *Matters of National Environmental Significance Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (DOE 2013). Likewise, Section 11.3 of this document explains why the Shore Crossing Site and surrounds does not constitute important habitat for listed migratory shorebird species.

As explained above, it is the southern extent of Gunn Point Beach that is the nearest important roost site, and the proposed shoreline crossing location is situated approximately 6 km from that site. As such, any construction phase related disturbance impacts are unlikely to affect migratory shorebird behaviour at this location.

10.3.2 Timing

Since the SEIS, more detail has become available regarding the timing of cable laying. One cable system will be laid first and will be adequate for development of the first stages of the Project. The second cable system will not be laid for many years. Moreover, for each system the three cables will not be laid in the same season. Total cable laying time relevant to the Shore Crossing Site will be 10 to 14 weeks indicatively spaced in time such that:

- Pole 1 is laid year 1 over three weeks
- Metallic Return is laid year 3 over three weeks
- Pole 2 is laid year 5 over four weeks.

The SEIS identifies that all construction works within the shoreline crossing location can be scheduled and completed during the austral winter season – May through to August – when most shorebirds will be at their northern hemisphere breeding grounds. Notwithstanding that based on the information presented in this response, construction works can occur at any time of year without significantly impacting an ecologically significant proportion of any migratory-listed shorebird or listed-threatened migratory shorebird species, the Proponent commits to restricting works on Gunn Point Beach and intertidal area to that time frame.

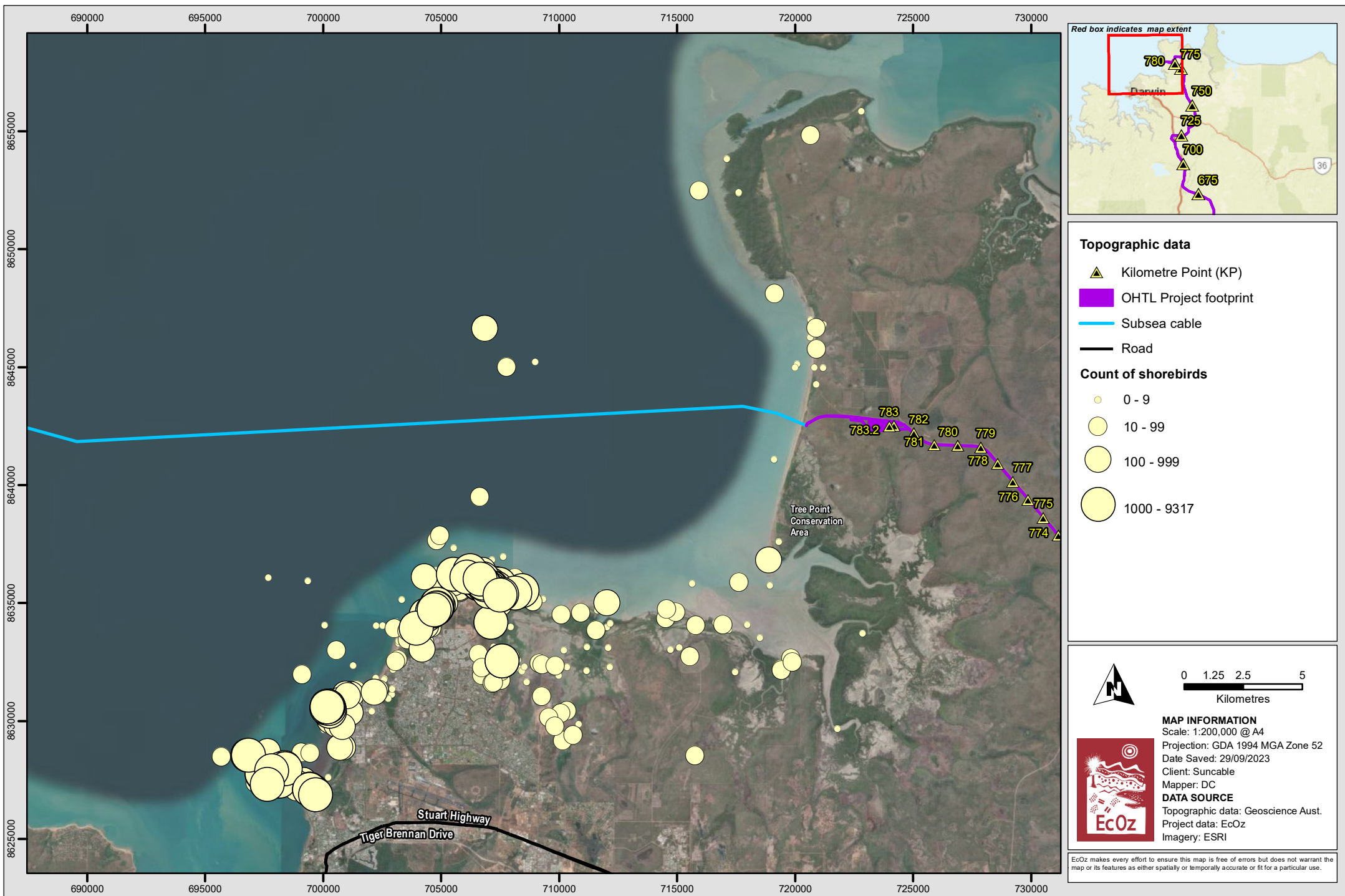
10.3.3 Recovery

Regarding disturbance to migratory shorebird intertidal foraging habitats and recovery timing, the SEIS explained the process as follows:

... Spoil from trench excavation will be stockpiled [side-cast] along the length of each trench alignment, and be reinstated on top of each cable system once installed. No fill from external sources will be used to reinstate excavated trenches in order to expedite the recovery of extant benthic and intertidal macroinvertebrates. Following the installation of the cable systems and reinstatement of excavated trench spoil, natural restoration of existing conditions is expected to occur relatively quickly, especially in those areas subject to routine tidal inundation. While it is anticipated that there will be an intertidal and beach infauna ecosystem recovery timeframe associated with excavation and reinstatement of the shoreline crossing cable system installation, areas subject to these actions are expected to be restored to pre-construction conditions largely via natural processes.

Coastal intertidal ecosystems are highly dynamic, constantly subject to dramatic fluctuations in environmental conditions as they transition between periods of exposure and submersion. Tidal cycling largely drives this dynamism, but it is also influenced by wave action and intensity, wind and sediment types. These influences are particularly strong in northern Australia due to the large tides, high rainfall events and propensity for cyclones. The various biota that reside in intertidal areas are well adapted to the constant predictable changes in conditions caused by tidal cycling, but are also able to respond to acute, more significant events such as storm surges, cyclones and flooding.

Intertidal macrofauna make up the majority of migratory shorebird species' diets. Infauna species inhabiting intertidal habitats are highly mobile, and in some cases migratory, responding to an array of environmental variables such as tidal conditions, temperature, salinity, and foraging resources.



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Figure 13. Map of shorebird records relevant to shore crossing site

The installation method of open trenching will cause temporary, localised disturbance to areas of intertidal beach and shallow nearshore seabed. This will primarily be in the form of a direct 'footprint' of disturbance caused by trenching, plant access areas and temporary side-cast stockpiling areas. Direct mortality of a range of subtidal, intertidal and supratidal infauna species is inevitable following removal of trench material. However, given that all excavated sediment from the proposed trenches will be side-cast and stockpiled in situ, the majority of individuals present within the excavated material are expected to emigrate to adjacent sediment strata according to their respective ecological requirements.

For marine intertidal soft sediment communities, some degree of physical habitat recovery or restatement is required before the subsequent recovery of the biotic assemblage (Dernie et al. 2003). The small footprint size and the linear nature of the proposed impact mean that upon reinstatement of excavated native trench spoil, adjacent undisturbed habitats will act as sources for recolonisation of the disturbed trench areas. Due to the existence of neighbouring infauna source populations, recovery rates within the impact footprint are envisaged to be relatively fast due to immigration facilitated by tidal cycling and wave-driven sediment transport.

Marine intertidal areas dominated by soft sediments are amenable to restoration following disturbance through a range of physical (e.g. wave action) and biological processes (e.g. bioturbation). This contrasts with other more stable biogenic habitats (such as coral reefs and seagrass beds), in which habitat recovery can take extensive periods of time (Hall-Spencer and Moore 2000; Peterson et al. 1987). The environmental stability provided by those habitat types allows organisms to attach themselves or to burrow into the substrate, meaning that the removal of any species may cause immediate and enduring impacts because the newly-cleared space must be actively colonised (e.g. Duran and Castilla 1989; Lasiak and Field 1995).

Sherman and Coull (1980) investigated the recovery response of meiofauna inhabiting an intertidal mudflat by hand-turning the sediment of a 9 m² area and monitoring the subsequent recolonization processes. The immediate impact of the disturbance was to remove more than 70 % of the infauna. However, after only one tidal cycle, total abundances of representatives of the infauna taxa were back to pre-disturbance density values.

Granulometry characteristics of intertidal environments provide insights into recovery timeframes. Less stable, clean sand-dominated intertidal systems have more rapid physical and biological recovery rates compared to intertidal systems dominated by finer silts or mud based largely on the mobility of the sediment (Dernie et al. 2003; Ferns et al. 2000; Schratzberger and Warwick 1999). The intertidal habitat of the shoreline crossing location are characterised by mainly sandy substrates.

Schoeman et al. (2000) note that manipulation of sandy beach communities is comparable to experimentation on planktonic assemblages: in both cases, the associated organisms live within their ambient medium (i.e. beach infauna within beach sediment strata, plankton within the water column). Disturbance to, or removal of, any part of these respective communities and their supporting medium results in the redistribution of remaining organisms (and/or medium). This was the observed effect of manual disturbance over an area of 200 m² of beach face. Subsequent to this disturbance, the rapid natural rearrangement of sediment – coupled with localised migratory cycles of resident infauna – would probably have obscured any evidence of biotic change within, at most, one semi-lunar cycle (i.e. approximately 15 days) (Schoeman et al. 2000).

Studies focusing on the impacts to intertidal infauna assemblages in response to applied disturbances that mimic anthropogenic activities – such as broad-scale manual and mechanical shellfish harvesting and dredging – have identified longer recovery timeframes. While these studies have largely been undertaken in intertidal mudflat habitats, they do identify a wide range of recovery timeframes relative to disturbance intensity – particularly excavation depth (Sherman and Coull 1980; Dernie et al. 2003; Dittmann et al. 1999; Hall and Harding 1997). Dernie et al. (2003) identified recovery timeframes from excavated 2 x 2 m plots to range from 64 to 208 days – noting that infaunal communities that are regularly subject to physical disturbances through exposure to wave action tend to recover quickly from disturbances because such assemblages are usually dominated by mobile species that are adapted to a highly dynamic environment

(Gorzelay and Nelson 1987). Such ecosystems therefore suffer few or short-lived negative effects in response to physical disturbances (Dernie et al. 2003). Investigating the effects of mechanical cockle harvesting, Hall and Harding (1997) found that infaunal structure in disturbed plots recovered (i.e. approached that of the un-disturbed controls) by 56 days post-disturbance. While high levels of mortality were observed in non-target benthic infauna immediately following disturbance, the recovery of disturbed sites was rapid and the overall effect on the local population was considered to be low (Hall and Harding 1997).

In summary, impacts to migratory shorebird species from the installation of the Subsea Cable System on Gunn Point Beach will be minimal because:

- The impacts will be acute, from both a spatial and temporal perspective. Only 1.5 % of available intertidal habitat will be temporarily disturbed.
- The extant environmental conditions will not change. The physical and chemical conditions of the current intertidal environment – such as sediment type, temperature, salinity, and oxygen levels – will not be altered in the long term by the temporary disturbance.
- The area that will be disturbed is already a dynamic environment to which the infaunal species present will have adapted.
- The reinstatement of all excavated materials will facilitate the recovery of the intertidal zone following completion of the works.
- Recovery timeframes for intertidal infauna to pre-disturbance levels are likely to be short-term (within two lunar cycles) following reinstatement of excavated, side-cast sediment.

The information presented in this response supports the conclusion reached in Chapter 5 of the SEIS that the Project is unlikely to have a significant impact on threatened shorebirds assessments. A significant impact assessment of Project activities on migratory shorebirds is presented in Section 11 of this response.

11 IMPACTS TO LISTED MIGRATORY SPECIES

11.1 Context provided by the NT EPA

The TOR (item #4.1.1) required that listed marine and/or migratory species need to be addressed. The appropriate guide for the assessment is the Listed Migratory Species criteria of the EPBC Significant Impact Guidelines (Significant Impact Guidelines 1.1). The migratory species that are also listed as threatened have not been assessed in line with the EPBC Significant Impact Guidelines – e.g. the Supplement included an assessment for threatened species of migratory shorebirds at Gunn Point but used the Vulnerable and Endangered impact criteria. An assessment against the migratory species criteria has not been provided.

11.2 Additional information required by the NT EPA

Provide an assessment of potential impacts on migratory species using the Listed Migratory Species significant impact criteria in the Significant Impact Guidelines 1.1.

11.3 Response

Significant impact assessments for relevant listed migratory species have been undertaken below in accordance with the *Matters of National Environmental Significance – Significant Impact Guidelines 1.1* (DoE 2013). It is noted that the guidelines state that the 'listed migratory species' significant impact criteria are only

relevant to migratory species that are not threatened (see page 12 of DoE 2013). Consequently, potential impacts to the migratory species that are also listed as threatened – including threatened migratory shorebirds – were appropriately assessed in the Draft EIS/SEIS using the ‘threatened species’ significant impact criteria, and therefore are not further assessed here.

The sections below focus on addressing the remaining information gap, which is to provide an assessment of potential impacts on non-threatened migratory species, using the listed migratory species significant impact criteria in the *Significant Impact Guidelines 1.1*. Potential impacts to these species were broadly considered in Section 15.5.2 of the SEIS (titled Marine and Migratory Species Populations) where it was concluded that the Project is unlikely to have a significant impact on any marine or migratory species. The sections below provide additional information to support that conclusion, by providing an assessment against the migratory species significant impact criteria for each group of marine migratory species that are known, or likely, to occur proximate to the AAPowerLink Project area.

11.3.1 Migratory species that are known or likely to occur proximate to the AAPowerLink Project

A Protected Matters Search Tool (PMST) report for the Subsea Cable System and Shore Crossing Site zone of influence (i.e. the disturbance footprint with a 5 km buffer applied) was presented in Appendix T – Marine Ecology Report – of the Draft EIS. The search identified 44 listed migratory species that are known, or likely, to occur proximate to the AAPowerLink Project as listed in Table 9.

Eighteen of the species are also listed as threatened. As explained above, potential impacts to those species are already assessed in the Draft EIS and SEIS. The likelihood of Project activities having a significant impact on any of the remaining 26 listed migratory species is assessed below.

Table 9. EPBC listed migratory species known, or likely, to occur proximate to AAPowerLink

Category	Common name	Scientific name	Threatened status
Dolphins	Australian Snubfin Dolphin	<i>Orcaella heinsohni</i>	-
	Indo-Pacific Humpback Dolphin	<i>Sousa chinensis</i>	-
	Spotted Bottlenose Dolphin	<i>Tursiops aduncus</i>	-
Dugong	Dugong	<i>Dugong dugon</i>	-
Manta rays	Giant Manta Ray	<i>Manta birostris</i>	-
	Reef Manta Ray	<i>Manta alfredi</i>	-
Marine reptiles	Flatback Turtle	<i>Natator depressus</i>	Vulnerable
	Green Turtle	<i>Chelonia mydas</i>	Vulnerable
	Hawksbill Turtle	<i>Eretmochelys imbricata</i>	Vulnerable
	Leatherback Turtle	<i>Dermochelys coriacea</i>	Endangered
	Loggerhead Turtle	<i>Caretta caretta</i>	Endangered
	Olive Ridley Turtle	<i>Lepidochelys olivacea</i>	Endangered
	Salt-water Crocodile	<i>Crocodylus porosus</i>	-
Other birds	Eastern Osprey	<i>Pandion haliaetus</i>	-
Sawfish	Dwarf Sawfish	<i>Pristis clavata</i>	Vulnerable
	Freshwater Sawfish	<i>Pristis pristis</i>	Vulnerable
	Green Sawfish	<i>Pristis zijsron</i>	Vulnerable
	Narrow Sawfish	<i>Anoxypristis cuspidate</i>	-
Seabirds	Brown Booby	<i>Sula leucogaster</i>	-
	Common Noddy	<i>Anous stolidus</i>	-
	Fork-tailed Swift	<i>Apus pacificus</i>	-
	Great Frigatebird	<i>Fregata minor</i>	-
	Lesser Frigatebird	<i>Fregata ariel</i>	-
	Red-footed Booby	<i>Sula sula</i>	-
	Streaked Shearwater	<i>Calonectris leucomelas</i>	-
	White-tailed Tropicbird	<i>Phaethon lepturus</i>	-
Sharks	Great White Shark	<i>Carcharodon carcharias</i>	Vulnerable
	Longfin Mako	<i>Isurus paucus</i>	-
	Oceanic Whitetip Shark	<i>Carcharhinus longimanus</i>	-
	Shortfin Mako	<i>Isurus oxyrinchus</i>	-
	Whale Shark	<i>Rhincodon typus</i>	Vulnerable
Shorebirds	Common Sandpiper	<i>Actitis hypoleucos</i>	-
	Curllew Sandpiper	<i>Calidris ferruginea</i>	Critically Endangered
	Far Eastern Curlew	<i>Numenius madagascariensis</i>	Critically Endangered
	Pectoral Sandpiper	<i>Calidris melanotos</i>	-
	Red Knot	<i>Calidris canutus</i>	Endangered
	Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	-
Whales	Blue Whale	<i>Balaenoptera musculus</i>	Endangered
	Bryde's Whale	<i>Balaenoptera edeni</i>	-
	Fin Whale	<i>Balaenoptera physalus</i>	Vulnerable
	Humpback Whale	<i>Megaptera novaeangliae</i>	Vulnerable
	Killer Whale	<i>Orcinus orca</i>	-
	Sei Whale	<i>Balaenoptera borealis</i>	Vulnerable
	Sperm Whale	<i>Physeter macrocephalus</i>	-

11.3.2 Significant impact assessment criteria for migratory species

In accordance with the MNES Significant Impact Guidelines (DoE 2013), an action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of *important habitat* for a migratory species
- Result in an invasive species that is harmful to the migratory species becoming established in an area of *important habitat* for the migratory species, or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an *ecologically-significant proportion* of the population of a migratory species.

Important habitat for a migratory species is:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
- Habitat that is of critical importance to the species at particular life-cycle stages, and/or
- Habitat utilised by a migratory species which is at the limit of the species range, and/or
- Habitat within an area where the species is declining.

What constitutes an *ecologically-significant proportion* varies depending on the species' life cycles and population sizes. Factors include the species' population status, genetic distinctiveness and species-specific behavioural patterns.

A *population* means the entire population or any geographically-separate part of the population of any species, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries (including Australia).

The potential for significant impact to each of the marine migratory species which may occur proximate to the Subsea Cable System and Shore Crossing Site footprint is assessed below.

11.3.3 Relevant AAPowerLink activities

The Project description presented in the Draft EIS (refer Chapter 2 Section 2.8), and SEIS (refer Chapter 2 Section 2.6) describe the activities which will be undertaken in the marine environment, and which may interact with migratory species. The key Project activities – and associated potential impacts – described in those documents are listed again below for ease of reference.

Construction activities:

- Initially, three cables are proposed to be laid: Pole 1, Metallic Earth Return (MER) and Pole 2. An additional three cables may be laid at a later stage, though this will be some years away.
- The cables will be laid approximately 50 to 200 m apart. The cables will mostly be buried to depths of 0.5 to 3 m; however, there are only some locations where cable would be laid directly on seabed.
- The disturbance footprint for burial of each cable is approximately 12 m wide (i.e. narrow direct disturbance footprint).
- Where the seabed is soft, jet trenching is the preferred method of cable burial. Where the seabed is hard (e.g. rock), trenching may be achieved by mechanical trenching (via chain cutter). Some sandwave areas have been identified which may require removal via dredging (refer SEIS Chapter 2 Figure 2-15).

- Construction will be undertaken by progressively moving vessels, with cable laying vessels moving at a speed of approximately 500 m/hour along the route. Duration for cable burial activities will vary according to the protection methodology. If burying by jet trenching, this will be moving at a speed of approximately 200 m/hour. If chain cutting is used, this could be as slow as 50 m/hour.
- Construction of the Subsea Cable System will result in direct disturbance of the seabed and generation of noise and light, but cable-laying and burial ships will move continuously and so any disturbances will occur in an isolated area for a short period of time (days).
- The construction of the AAPowerLink is not expected to result in the introduction or establishment of invasive species. Measures will be implemented to avoid and mitigate the potential for the introduction of invasive species and marine pests, including adherence to the *Australian Biofouling Management Requirements* (DAWE 2022) and the *Australian Ballast Water Management Requirements* (DAWE 2020).

Operational activities

- There will be very little activity during operations. The cables will remain buried unless an issue is identified which requires repair, which is considered to be an extremely rare fault event. In this situation, the damaged section of cable will be lifted to the surface, repaired, or replaced and the cable reburied using the same methods as above.
- During operations, electric and magnetic fields (EMF) and heat may be generated by the cables, but this would be isolated to the area surrounding the cable and is not expected to impact habitat value for any marine species due to the scale of the potential impact (see Section 15)
- The MER is a redundancy cable in case there is an issue with Pole 1 or Pole 2. It will generally not be in use or generating current unless it is required because one of the other cables is no longer working.

Route

- The Subsea Cable System will commence at Murrumujuk, Gunn Point, and head west/north-west, crossing the edge of the Commonwealth Marine Area to the south of Rote Island (which is south-west of Timor). The Subsea Cable System crosses the North Marine Region and the North-West Marine Region, the Oceanic Shoals Marine Park area, and three Key Ecological Features; the carbonate bank and terrace system of the Van Diemen Rise, the pinnacles of the Bonaparte Basin and the carbonate banks and terrace system of the Sahul Shelf. Within these features, cables will be laid (up to 6 cables, with a 12 m wide direct disturbance footprint per cable).

11.3.4 Significant impact assessments

The sections below present a significant impact assessment using the 'listed migratory species' criteria in the *Significant Impact Guidelines 1.1* (DoE 2013) for each group of non-threatened marine migratory species which may occur proximate to the Cable Transition Facilities and Subsea Cable System.

Shorebirds

Table 9 lists three species of non-threatened migratory shorebirds – Common Sandpiper, Sharp-tailed Sandpiper and Pectoral Sandpiper. This section presents an evaluation for potential significant impacts to those species in accordance with the *Significant Impact Guidelines 1.1* (DoE 2013) and *EPBC Act Policy Statement 3.21 – Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DoEE 2017). This section should be read in conjunction with Section 16.4.2.1 of the Draft EIS.

Under *EPBC Act Policy Statement 3.21*, the following actions may constitute a significant impact on migratory shorebirds (Table 2):

- Loss (for example, clearing, infilling or draining) of *important habitat* for migratory shorebirds?
- Degradation of *important habitat* leading to a substantial reduction in migratory shorebirds using the site?
- Increased disturbance leading to substantial reduction in migratory shorebirds using *important habitat*?
- Direct mortality of birds leading to a substantial reduction in migratory shorebirds using *important habitat*?

Central to all of these is the presence of *important habitat*. Under *EPBC Act Policy Statement 3.21*, important habitats in Australia for migratory shorebirds include those that are recognised as nationally or internationally important. To determine if habitat for shorebirds is internationally important, the Ramsar Convention approach is used, where wetland habitats are regarded as internationally important if they regularly support:

- 1 % of the individuals in a population of one species or sub-species of waterbird, or
- A total abundance of at least 20,000 waterbirds.

Wetland habitats are regarded as nationally important if they regularly support:

- 0.1% of the flyway population of a single species of migratory shorebird, or
- 2,000 migratory shorebirds, or
- 15 migratory species.

As explained in Section 5.12.1.2 of the SEIS, the Shorebird Crossing Site is within the North Darwin Shore Bird Area (SBA) – a large area that includes northern Darwin, Shoal Bay and the coastline up to Gunn Point. Within North Darwin SBA there are sites that meet the criteria to be *important habitats* for migratory shorebirds because they support significant numbers of particular shorebird species. The nearest to the Shore Crossing Site is Tree Point which is more than 6 km to the south. A few shorebirds have been recording feeding in the vicinity of the Shore Crossing Site – likely due to lower abundance of invertebrates due to coarse sandy substrates, and high levels of disturbance by vehicles, people and pets along the beach. The Shore Crossing Site does not meet the criteria as an *important habitat* for migratory shorebirds, and so Project activities cannot have a significant impact on migratory shorebirds as per the criteria in *EPBC Act Policy Statement 3.21*.

Seabirds

Table 9 lists eight species of non-threatened migratory seabirds which may occur proximate to the Cable Transition Facilities and Subsea Cable System. These are the Red-footed Booby, Brown Booby, White-tailed Tropicbird, Streaked Shearwater, Great Frigatebird, Lesser Frigatebird, Fork-tailed Swift and Common Noddy.

Key information that has informed the significant impact assessment for these seabirds is as follows:

- The Red-footed Booby has an extensive distribution in tropic regions of the Indian, Pacific and Atlantic Oceans. It mainly breeds off the Queensland and WA coasts (Marchant and Higgins 1990), but has also been recorded breeding at Ashmore Reef, 80 km south of the Subsea Cable System (Burbidge and Fuller 1996).
- The Brown Booby occurs throughout tropical waters of all major oceans, and may occur around the NT coastline. The species breeds on islands and coastal areas, including Ashmore Reef (Marchant and Higgins 1990). The Brown Booby feeds in inshore waters (del Hoyo et al. 1992).
- The White-tailed Tropicbird, Streaked Shearwater, Great Frigatebird and Lesser Frigatebird all may occur throughout NT and Commonwealth waters, and have been identified as a conservation value

in the North-west and North marine regions (DCCEEW 2023). All except the Streaked Shearwater breed on Ashmore Reef; the Streaked Shearwater breeds on islands off Japan and Korea.

- The Fork-tailed Swift does not breed in Australia, but is known to occur seasonally throughout Australia and on offshore islands. The species feeds on insects and lives almost exclusively aerially (DCCEEW 2023).
- The Common Noddy is widespread in tropical and subtropical seas, and in Australia occurs mainly off the coast of Queensland and WA, and rarely off the NT coast (DCCEEW 2023). The species breed on islands and shoals.
- Apart from the Fork-tailed Swift, all of these species primarily feed on fish and/or cephalopods by dipping or gleaning items from the surface.

There is little opportunity for interactions between seabirds and Project activities. The Subsea Cable System does not pass close to any breeding habitat. The most disturbing activities associated with cable-laying occur on the ocean floor, which is not habitat for these species. Furthermore, at any one time – and for a short duration – an insignificant proportion of potential foraging habitat (i.e. the sea’s surface) will be disturbed by cable-laying activities, with negligible risk of surface water pollution.

For a project to have a significant impact assessment on a listed migratory species, there has to either be important habitat or an ecologically-significant proportion of the population of that species within the zone of influence (DoE 2013). The zone of influence contains neither. Assessed against the criteria in *Significant Impact Guidelines 1.1* (DoE 2013), Table 10 demonstrates that the AAPowerLink Project is unlikely to have a significant impact on seabirds, as described below.

Table 10. Significant impact assessment – non-threatened seabirds

Criterion	Criterion likely met?	Summary of impact assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of <i>important</i> habitat for a migratory species	No	No biologically important areas ³ (BIA's) for seabirds are crossed by the Subsea Cable System (DCCEEW 2022). BIA's are declared around Ashmore Reef for breeding and foraging for the Brown Booby, Red-footed Booby, Greater Frigatebird, Lesser Frigatebird and the White-tailed Tropicbird (DCCEEW 2022). These areas are not traversed by the Subsea Cable System, which crosses north of the BIA and is 22 km away at the closest point.
Result in an invasive species that is harmful to the migratory species becoming established in an area of <i>important</i> habitat for the migratory species	No	Moreover, habitat for these species within the Project's zone of influence is not <i>important habitat</i> because it does not support an ecologically-significant proportion of the population of these species (as explained below), is not of critical importance to these species at particular life-cycle stages, is not at the limit of these species' ranges, and is not within an area where these species are declining.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an <i>ecologically significant proportion</i> of the population of a migratory species	No	Apart from at breeding colonies, most of these seabirds only occur in small numbers at sea. The Streaked Shearwater and Common Noddy can feed in flocks, the location of which depends on where fish shoals are surfacing. These flocks, however, are small in proportion to the population of these species. Consequently, there are no ecologically significant proportions of the populations of any of these species within the Subsea Cable System route. Moreover, these highly mobile species would be able to

³ The Commonwealth marine bioregional planning program led to the identification and mapping of biologically important areas (BIA's) for Commonwealth protected species.

Criterion	Criterion likely met?	Summary of impact assessment
		avoid any minor disturbances caused by construction or operation of the Subsea Cable System without major disruption to breeding, feeding, migration or other behaviour.

Other birds

The Eastern Osprey (*Pandion cristatus* also known as *Pandion haliaetus*) is a medium-sized raptor with a concentrated distribution along the northern coastline of Australia and offshore islands – from south-western WA to south-eastern NSW), but also occurring along all mainland coastlines (DAWE 2020). The Eastern Osprey is a sedentary, breeding resident in the Darwin region (DoE 2015; McCrie and Noske 2015). The species requires extensive areas of open water (fresh, brackish or saline) for foraging (DAWE 2020).

The Commonwealth’s *Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act* (Department of the Environment 2015) provides guidance as to what would constitute a significant impact to the Eastern Osprey. The guidelines discuss *important habitat* for these species, but do not identify particular high value habitats – instead presenting all known habitats for the species. An assessment of important habitat for the Eastern Osprey is presented in Table 12, concluding that no such habitat is present within the zone of influence.

For a project to have a significant impact assessment on a listed migratory species, there has to either be important habitat or an ecologically-significant proportion of the population of that species within the zone of influence (DoE 2013). The zone of influence contains neither. Assessed against the criteria in *Significant Impact Guidelines 1.1* (DoE 2013), Table 12 demonstrates that the AAPowerLink Project is unlikely to have a significant impact on the Eastern Osprey.

Table 11. Significant impact assessment – Eastern Osprey

Criterion	Criterion likely met?	Summary of impact assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of <i>important habitat</i> for a migratory species	No	The Project’s zone of influence does not constitute <i>important habitat</i> for the Eastern Osprey because: <ul style="list-style-type: none"> • It does not support an ecologically-significant proportion of the population of this species (as explained below) • Tall nesting trees adjacent to the coast or large waterbodies are the only limited habitat resource that could be considered critical to this species, and these have not been identified as occurring within the Project footprint.
Result in an invasive species that is harmful to the migratory species becoming established in an area of <i>important habitat</i> for the migratory species	No	<ul style="list-style-type: none"> • Being a habitat-generalist, the habitat for this species within the zone of influence is not of critical importance to these species for any particular life-cycle stages. • The range of this species extends significantly beyond the zone of influence. • This species is listed as Least Concern in the NT and there is no indication that the Top End is an area within which this species is in decline.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an <i>ecologically significant proportion</i> of the population of a migratory species	No	The <i>Commonwealth’s Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act</i> (Department of the Environment 2015) identify an ecologically-significant proportion of the population of Eastern Osprey to be 24. Such a high number of this species is highly unlikely to occur within the Project’s zone of influence. Individuals may occur in the region, but these mobile species would be able to avoid any minor disturbances caused by construction or operation of the Project infrastructure without major disruption to breeding, feeding, migration or other behaviour.

Whales

Table 9 lists three species of non-threatened migratory whales which may occur proximate to the Subsea Cable System – Killer Whales (Orca), Bryde’s Whales and Sperm Whales. The Killer Whale is part of the dolphin family, but in this region has similar habitat, behaviour and biology to whales, and so is grouped with whales.

Key information which has informed the significant impact assessment for whales is as follows:

- The Subsea Cable System route does not cross any biologically important areas for foraging, provisioning of young, feeding and breeding for whales.
- Bryde’s Whales occur in temperate to tropical waters, both oceanic and inshore. The species has been recorded from all Australian states, except the Northern Territory (Bannister et al. 1996). No specific feeding or feeding grounds are known to occur in Australian waters (DCCEEW 2023). Bryde’s Whales are thought to be pelagic, occupying the upper layers of the ocean (Best et al. 1984). They are considered an opportunistic feeder on schooling fishes and crustaceans (DCCEEW 2023).
- Sperm Whales have been recorded in all Australian states. Females and young sperm whales are restricted to warmer waters, while older male whales travel to and from colder waters. However, they are generally known from around Albany in Western Australia, Kangaroo Island in South Australia, deep waters off Tasmania and areas off southern NSW. They generally occur in deep waters (>600 m) and feed mainly on cephalopods, but also fish, rays, sharks etc.
- Killer Whales are recorded from all states, with concentrations reported around Tasmania (DCCEEW 2023). The species may be seen in any marine waters, although they are most numerous in coastal waters and cooler regions where productivity is high. Killer Whales are top-order carnivores, and have a diverse diet including fish, birds and mammals (Saulitis et al. 2000).

Apart from boat operations, there is little opportunity for interactions between seabirds and Project activities. Activities associated with the AAPowerlink Project are not expected to disrupt the lifecycle of any of these species. Key threats to these species include collision with large vessels and disturbance by loud, unfamiliar noise. The ships used during cable laying will be large and slow-moving, which reduces the potential for a collision with a marine mammal. The generation of noise and light during construction will have a minor, spatially- and temporally-limited impact which, at worst, could deter whales from the construction area for a short time. Whales are mobile and can easily avoid the construction footprint. The same habitat values are likely to be provided by the surrounding (and large) region of unimpacted ocean.

For a project to have a significant impact assessment on a listed migratory species, there has to either be important habitat or an ecologically-significant proportion of the population of that species within the zone of influence (DoE 2013). The zone of influence contains neither. Assessed against the criteria in *Significant Impact Guidelines 1.1* (DoE 2013), Table 12 demonstrates that the AAPowerLink Project is unlikely to have a significant impact on migratory whales.

Table 12. Significant impact assessment – non-threatened whales

Criterion	Criterion likely met?	Summary of impact assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of <i>important habitat</i> for a migratory species	No	All three species have the potential to occur within the north and north-western marine regions; however, their habitat is broad, and includes large areas of Australian and international marine waters. The Project zone of influence does not contain BIA’s for these three whale species (DCCEEW 2022), nor is their general habitat restricted to the Project zone of influence.
Result in an invasive species that is harmful to the migratory species	No	Habitat for these species within the Project’s zone of influence is not <i>important habitat</i> because it does not support an

Criterion	Criterion likely met?	Summary of impact assessment
becoming established in an area of <i>important habitat</i> for the migratory species		ecologically-significant proportion of the population of these species (as explained below), is not of critical importance to these species at particular life-cycle stages, is not at the limit of these species' ranges, and is not within an area where these species are declining.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an <i>ecologically significant proportion</i> of the population of a migratory species	No	No ecologically significant proportions of a population of these whale species have been identified as likely to be within, or proximate to, this Project's zone of influence. Individuals may occur in the region, but these mobile species would be able to avoid any minor disturbances caused by construction or operation of the Subsea Cable System without major disruption to breeding, feeding, migration or other behaviour.

Dolphins

Table 9 lists three species non-threatened migratory dolphins which may occur proximate to the Cable transition Facilities and Subsea Cable System – the Australian Humpback, Australian Snubfin and Spotted Bottlenose Dolphin. These dolphin species occur in the Darwin region and have been recorded around the Gunn Point peninsula (Palmer and Smit 2020).

Key information which has informed the significant impact assessment for dolphins is as follows:

- Dolphin surveys were undertaken throughout Darwin Harbour, Shoal Bay and Bynoe Harbour between 2011 and 2019 (Griffiths et al. 2020). The results highlighted the small, mobile and variable nature of coastal dolphin populations in the Darwin region. All three species have been shown to occur at low densities in Shoal Bay and the Gunn Point Peninsula area, exhibit substantial temporary emigration and have fluctuating population size. Humpback Dolphins were the most commonly observed dolphin species (up to 107 individuals recorded), while Bottlenose and Snubfin Dolphins were observed in smaller numbers (maximum of 41 and 67 individuals respectively).
- The Australian Snubfin Dolphin inhabits shallow coastal waters and estuaries, and appear to occur in isolated populations. The species feeds on fish in a variety of habitats – including mangroves, sandy bottomed estuaries and embayments, and reefs (DCCEEW 2023). Data on diet are limited, but the species has been described as an opportunistic generalist feeder.
- The Australian Humpback Dolphin occurs along the northern coastline of Australia and is generally recorded within 10 km of the coastline, and in waters less than 15 to 20 m deep (Parra & Cagnazzi 2016). The species is an opportunistic-generalist feeders, preying on a variety of bottom-dwelling and pelagic fish, in a wide range of inshore-estuarine coastal habitats (Parra & Cagnazzi 2016).
- The Spotted Bottlenose Dolphin (Arafura/Timor Sea population) occurs in coastal waters off the NT and northern WA coast. Part of the genus Tursiops, there is currently controversy around the taxonomy and species of bottlenose dolphins in Australia, with little information on this species. In general, Bottlenose Dolphins inhabit tropical and sub-tropical coastal waters, and are restricted to inshore areas such as bays and estuaries, nearshore waters and shallow coastal areas – including around oceanic islands (DCCEEW 2023). The species feeds on a variety of fish and cephalopods.
- The population density of the three dolphin species in the Darwin region appears to be similar to average densities in Northern Territory coastal waters (Griffiths et al. 2020) – i.e. coastal dolphin populations in northern Australia typically occur at relatively low densities.

There is the potential for these dolphin species to be indirectly impacted by changes in coastal water quality from AAPowerLink Project activities. Sediment transport modelling undertaken for the EIS identified zones of influence where water quality may exceed the Darwin Harbour Water Quality Objective (turbidity of 10 NTU) due to disturbance of the seabed for cable laying and burial (see [Draft EIS Chapters 9 and 10](#)). The

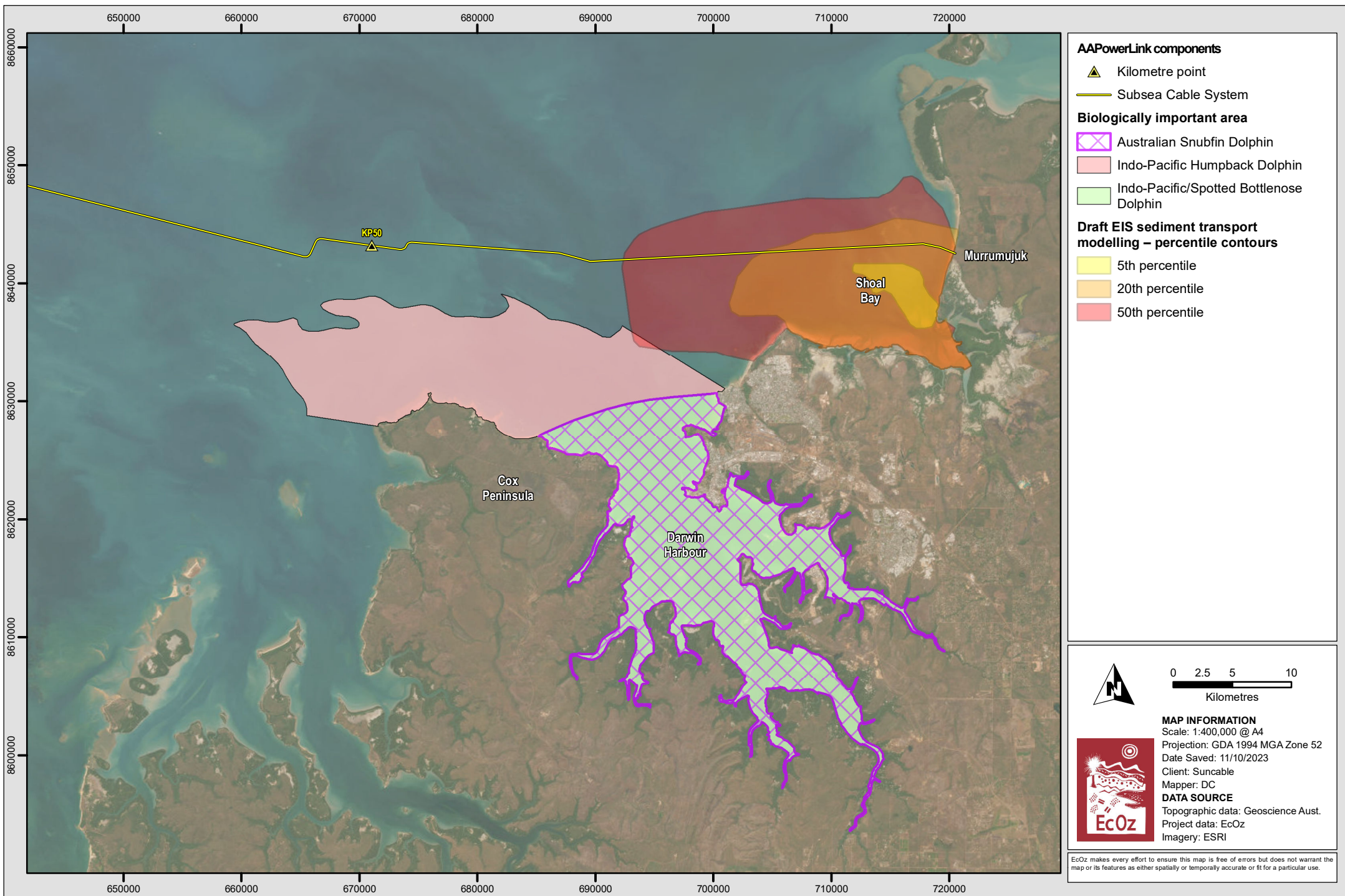
50th percentile contour (the area where there is a 50% chance of turbidity exceeding the Water Quality Objective) covers a small portion of the north-eastern section of the BIA (112 ha of the 60,073 ha BIA area, which equals <0.02%) for the Australian Humpback Dolphin. This is not considered a substantial modification of the important habitat for the Humpback Dolphin. The water quality will also be altered for a short period of time, during and immediately following cable laying, and will return to natural conditions within weeks of cable laying activities (see [Draft EIS Chapter 9](#)). The coastal waters of the Darwin Region, including Darwin Harbour and Shoal Bay, are naturally turbid and the dolphins would be adapted to short periods of elevated turbidity (e.g. as naturally occurs during the wet season and spring tides).

Inshore dolphins do not rely directly on habitat types within the Subsea Cable System's zone of influence. Their primary source of food is fish, and no impacts from construction or operation of the AAPowerLink are anticipated to impact on fish. Indirect impact pathways (e.g. noise and light) will occur for a short period of time during construction, outside of BIAs, and are not expected to impact on dolphins or their key food sources. Dolphins are mobile and can easily avoid the construction footprint. The same habitat values are likely to be provided by the surrounding (and large) region of unimpacted ocean.

Assessed against the criteria in Significant Impact Guidelines 1.1 (DoE 2013), Table 13 demonstrates that the AAPowerLink Project is unlikely to have a significant impact on migratory dolphins.

Table 13. Significant impact assessment – non-threatened dolphins

Criterion	Criterion likely met?	Summary of impact assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of <i>important habitat</i> for a migratory species	No	There are two BIA's for dolphins which are proximate to, but not intersected by, the Subsea Cable System (see Figure 14). Within Darwin Harbour, there is breeding and foraging habitat for the Spotted Bottlenose Dolphin, Australian Snubfin Dolphin and the Australian Humpback Dolphin. This BIA extends to the outer harbour and west of Darwin Harbour (around Cox Peninsula) for the Australian Humpback Dolphin. However, there will be no direct impacts to the BIA's due to construction and operation of the AAPowerLink. At the closest point, the Subsea Cable System route crosses approximately 3.8 km to the north of the northern-most point of the BIA for the Australian Humpback Dolphin. As discussed in the main text, indirect impacts to the BIA will be minimal in terms of extent and duration.
Result in an invasive species that is harmful to the migratory species becoming established in an area of <i>important habitat</i> for the migratory species	No	
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an <i>ecologically significant proportion</i> of the population of a migratory species	No	A nine-year monitoring program of dolphins in Darwin Harbour (Griffiths et al. 2020) found that the population density of the three dolphin species in the Darwin region appears to be similar to average densities in Northern Territory coastal waters. This suggests that the occurrences of these species in the vicinity of the Project zone of influence are not as ecologically significant proportions of those species' populations. Moreover, as discussed in the main text, indirect impacts to these local occurrences will be minimal in terms of extent and duration



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ23168 - Responding to NT EPA Direction to provide Additional Information\1. Project Files\2. Report Maps\Map of biologically important areas for dolphins.mxd

Figure 14. Biologically important areas for dolphins proximate to the Subsea Cable System

Dugong

The Dugong is a non-threatened migratory species which may occur proximate to the Cable transition Facilities and Subsea Cable System, particularly in Shoal Bay. Dugongs are marine herbivores; their main diet is seagrass, although they may occasionally eat macro-algae (Palmer and Smitt 2020; Whiting 2001). Apart from an isolated population at Ashmore Reef, Dugongs live in northern Australia's sheltered coastal waters. The NT waters support a large population of Dugongs, with recent aerial survey results used to estimate a population of 8,176 individuals (Groom et al. 2017). Dugongs are known to occur within Shoal Bay and around the Gunn Point Reef, with the population estimates for the Darwin - Gunn Point region varying between 1012 ± 384 (Bayliss 1986) and 243 ± 67 (Cardno 2013), but more likely at the higher end of that range (Whiting 2008).

Dugongs generally occur in waters up to 5 m deep (where seagrass commonly occurs), but can occur in deeper waters (e.g. up to 20 m deep). Dugongs are known to travel significant distances (e.g. over 900 km) and move between seagrass meadows, which fluctuate in size and density seasonally (Palmer and Smitt 2020).

There is the potential for the Dugong to be indirectly impacted by changes in coastal water quality from AAPowerLink Project activities. The construction of the Subsea Cable System will result in direct disturbance of a narrow footprint (12 m wide per cable), and temporary disturbance of sediments which in turn may result in short-term (weeks) impacts to water quality. This will not result in a substantial modification of habitat. Sediment transport modelling in Shoal Bay indicates water quality will return to baseline within three weeks of cable laying and burial (see [Chapter 9 of the Draft EIS](#)).

Dugongs feed on seagrass. Benthic habitat mapping for Shoal Bay indicates high likelihood of seagrass patches in Shoal Bay within the vicinity of the Subsea Cable System (Siwabessy et al. 2020). However, benthic video surveys undertaken along the nearshore portion of the Subsea Cable System route did not identify any seagrass at any of the survey locations. Macro-algae, which may also be a food source for dugong, was identified at eight of the survey sites, but was isolated and sparse. Seagrass is known to fluctuate in the Darwin region; the spatial extent and percentage cover of seagrass generally declines during the wet season, and recovers and expands during the dry season (Cardno 2014). This means that if seagrass did occur within or proximate to the Subsea Cable System, and was disturbed, it would be likely to regenerate, as it does so naturally from seasonal disturbances (e.g. increased turbidity and light attenuation, wind and waves during the wet season).

Dugongs breed at low rates. Females give birth underwater to a single calf at three-to-seven-year intervals (DCCEEW 2021). The area around the Subsea Cable System is not known as a key breeding area. Considering the timing of breeding (individuals breeding once every several years) and vast areas inhabited by Dugongs in the NT coastal waters, the construction of the Subsea Cable System is unlikely to impact on breeding.

Dugongs are known to migrate around the NT coastline, moving between seagrass beds. Therefore, if dugong were deterred from the area immediately surrounding the Subsea Cable System due to short-term construction disturbances (e.g. noise or shipping) they would likely move to other known seagrass beds without a significant impact on their lifecycle.

For a project to have a significant impact assessment on a listed migratory species, there has to either be important habitat or an ecologically-significant proportion of the population of that species within the zone of influence (DoE 2013). The zone of influence contains neither. Assessed against the criteria in *Significant Impact Guidelines 1.1* (DoE 2013), Table 14 demonstrates that the AAPowerLink Project is unlikely to have a significant impact on Dugongs.

Table 14. Significant impact assessment – Dugong

Criterion	Criterion likely met?	Summary of impact assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of <i>important habitat</i> for a migratory species	No	There are no BIA's for Dugongs which are crossed by, or proximate to, the Subsea Cable System. Dugongs are known to occur in Shoal Bay, and suitable habitat therefore occurs within, and proximate to, the Subsea Cable System's zone of influence. However, as explained below, that habitat is not <i>important habitat</i> because it does not support an ecologically-significant proportion of the Dugong population of the species, is not of critical importance to the species at particular life-cycle stages, is not at the limit of the species' range, and is not within an area where the species is declining.
Result in an invasive species that is harmful to the migratory species becoming established in an area of <i>important habitat</i> for the migratory species	No	
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an <i>ecologically significant proportion</i> of the population of a migratory species	No	A 2015 Dugong survey within 19 blocks that covered all NT waters estimated that the survey block relevant to Shoal Bay supported the third lowest abundance of Dugongs. This does not constitute an ecologically significant proportion of the Dugong population.

Marine reptiles

The Saltwater Crocodile is a non-threatened migratory species which may occur proximate to the Cable Transition Facilities and Subsea Cable System, particularly in Shoal Bay. The Saltwater Crocodile is common throughout coastal and inland waters of Northern Australia.

For a project to have a significant impact assessment on a listed migratory species, there has to either be important habitat or an ecologically-significant proportion of the population of that species within the zone of influence (DoE 2013). The zone of influence contains neither. Assessed against the criteria in *Significant Impact Guidelines 1.1* (DoE 2013), Table 15 demonstrates that the AAPowerLink Project is unlikely to have a significant impact on the Saltwater Crocodile.

Table 15. Significant impact assessment – Saltwater Crocodile

Criterion	Criterion likely met?	Summary of impact assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of <i>important habitat</i> for a migratory species	No	There are no BIA's for the Saltwater Crocodile proximate to the Subsea Cable System. The Saltwater Crocodile is common across northern Australia and throughout NT coastal waters. Habitat for this species within the Project's zone of influence is not <i>important habitat</i> because it does not support an ecologically-significant proportion of the population of this species (as explained below), is not of critical importance to this species at particular life-cycle stages, is not at the limit of this species' ranges, and is not within an area where this species is declining.
Result in an invasive species that is harmful to the migratory species becoming established in an area of <i>important habitat</i> for the migratory species	No	
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an <i>ecologically significant proportion</i> of the population of a migratory species	No	The Subsea Cable System and surrounds are not known to support an ecologically significant proportion of the population of Saltwater Crocodiles. Preferred nesting habitat for the Saltwater Crocodile includes elevated, isolated freshwater swamps that do not experience the influence of tidal movements (Webb et al. 1987). None of this habitat occurs proximate to the Subsea Cable System and there are no known migratory paths that would be interrupted by the Subsea Cable System. Individual Saltwater Crocodiles may occur in the region, but these highly mobile species would be able to avoid any minor

Criterion	Criterion likely met?	Summary of impact assessment
		disturbances caused by construction or operation of the Subsea Cable System without major disruption to breeding, feeding, migration or other behaviour.

Sawfish

Table 9 lists one species of non-threatened migratory sawfish which may occur proximate to the Cable transition Facilities and Subsea Cable System – the Narrow Sawfish. This species has been recorded at the mouth of Buffalo Creek, in southern Shoal Bay. The Narrow Sawfish is a marine species which is found in inshore waters in depths of up to 40 m. Details of its ecology are not well known, but it is likely to spend most of its time on or near the bottom (benthic dwelling) in coastal waters and estuaries (Compagno et al. 2006). The Narrow Sawfish has a recorded distribution through the Indo-Pacific from the Red Sea, to Australia, and north to Japan and China. The species’ distribution in Australia is not well known, but it is most common in the Gulf of Carpentaria (Compagno et al. 2006, Last and Steven 2009, DCCEE 2023).

For a project to have a significant impact assessment on a listed migratory species, there has to either be important habitat or an ecologically-significant proportion of the population of that species within the zone of influence (DoE 2013). The zone of influence contains neither. Assessed against the criteria in *Significant Impact Guidelines 1.1* (DoE 2013), Table 16 demonstrates that the AAPowerLink Project is unlikely to have a significant impact on the Narrow Sawfish.

Table 16. Significant impact assessment – non-threatened sawfish

Criterion	Criterion likely met?	Summary of impact assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of <i>important habitat</i> for a migratory species	No	The Project does not impact a BIA for this species. Moreover, habitat for this species within the Project’s zone of influence is not <i>important habitat</i> because it does not support an ecologically-significant proportion of the any population of the species (as explained below), is not of critical importance to this species at particular life-cycle stages, is not at the limit of this species’ very broad range, and is not within an area where this species is declining.
Result in an invasive species that is harmful to the migratory species becoming established in an area of <i>important habitat</i> for the migratory species	No	As discussed in the main text above for dolphins, indirect impacts to the nearshore habitat in Shoal Bay will be minimal in terms of extent and duration.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an <i>ecologically significant proportion</i> of the population of a migratory species	No	The Subsea Cable System and surrounds are not known to support an ecologically significant proportion of the population of Narrow Sawfish. Individual Narrow Sawfish may occur in the region, but these highly mobile species would be able to avoid any minor disturbances caused by construction or operation of the Subsea Cable System without major disruption to breeding, feeding, migration or other behaviour.

Sharks

Table 9 lists three species of non-threatened migratory sharks which may occur proximate to the Subsea Cable System – the Oceanic Whitetip Shark, Shortfin Mako and Longfin Mako. Key information which has informed the significant impact assessment for sharks is as follows:

- The Shortfin Mako occurs globally, inhabiting tropical and temperate waters. It primarily occurs in offshore, oceanic waters and is pelagic (Last and Stevens 2009). In Australia, Shortfin Mako are believed to breed offshore from the NSW coastline (Last and Stevens 2009). The diet of the Shortfin

Mako consists mainly of fish and cephalopods. The species is highly migratory, travelling large distances across oceans, and between continents (Rogers et al. 2009).

- The Longfin Mako co-inhabits much of the same range as the Shortfin Mako within Australian waters (Last and Stevens, 2009); however, it is less common and has a more tropical distribution (Last and Stevens 2009). It is a pelagic species that occurs principally in the upper zones on the ocean, but can be deep dwelling in offshore waters oceanic waters (Macbeth et al. 2008). As with the Shortfin Mako Shark, this species' diet main comprises fish and cephalopods (Last and Stevens 2009).
- The Oceanic Whitetip Shark may occur in NT and Commonwealth waters of Northern Australia, but is mostly known off the WA and Queensland coast (DCCEEW 2023). It occurs in oceanic waters, is pelagic, and is usually found far offshore in surface waters (but can dive to depths of over 1,000 m) (Bonfil et al. 2008, Tolotti et al. 2015, Weigmann 2016). As with the Mako Sharks, this species is a predator which feeds mainly on fish and cephalopods.

For a project to have a significant impact assessment on a listed migratory species, there has to either be important habitat or an ecologically-significant proportion of the population of that species within the zone of influence (DoE 2013). The zone of influence contains neither. Assessed against the criteria in *Significant Impact Guidelines 1.1* (DoE 2013), Table 17 demonstrates that the AAPowerLink Project is unlikely to have a significant impact on sharks.

Table 17. Significant impact assessment – non-threatened sharks

Criterion	Criterion likely met?	Summary of impact assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of <i>important habitat</i> for a migratory species	No	There are no BIAs for the Shortfin Mako, Longfin Mako or Oceanic Whitetip Shark within or proximate to the Subsea Cable System. The species inhabit oceans around the world and migrate long distances. The habitat for these species within the Project's zone of influence is not <i>important habitat</i> because it does not support an ecologically-significant proportion of the population of these species (as explained below), is not of critical importance to these species at particular life-cycle stages, is not at the limit of these species' ranges, and is not within an area where these species are declining.
Result in an invasive species that is harmful to the migratory species becoming established in an area of <i>important habitat</i> for the migratory species	No	
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an <i>ecologically significant proportion</i> of the population of a migratory species	No	The Subsea Cable System and surrounds are not known to support an ecologically significant proportion of the population of these shark species, nor are they known to breed in the region. Individuals may occur in the region, but these highly mobile species would be able to avoid any minor disturbances caused by construction or operation of the Subsea Cable System without major disruption to breeding, feeding, migration or other behaviour.

Manta rays

Table 9 lists two species of non-threatened migratory manta rays that may occur proximate to the Subsea Cable System – the Giant Manta Ray and the Reef Manta Ray. Both may occur around much of the Australian coast, in tropical and sub-tropical waters extending from south of Perth to approximately Sydney (DCCEEW 2023). Key information which has informed the significant impact assessment is as follows:

- The Reef Manta Ray is a large filter-feeding elasmobranch, reaching up to 5 m wide (Couturier et al. 2012). The species feeds mostly on plankton. The Reef Manta Ray aggregates in particular locations depending on the seasonal availability of food, ocean currents and temperatures, mating behaviour and cleaning station visitation (in shallow reefs). They are often present in shallow reefs and coastal

areas during the day, and move offshore to deeper water at night (Anderson et al. 2011; Clark, 2010; Couturier et al. 2011).

- The Giant Manta Ray is the largest species of ray in the world, growing up to 6.7 m wide. The species inhabits coastal and oceanic waters that experience regular upwelling along coastlines, oceanic islands, and offshore seamounts and pinnacles (Marshall et al. 2011). As with the Reef Manta Ray, the species feeds on plankton.

For a project to have a significant impact assessment on a listed migratory species, there has to either be important habitat or an ecologically-significant proportion of the population of that species within the zone of influence (DoE 2013). The zone of influence contains neither. Assessed against the criteria in *Significant Impact Guidelines 1.1* (DoE 2013), Table 18 demonstrates that the AAPowerLink Project is unlikely to have a significant impact on manta rays.

Table 18. Significant impact assessment – manta rays

Criterion	Criterion likely met?	Summary of impact assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of <i>important habitat</i> for a migratory species	No	There are no BIA's or known important breeding areas for these two manta ray species proximate to the Subsea Cable System. Individuals or small aggregations may occur in the region, but the habitat for these species within the Project's zone of influence is not <i>important habitat</i> because it does not support an ecologically-significant proportion of the population of these species (as explained below), is not of critical importance to these species at particular life-cycle stages, is not at the limit of these species' ranges, and is not within an area where these species are declining.
Result in an invasive species that is harmful to the migratory species becoming established in an area of <i>important habitat</i> for the migratory species	No	There are no BIA's or known important breeding areas for these two manta ray species proximate to the Subsea Cable System. Individuals or small aggregations may occur in the region, but the habitat for these species within the Project's zone of influence is not <i>important habitat</i> because it does not support an ecologically-significant proportion of the population of these species (as explained below), is not of critical importance to these species at particular life-cycle stages, is not at the limit of these species' ranges, and is not within an area where these species are declining.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an <i>ecologically significant proportion</i> of the population of a migratory species	No	For both species, the waters around the Subsea Cable System are not known to be a particular aggregation location (e.g. the Reef Manta Ray predictably aggregates at Lady Elliot Island and North Stradbroke Island off the Queensland coast, and Byron Bay off the NSW coast; Couturier et al. 2011). Consequently, ecologically significant proportions of the populations of either of these species are not likely to occur within the Project zone of influence. Individuals may occur in the region, but these highly mobile species would be able to avoid any minor disturbances caused by construction or operation of the Subsea Cable System without major disruption to breeding, feeding, migration or other behaviour.

12 IMPACTS TO COMMONWEALTH MARINE AREAS

12.1 Context provided by the NT EPA

DCCEEW comments on the EIS and the Supplement Direction required an assessment of avoidance, mitigation and monitoring of potential impacts to Key Ecological Features within and outside of the Oceanic Shoals Marine Park. The assessment has not been provided.

12.2 Additional information required by the NT EPA

1. Describe the values of the Oceanic Shoals Marine Park, in accordance with the *North Marine Parks Network Management Plan 2018*, that could potentially be affected by the proposed action.
2. Demonstrate the adequacy of proposed avoidance, mitigation and monitoring measures to reduce impacts to Marine Park values, including Key Ecological Features, to an acceptable level (i.e. not significant).

12.3 Response

12.3.1 Values of the Oceanic Shoals Marine Park

The values of the Oceanic Shoals Marine Park (OSMP) were previously described in Section 9.3.5.2 of Chapter 9 of the Draft EIS, Section 10.3.1.2 and 10.3.2.2 of Chapter 10 of the Draft EIS, and Appendix T of the Draft EIS, and reiterated in Chapter 9 of the Supplementary EIS. The values of the OSMP, as per the North Marine Parks Network Management Plan 2018 (DNP 2018), are described again below for ease of reference.

The North Marine Park Network includes several marine parks. The only marine park that will be intersected by the Subsea Cable System is the OSMP, which will be traversed by the Subsea Cable System from approximately KP274 to KP575 (see Figure 15). The values of the OSMP are described in Table 19 below and illustrated on Figure 15. For additional detail, refer to Appendix T of the Draft EIS – Marine Ecology Report.

The sections of the OSMP which are traversed by the Subsea Cable System are zoned Special Purpose Zone (Trawl) (IUCN VI) and Special Purpose Zone (IUCN VI) – see Figure 15. Structure and works activities including excavation and erection of structures (which will be undertaken to construct the Subsea Cable System) are allowable, subject to assessment and authorisation.

Table 19. Overview of the values of the Oceanic Shoals Marine Park and potential effects from the AAPowerLink

Values of the Oceanic Shoals Marine Park	Potential effects from Subsea Cable System
Natural values	
Bioregion The OSMP covers the North Marine Bioregion and North-west Marine Bioregion	The Subsea Cable System route will traverse both the North and the North-west Marine Bioregions. The route through these areas is shown in Figure 15.
Key Ecological Features (KEFs) There are three key ecological features within the OSMP. From east to west, these are: <ul style="list-style-type: none"> • Carbonate bank and terrace system of the Van Diemen Rise • Pinnacles of the Bonaparte Basin 	The Subsea Cable System route traverses all three KEFs in the OSMP. The location of the route in relation to the features is shown on Figure 17, and Table 20 provides details of the values that are present. Within the extent of these features, subsea cables will be laid, which will involve direct disturbance of the seabed,

Values of the Oceanic Shoals Marine Park	Potential effects from Subsea Cable System
<ul style="list-style-type: none"> Carbonate banks and terrace system of the Sahul Shelf 	noise and light emissions, and increased turbidity. These could have localised impacts on the KEFs. Section 12.3.4 below considers the potential impacts and adequacy of proposed avoidance, mitigation, and monitoring measures to reduce impacts to KEFs.
<p>Threatened and migratory species</p> <p>The North Marine Region is known for its high diversity of tropical species, but relatively low endemism (DSEWPC 2012). The region, including the OSMP, provides habitat for threatened and migratory species listed under the TPWC Act and/or EPBC Act.</p>	The occurrence of these species within or proximate to the Subsea Cable System route and potential impacts are further addressed in our response to Item 11 – see Section 11 below.
<p>Biologically important areas and critical habitat for marine turtles</p> <p>There are biologically important areas of foraging habitat for the Olive Ridley Turtle, Flatback Turtle and Loggerhead Turtle in the OSMP. Critical habitat for the Flatback Turtle occurs around the Northern Territory coastline, including the Darwin Region and around the Tiwi Islands; a small portion of this critical habitat is within the OSMP.</p>	The Subsea Cable System route traverses two biologically important areas and an area of critical habitat for marine turtles. The location of the route in relation to these areas is shown in Figure 15, and Table 20 provides details of the values that are present. Within these areas subsea cables will be laid, which will involve direct disturbance of the seabed, noise and light emissions, and increased turbidity. These could affect marine turtles if they are present at the time of construction. Section 12.3.4 below considers the potential impacts and the adequacy of proposed avoidance, mitigation, and monitoring measures to reduce impacts to marine turtles.
<p>Benthic habitats</p> <p>Benthic habitat modelling has been undertaken for the OSMP, with results presented in Figure 16 (based on Miller et al. 2016). Areas of higher benthic species richness generally correlate with shallower areas (e.g. banks and terraces), and benthic communities and habitats are related to geomorphic features and seascapes (e.g. depth and exposure to currents). Dominant benthic species include sponges, octocorals, polychaetes and amphipods .</p>	The benthic habitat values that occur along the Subsea Cable System route are described in Table 20. Laying and burial of the Subsea Cable System will result in the direct disturbance of benthic habitat within the cable footprint, which is 12 m wide per cable (with up to 6 cables laid). There is also potential for indirect impacts associated with increased turbidity and sediment deposition into areas surrounding the footprint. Section 12.3.4 below considers the potential impacts and the adequacy of proposed avoidance, mitigation, and monitoring measures to reduce impacts to benthic habitats.
Cultural values	
Aboriginal and Torres Strait Islander people have rights and responsibilities over sea country and continue to actively manage sea country. Within the OSMP, there are no declared Indigenous Protected Areas or Native Title Determinations.	No residual impacts to declared Indigenous Protected Areas or determined Native Title areas will occur within the OSMP. There will be temporary restrictions on marine traffic within proximity to the cable laying operations during construction, but no long-term limitation on the access or use of the area by Aboriginal and Torres Strait Islander people.
Heritage values	
Heritage includes World Heritage properties and National Heritage places, and places on the Commonwealth Heritage List or shipwrecks listed on the <i>Historic Shipwrecks Act 1976</i> . A Heritage Impact Assessment was undertaken for the Draft EIS. No heritage values or shipwrecks are known to occur within the OSMP proximate to the Subsea Cable System.	No known heritage values or shipwrecks occur within the OSMP proximate to the Subsea Cable System. Undetected archaeological features may occur, but have been identified as a low risk (see Appendix X of the Draft EIS). Any undetected features would be detected during the final route surveys that are undertaken to ensure the route is free from obstacles that would impact the cable lay and burial.
Social and economic values	
The North Network supports shipping, commercial fishing, marine tourism and other social and economic values. Values supported within the OSMP area proximate to the Subsea Cable System include Commonwealth fishing activities, Defence exercise areas and shipping movements.	Construction and operation of the Subsea Cable System will not restrict use of the area to the extent that social and economic values are impacted. Construction activities take place over a period of months and will be occurring in discrete locations each day with only small exclusion zones required around the cable laying

Values of the Oceanic Shoals Marine Park	Potential effects from Subsea Cable System
	vessels. Once the cable is laid and buried / protected, there is no requirement for exclusion or restrictions on any activities.

The natural values of the OSMP which will be traversed by the Subsea Cable System are further detailed in Table 20.

Table 20. Specifics regarding the values of the Oceanic Shoals Marine Park traversed by the Subsea Cable System

Section of Subsea Cable System	Key ecological features	Benthic habitat	Biologically important areas
KP 255-327 VDR1 to VDR2 Figure 16	This section crosses the southern tip of a carbonate terraces of the Van Diemen Rise ⁴ .	This section crosses a carbonate terrace which ranges between 55 and 65 m depth. Compared to other features in the Timor Sea, terraces at depths of 27 to 67 m have been found to support moderate epibenthic species richness, but low infaunal species richness.	Foraging habitat for the Olive Ridley Turtle (see Figure 15).
KP 327-452 VDR2 to OS2 on Figure 16	This section crosses the pinnacles of the Bonaparte Basin . It starts by steeply dipping from the Van Diemen Rise to the Bonaparte depression, and crosses banks and pinnacles, exceeding 10° slope in multiple locations. Being in a basin, the section is mostly greater than 90 m depth.	This section is mostly below the euphotic zone. It coincides with carbonate banks – recorded as having high biodiversity relative to other features at depths between 20 and 60 m. The features intersected by the Subsea Cable System are at depths below 90 m, reducing the likelihood of high biodiversity being present.	Foraging habitat for the Olive Ridley Turtle in the east, foraging habitat for the Olive Ridley, Loggerhead and Flatback Turtles.
KP 452-575 OS2 to OS3 on Figure 16	This section crosses the terraces associated with the Sahul Shelf ⁵ and intersects some banks/shoals . The terraces are ~90 to 100 m deep, the banks rise to 55 m. Roughly halfway through this section, the route rises from terraces to banks intersecting regular slopes exceeding 10°.	The key feature in the section is the banks/shoals rising up to 55 m depth. These features have been recorded as supporting high biodiversity relative to other features at depths up to 60 m because they provide the hardest substrates. The banks/shoals in this section are at the deeper end of those studied, reducing the likelihood of high biodiversity being present.	Foraging habitat for the Olive Ridley, Loggerhead and Flatback Turtles.

The carbonate banks and terrace system of the Sahul Shelf also intersect a small portion of critical habitat for Whale Sharks (as shown on Figure 15), from approximately KP 610 to 680. The values that the KEF provide are similar to those described in Table 20 (for KP 452 to 575), but potential impacts to Whale Sharks are not assessed herein because the critical habitat is not within the OSMP. Migratory species, including Whale Sharks, have been assessed separately – refer to Item 11.

⁴ Key ecological features are highlighted in **bold**.

⁵ From KP 575 – 665, and KP 677-682 the Subsea Cable System route is no longer within the OSMP but continues to traverse the carbonate banks and terrace system of the Sahul Shelf. The values within this area are similar to those between KP 452-575.

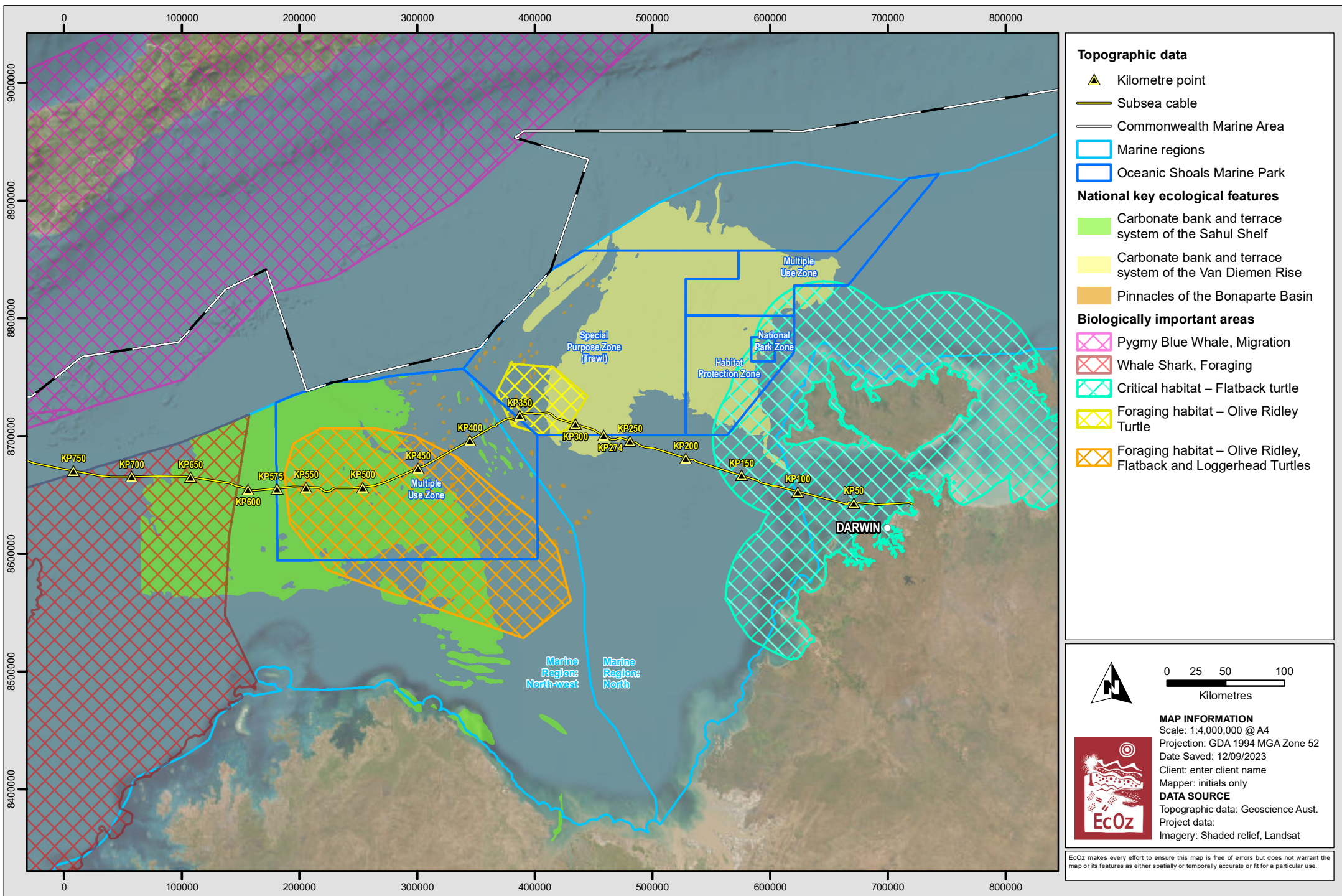
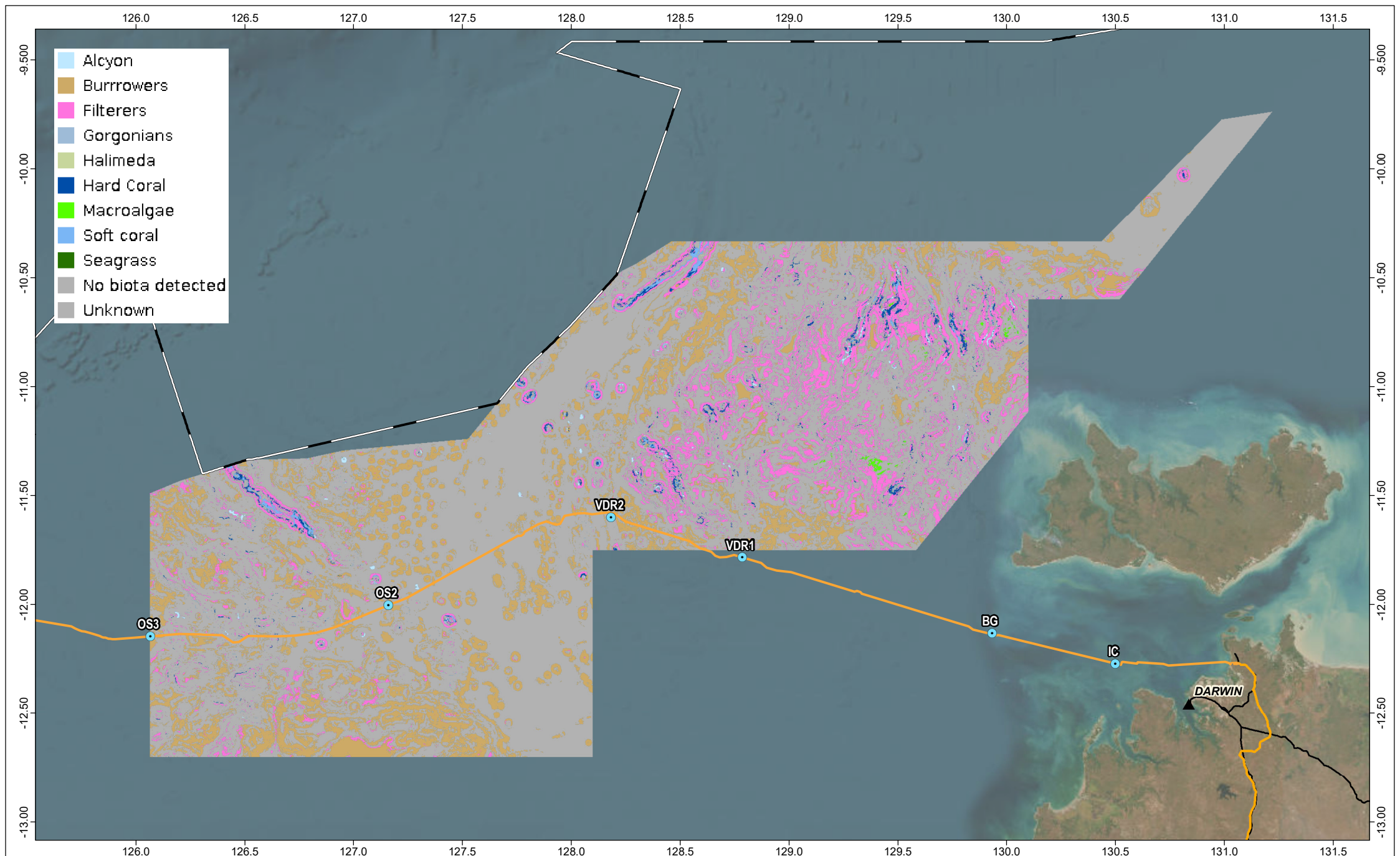


Figure 15. Map of Subsea Cable System route through Oceanic Shoals Marine Park



- Alcyon
- Burrowers
- Filterers
- Gorgonians
- Halimeda
- Hard Coral
- Macroalgae
- Soft coral
- Seagrass
- No biota detected
- Unknown

- Legend**
- AAPowerLink Infrastructure
 - Commonwealth Marine Area
 - Reference points used in the report

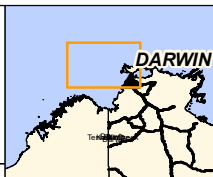


Figure 16: Map of predicted benthic habitats in Oceanic Shoals Marine Park

Project: **Australia-Asia PowerLink** Reference #: Document 203032 Revision: A

Coordinate System: GDA2020 Date: 11/11/2021

Scale: 1:2,408,307 A4

Source: NTG - Roads, Marine Communities, Artificial Reefs, WA Govt Data - Pipelines. Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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12.3.2 Activities to be undertaken within the Oceanic Shoals Marine Park

The sections below summarise the activities proposed to be undertaken within the OSMP; a summary of the impact assessment; and proposed impact avoidance, mitigation and monitoring measures. The adequacy of each measure is assessed in Table 4.

The Project description presented in Section 2.8 of Chapter 2 of the Draft EIS, and Section 2.6 of Chapter 2 of the Supplementary EIS describe the activities associated with the Subsea Cable System, including construction and operation. Key activities are listed again below for ease of reference.

Construction activities

- Initially, three cables are proposed to be laid: Pole 1, Metallic Earth Return (MER) and Pole 2. An additional three cables may be laid at a later stage, though this will be some years away.
- The cables are approximately 161 to 176 mm in diameter, and the MER is approximately 120 mm in diameter.
- The cables will be laid approximately 50 to 200 m apart.
- The cables will mostly be buried; however, there are only some locations where cable would be laid directly on seabed.
- Cable burial depths will be between 0.5 m and 3 m.
- The disturbance footprint for burial of each cable is approximately 12 m wide (i.e. narrow direct disturbance footprint).
- Where the seabed is soft, jet trenching is the preferred method of cable burial. Where jet trenching is the cable burial method, the sediment is fluidised with a water jetting tool and the cable sinks, resulting in burial under sediment.
- Where the seabed is hard (e.g. rock), trenching may be achieved by mechanical trenching (via chain cutter). Where a chain cutter is used, the trench will be cut and the cable laid in the trench, but it will not be actively backfilled (rather the trench will be allowed to fill naturally with marine sediment over time). The cable being laid in an open trench is considered sufficient protection as it is placed below the threat line of most hazards (e.g. fishing, etc).
- Some sandwave areas have been identified which may require removal via dredging; none are within the OSMP.
- Construction will be undertaken by progressively moving vessels, with cable laying vessels moving at a speed of approximately 500m/hour along the route. Therefore, impacts from cable laying within any particular location will occur over hours to days. The total duration to lay within the OSMP is expected to take approximately 30 – 40 days per cable, excluding time for transits, cable loading activities, weather and equipment downtime.
- Cable burial will be achieved using different vessels to the cable laying vessel (the gap between the two vessels could be days to weeks). The duration for cable burial activities will vary according to the protection methodology. If burying by jet trenching, this will be moving at a speed of approximately 200 m/hour. If chain cutting is used, this could be as slow as 50 m/hour. Assuming 85% of the route could be protected by jet trenching and the remainder with chain cutting, this would take approximately 115 days per cable for protection activities within the OSMP, excluding time for transits, weather and equipment downtime.

Operational activities

- There will be very little activity during operations. The cables will remain buried unless an issue is identified which requires repair. In this situation, the damaged section of cable will be exposed, lifted to the surface, repaired, or replaced and the cable reburied using the same methods as above.
- The MER is a redundancy cable in case there is an issue with Pole 1 or Pole 2. It will generally not be in use or generating current unless it is required because one of the other cables is no longer working.

12.3.3 Potential impacts

The impact assessment presented in Appendix E of the Draft EIS and discussed in Chapter 9 (Marine Environmental Quality) and Chapter 10 (Marine Ecosystems) of the Draft EIS, identified and assessed the potential impacts associated with the construction and operation of the Subsea Cable System. These impacts were reassessed and presented in Chapters 8 and 9 of the SEIS. For ease of reference, the impacts that have potential to occur within the OSMP are summarised below.

Habitat loss and degradation

Direct loss of benthic habitat within the Subsea Cable System construction footprint will occur (12 m wide per cable, for a length of approximately 300 km through the OSMP). The direct disturbance footprint of the Subsea Cable System is provided in Table 21 for the KEFs and biologically important areas within the OSMP. The impact of removal of benthic habitat within the Subsea Cable System footprint was rated Minor due to the narrow footprint (12 m wide per cable) and the fact that most of the substrate that will be disturbed is bare sediment.

Direct loss of benthic habitat that has recolonised the cable footprint post-burial will occur if cable repairs are required. This impact was assessed as Minor in Section 9.4.3.1 of the Draft EIS Chapter 9, due the highly localised impact that would occur during cable repairs.

Spills of fuels or hazardous chemicals

Spills from ships impacting marine water quality was assessed in Section 9.4.2.4 of the Draft EIS Chapter 9. The potential for this to impact marine fauna was assessed in Section 10.4.2.4 of Chapter 10 of the Draft EIS and was found to be Minor, because standard controls will minimise the likelihood of a spill and ensure that any minor spills which do occur are promptly detected, contained and cleaned up.

Introduction of marine pests

Introduction of marine pests is addressed in Section 10.4.2.5 of Chapter 10 of the Draft EIS and was found to be Minor, because industry standards and guidelines will be followed which minimise the potential for marine pest introduction.

Direct fauna mortality/collision with vessels

Direct fauna mortality/collision with vessels was assessed in Section 10.4.2.6 of Chapter 10 of the Draft EIS and was found to be Minor because the vessels will travel slowly and will only be operating in an isolated area.

Impacts to threatened and migratory species from the above impacts were assessed in Section 16.3.2.2 and 16.4.2.2 of Chapter 16 of the Draft EIS. Impacts to the Commonwealth marine area were assessed in Section 16.5.2 of Chapter 16 of the Draft EIS.

Changes to fauna behaviour

Changes to fauna behaviour due to noise and light during construction (see Section 10.4.23 of Chapter 10 of the Draft EIS) were assessed as Minor, because standard controls will be implemented to minimise impacts and the construction activities will only occur in one particular area for a short duration, as the vessels will continuously move.

Increased turbidity in marine waters

Increased turbidity and suspended sediment concentration in marine waters due to cable burial. This was modelled – see Appendix R of the Draft EIS – and is considered negligible in the offshore environment, including the OSMP, due to the sediment types, hydrodynamics and water depth). The modelling results are presented in Section 9.4.2.1 of the Draft EIS Chapter 9 and the potential for habitat degradation was assessed in Section 10.4.2.2 of Chapter 10 of the Draft EIS and was found to be Minor.

Temperature increases around cables

Localised temperature increase around the cables during operation will be negligible because temperatures are anticipated to return to ambient within 20 cm – 1 m of the cable, depending on burial depth and sediment type. The information supporting this conclusion is provided in Section 9.4.3.1 of the Draft EIS Chapter 9. The potential for temperature increases to impact fauna behaviours was assessed in Section 10.4.3.2 of Chapter 10 of the Draft EIS and was found to be Minor.

Electromagnetic fields

There will be localised EMF around the cables during operation. The potential for EMF to impact fauna behaviours was assessed in Section 10.4.3.2 of Chapter 10 of the Draft EIS, and was found to be Minor due to the localised area that may be influenced by EMF in relation to the broader marine region. This matter is further addressed in our response to Item 15 (see Section 15 below).

Impacts to undetected heritage features

The potential for impacts to undetected heritage was assessed in Section 14.4.4.3 of the Draft EIS and was found to be Minor, because heritage assessment determined there is a low risk of undetected heritage occurring within the marine environment, particularly in offshore areas such as the OSMP.

Table 21. Subsea Cable System direct disturbance footprint through key ecological features and biologically important areas of the Oceanic Shoals Marine Park

Features	Total area (km ²)	Direct disturbance footprint (per cable) (km ²)	Total area disturbed (Phase 1 and 2 – total 6 cables) (km ²)	Percentage of feature disturbed (%)
Key ecological features				
Carbonate bank and terrace system of the Van Diemen Rise	31,278	0.817	4.9	0.016
Pinnacles of the Bonaparte Basin	530	0	0	0
Carbonate banks and terrace system of the Sahul Shelf	41,158	7.617	45.70	0.111
Biologically important areas				
Foraging habitat for the Olive Ridley Turtle	2,679	0.684	4.10	1.532
Foraging habitat for the Olive Ridley, Loggerhead and Flatback Turtle	27,262	1.740	10.44	0.383

12.3.4 Adequacy of proposed impact avoidance, mitigation and monitoring

For each of the potential impacts listed above, the avoidance, mitigation and monitoring measures that will be implemented to minimise impacts to the marine environment, including the values supported by the OSMP, are provided in Table 22 below. Note that only measures relevant to the OSMP are listed. Refer to Chapters 9 and 10 of the Draft EIS, and Chapters 8 and 9 of the SEIS, for a full list of proposed impact avoidance, mitigation and monitoring measures.

Table 22. Adequacy of impact avoidance, mitigation and monitoring measures

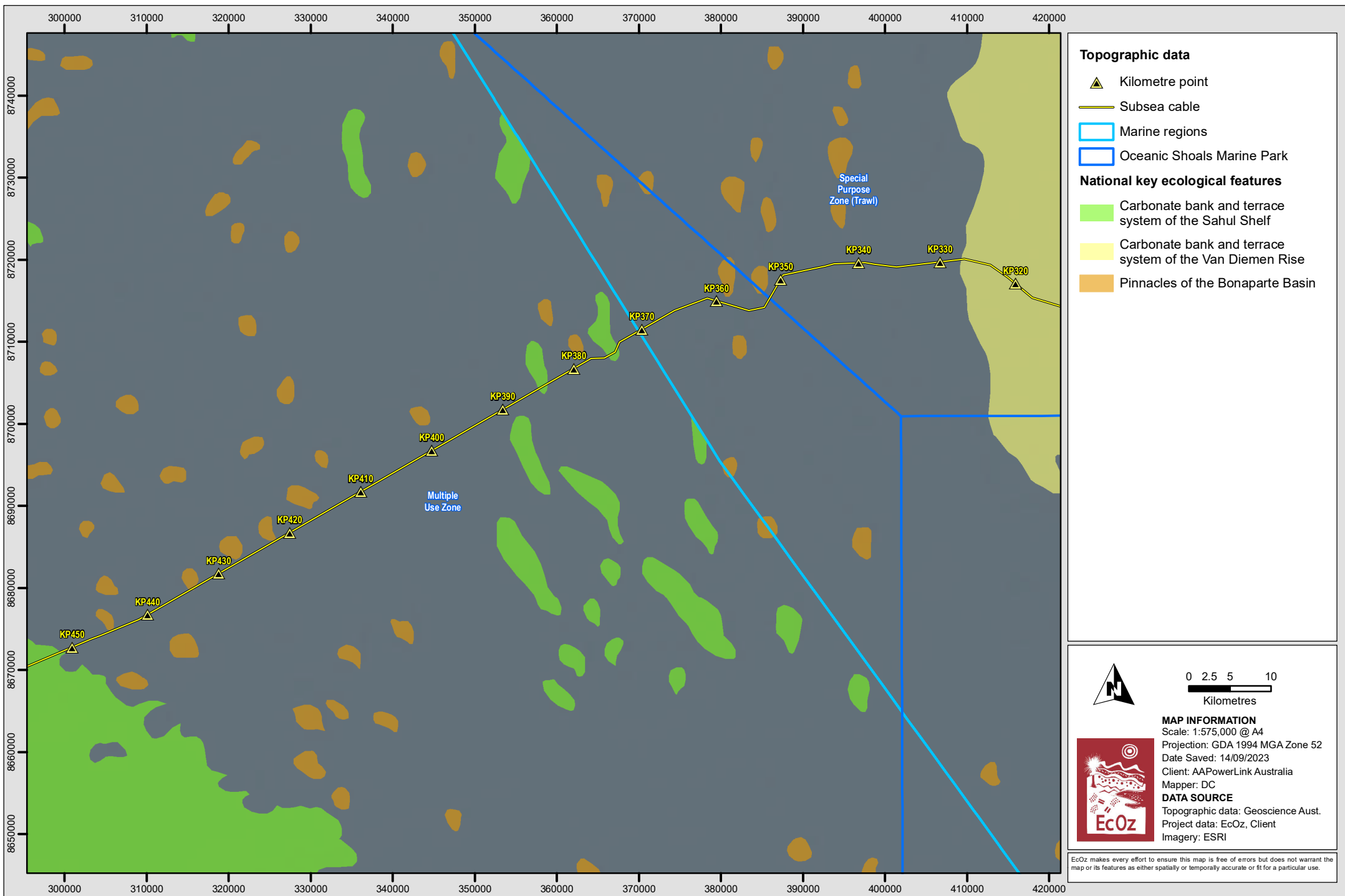
Impact	Avoidance	Mitigation	Monitoring	Adequacy
Habitat loss and degradation (including direct disturbance of benthic communities and habitat, and key ecological features)	The Subsea Cable System route avoids significant features along the seafloor as much as possible, including areas of higher habitat value (such as pinnacles of the Bonaparte Basin). This includes KEFs in the OSMP. See Figure 17 for an example of the Subsea Cable System route deviating around pinnacles of the Bonaparte Basin.	Design, install and operate Subsea Cable System in accordance with the <i>Guidelines on Best Environmental Practices in Cable Installation and Operation</i> (OSPAR 2012).	A post-burial survey will be undertaken to verify that the cable has been laid in the correct location and to the appropriate depth.	<p>Minimising the direct disturbance of key ecological features and the OSMP as much as possible is considered effective and adequate to avoid significant impacts to the park and supported values.</p> <p>As shown in Figure 17, the design of the cable footprint and route means that less than 0.1% of any KEF area will be disturbed. Disturbance of the Pinnacles of the Bonaparte Basin has been avoided completely, and less than 1.5 % of any biologically important area will be disturbed.</p> <p>Adherence to applicable best practice guidelines (including the OSPAR guidelines) is considered an effective and adequate mitigation measure.</p>
	The Subsea Cable System has been designed to only disturb a narrow footprint (12 m wide) per cable, avoiding direct disturbance of the seabed and supported values outside of this footprint.			
	If cable repairs are required, disturbance will be minimised through undertaking targeted repairs.			
Spills of fuels or hazardous chemicals impacting marine water quality, or marine ecosystems	Besides marine fuel oil, no HAZMAT materials will be used on vessels during construction.	Compliance with MARPOL requirements regarding refuelling and spill prevention.	In the event of a significant spill, water quality monitoring will be undertaken.	<p>Minimising the use and storage of hazardous chemicals, and adherence to Australian Standards and international standards (i.e. MARPOL) is proven to be effective in minimising the potential for a spill, and mitigating the impacts associated with a spill on the marine environment. These measures are expected to adequately protect the values of the OSMP from</p>
		An Environmental Emergency and Spill Response Plan will be in place and equipment		

Impact	Avoidance	Mitigation	Monitoring	Adequacy
		<p>provided at all storage and handling locations.</p> <p>Fuels and hazardous chemicals will be stored and handled in accordance with Australian standards and guidelines</p> <p>Construction and operations staff will be trained in spill response.</p>		spills.
Introduction of marine pests	Vessels will adhere to the <i>Australian Biofouling Management Requirements</i> (DAWE 2022), to avoid the introduction of marine pests.	Vessels will adhere to all relevant biosecurity requirements, including <i>Australian Ballast Water Management Requirements</i> (DAWE 2020).	<p>Vessels will be inspected and treated in accordance with requirements of the NT Aquatic Biosecurity Unit.</p> <p>Monitoring will be undertaken in accordance with the requirements of the <i>Australian Biofouling Management Requirements</i>, <i>Australian Ballast Water Management Requirements</i>, and other applicable guidelines.</p>	Adherence to the Australian and NT biosecurity guidelines and requirements is proven effective in avoiding the introduction of marine pests, including minimising potential associated impacts to the OSMF and supported values.
Direct fauna mortality/collision with vessels	No marine fauna will actively be approached by vessels.	<p>Adhere to the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (Cwth of Australia 2017).</p> <p>Cable-laying vessels will move slowly (up to 600m/hr, which equates to approximately 0.3 knots)</p> <p>Support vessels will adhere to speeds of less than 10 knots within high-risk areas, including foraging zones for marine turtles within the OSMF.</p>	Marine fauna spotters will visually monitor for marine fauna in biologically important areas, including the turtle foraging habitat within the Oceanic Shoals Marine Park. If fauna is spotted, support vessels will reduce their speed to below 6 knots (in accordance AMSA 2023).	<p>Adherence to the <i>National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna</i> is considered best practice for minimising potential impacts of vessel strike on marine cetaceans.</p> <p>Studies have shown that speed is a key contributor to the likelihood of a collision between a marine animal (including turtles) and a vessel and that faster speeds are more likely to seriously injure or kill an animal (e.g. Hazel et al. 2007 and Hodgson 2004). Ensuring vessels travel at slow speeds is therefore considered an effective and adequate measure for minimising the potential for vessel collision with marine animals. Vessel speed will be limited to 10 knots</p>

Impact	Avoidance	Mitigation	Monitoring	Adequacy
		<p>If marine fauna is spotted, vessels will reduce speeds to below 6 knots until fauna has passed.</p> <p>If a listed species is injured or killed, the proponent must ensure that:</p> <ul style="list-style-type: none"> • All use of the equipment that injured or killed the listed species ceases immediately. • The activity does not resume without the written permission of the Director. <p>Any interference with a cetacean (even unintentional) is to be reported to DCCEEW as per the requirements of Division 3, Part 13 of the EPBC Act the EPBC Act.</p>		<p>within biologically important areas, which is the speed adopted by the Queensland Government in 'go slow areas' to protect marine turtles and dugong in Moreton Bay. Additionally, if marine fauna is spotted, vessel speed will be further reduced to 6 knots, which is based on the AMSA guidelines for reducing vessel strike impacts. The proposed mitigation measures are therefore based on best practice implemented throughout Australia and are considered effective and adequate to protect marine mammals.</p> <p>Any vessel strike of a cetacean will be reported to DCCEEW in accordance with the requirements of the EPBC Act, and any corrective measures or adaptive management will be implemented to minimise the risk of additional vessel strikes.</p>
<p>Changes to fauna behaviours due to noise, light and other disturbances</p>	<p>Route selection avoids important turtle breeding beaches.</p> <p>Cable laying activities move up to 600m per hour which limits the duration of noise emissions in any given area.</p>	<p>Lighting will be designed and managed in accordance with the principles of best practice lighting design in the <i>National Light Pollution Guidelines for Wildlife</i> (DEE 2020).</p>	<p>Visual inspections of construction and/or operational work areas, to ensure that lighting adheres to the best practice lighting design in the <i>National Light Pollution Guidelines for Wildlife</i>.</p>	<p>Adherence to the <i>National Light Pollution Guidelines for Wildlife</i> is considered effective and adequate for avoiding and mitigating impacts associated with lighting, including to marine turtles and other wildlife within the OSMP.</p> <p>Noise impacts are unlikely to be significant because the noise will occur within a small area immediately surrounding the cable laying vessels and equipment (e.g. jet trencher or jet chain cutter), and the vessels and equipment will continuously move along the Subsea Cable System route. The route avoids turtle breeding beaches. Biologically important areas that are crossed by the route are foraging areas (not breeding areas), which are large and any fauna deterred by noise will have large areas of foraging habitat available away from the noise</p>

Impact	Avoidance	Mitigation	Monitoring	Adequacy
				generating activities. Therefore, measures are considered adequate in relation to the short term and localised noise disturbances which will occur during construction of the Subsea Cable System.
Increased turbidity in marine waters caused by cable burial activities	<p>Dredging will not be undertaken within the OSMP.</p> <p>Cable burial methods selected will consider minimising sediment disturbance, and associated turbidity.</p> <p>Cable burial methods will be selected to suit the local seabed conditions.</p>	Design, install and operate Subsea Cable System in accordance with the Guidelines on Best Environmental Practices in Cable Installation, and Operation (OSPAR, 2012).	Nil in the Oceanic Shoals Marine Park.	The preferred cable burial methods – jet trenching or chain / wheel cutter – have been selected because they have a small disturbance footprint and therefore generate a small plume of suspended sediment and associated turbidity. Modelling indicates negligible change in marine water quality (<1 mg/L of suspended sediment concentration [SSC] at the surface and <4 mg/L of SSC at the seabed) within the OSMP (see Appendix R or the Draft EIS). Therefore, avoidance and mitigation measures are considered effective and adequate to minimise impacts to the OSMP and supported values.
Increased temperature in the vicinity of the subsea cable	Cable design (e.g., insulation) minimises heat loss.	Cables will be buried along the majority of the route, and within the OSMP, which minimises heat transfer at the seabed and in the water column.	Nil	Modern cables will be used which adhere to industry standards, including insulation to minimise heat generation. Based on the literature (presented in Chapter 10 of the Draft EIS), there is little evidence of temperature generated by subsea cables impacting marine ecosystems. Proposed measures are considered adequate given the narrow area that may be influenced by elevated temperature (less than one metre from the cable) in the context of the scale of the OSMP, including biologically important areas and KEFs.

Impact	Avoidance	Mitigation	Monitoring	Adequacy
Increased EMF in the vicinity of the subsea cable	Cables which adhere to industry standards will be used; this includes insulation and metallic screening within the cables to minimise EMF.	Cables will be buried along the majority of the route, and within the OSMP, which minimises EMF at the seabed and in the water column.	Nil	<p>Modern cables will be selected which adhere to industry standards. Standards require shielding to block the electric field emitted using conductive sheathing (Boehlert and Gill, 2010). These measures are considered best practice and effective in minimising the EMF generated from the subsea cables.</p> <p>Literature review and additional EMF modelling has been undertaken (see Response to Item 15) which indicates that, when cables are buried (as they will be within the OSMP), the effects of EMF are restricted to within several meters of the cable. This is unlikely to impact on marine ecosystems, including fauna sensitive to EM. Burial is considered an effective measure for minimising EMF from subsea HVDC cables, as based on a review of literature and studies of other subsea cables (see Item 15).</p>
Impacts to undetected heritage features	The Subsea Cable System route will be surveyed prior to laying, and any anomalies which may be heritage objects will be identified and investigated as required prior to construction.	<p>Cultural Heritage Management Plans will provide measures for managing the inadvertent discovery of heritage features.</p> <p>If there are unexpected finds during construction, consultation will be undertaken with the NT Heritage Branch (if in NT waters) or DCCEE (if in Cth waters) to determine the most appropriate measures to be implemented.</p> <p>Where impacts to an undetected heritage feature are unavoidable, appropriate permits will be obtained under relevant NT and Cth legislation.</p>	Nil	<p>Additional detailed survey of the Subsea Cable System route is an effective and standard measure to identify discrepancies in the seabed which may include heritage features. Any features identified which may be heritage will be investigated as appropriate by a suitably qualified heritage and archaeological consultant.</p> <p>Standard measures will be detailed in Cultural Heritage Management Plans for unexpected finds, which is industry standard and effective in minimising potential impacts to heritage and archaeological features. There are existing processes and permitting requirements under the NT <i>Heritage Act 2011</i> and Cth <i>Underwater Cultural Heritage Act 2018</i> which protect cultural heritage, including underwater heritage.</p>



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ23168 - Responding to NT EPA Direction to provide Additional Information\1. Project Files\2. Report Maps\Example of Subsea Cable System route through Key Ecological Features.mxd

Figure 17. Example of Subsea Cable System route through Key Ecological Features

12.4 Conclusion

Impacts to the OSMP and supported values are unlikely to be significant. The proposed construction and operation of the Subsea Cable System poses an inherently low impact to many of the values of the OSMP (presented in Table 1 and Table 2) because the value either is not present where the Subsea Cable System will be laid, or because the scale and/or duration of the proposed activities is such that potential impacts will be insignificant. Potential impacts to marine water quality and marine ecosystems which may occur within the OSMP have been identified and assessed and impact avoidance, mitigation and monitoring measures identified (Table 4). Measures are considered adequate because they are standard practice, comply with relevant guidelines and legislation, and/or are proven effective.

AAPowerLink will apply for relevant authorisations to undertake structure and works activities in accordance with the zoning of the Oceanic Shoals Marine Park (as defined in the North Marine Parks Network Management Plan 2018, DNP 2018).

13 IMPACTS TO AMENITY

13.1 Context provided by the NT EPA

The Supplement Direction (item #9) required clarification of whether and/or where the OHTL may be installed underground in areas to avoid potential significant impacts (and any residual significant impact) on sensitive receptors. The Supplement includes a discussion of avoiding visual impacts by installing the entire OHTL underground, but the avoidance of potential visual impacts by placing the OHTL underground only near sensitive receptors has not been addressed.

13.2 Additional information required by the NT EPA

Discuss the potential to avoid visual impacts during operation by placing the OHTL underground near sensitive receptors which may include but not be limited to the sensitive receptors at Pine Creek, Katherine and between Stuart Highway at Hughes to the Darwin Converter site (including reasonably foreseeable future land uses described in the Litchfield subregional land use plan 2016 Murrumujuk, Noonamah Ridge, Noonamah and South-East Weddell).

13.3 Response

Undergrounding through Katherine, Pine Creek and from Hughes through to Murrumujuk would affect approximately 100 km of the transmission line, or 13% of the total alignment length from Powell Creek through to Murrumujuk. This is a substantial portion of the alignment and therefore the disadvantages discussed in the SEIS are relevant to consider. As indicated in the SEIS, the option of undergrounding a HVDC dual circuit system of such high voltage poses significant technical challenges, would involve significant ground disturbance and therefore a higher level of environmental impact, and would cost nearly an order of magnitude more than overhead.

Undergrounding of the dual circuit 525kV system would require thermal and physical separation between each of the underground circuits and the metallic return, driving a material increase in easement width. Installation and operation techniques also require ground disturbance (trenching) along the entire section of the underground transmission route (expected to be a 40m+ construction trench + areas to support the construction methodology) to install and maintain cables for the life of the asset. Thus, undergrounding is a

more likely to impact on environmental and heritage values along the route, whereas overhead has greater flexibility to span and avoid localised values.

Because of the disadvantages of undergrounding, it is standard industry practice that it is only considered when there is no practical overhead solution, or in extreme cases where surrounding land is heavily populated, or the area is highly sensitive to visual disturbance (such as urban environments). The AAPowerLink OHTL does not traverse densely populated urban residential areas, or protected areas, that would be considered highly sensitive to visual disturbance, and there are multiple environmental, heritage and cultural considerations along the length of the route. It is SunCable's position that undergrounding sections of the transmission line at the above-mentioned locations is not justified by the level of visual impact posed. Importantly, the scale of environmental impact, extended approval timeframes (due to the larger footprint) and cost of a comparative underground system renders such a solution highly unfavourable.

The residual impact of the OHTL to visual amenity is rated as Moderate in the SEIS (see Chapter 10, Section 10.7), which indicates the impact is unlikely to be significant according to the EP Act definition⁶. The sections below provide further details of the visual impacts and the disadvantages of undergrounding and reiterate why an OHTL is SunCable's preferred option OHTL. All this information is important to consider when deciding whether the benefits of undergrounding outweigh the disadvantages to the Project.

13.3.1 Disadvantages of undergrounding

Further engineering consideration was given to the feasibility of undergrounding sections of the OHTL through Katherine, Pine Creek and from Hughes to Murrumjuck. The sections below summarise the findings and the implications for the Project. The disadvantages associated with undergrounding in terms of cost, time, land requirements and environmental/heritage impacts are the primary reasons for SunCable choosing the OHTL as the preferred option.

System losses

System losses are a major economic driver for transmission systems and are a key reason for using an OHTL system. Buried cables are more thermally limited than overhead lines due to insulating effect of surrounding earth, which affects the current carrying limits of cables. Further, system losses occur when there is a need to switch between trenching and trenchless techniques (e.g. jack and bore or horizontal directional drilling (HDD)) to traverse the alignment of existing linear infrastructure or natural features as discussed below. Larger cables or more cables would be needed to achieve the required power transfer and to maintain system reliability, which requires a larger footprint, will take longer to construct, and will cost substantially more.

Footprint

The current OHTL for which approval is being sought will require 22 cables (including metallic return). To achieve the same power transfer, an underground system would require additional cables to account for cable derating factors required with cable burial. Spacing of buried cables would require a substantial trench and construction footprint estimated at greater than 40 m wide to account for benching safety requirements and stockpiling, compared to an approximate 22 m wide construction corridor required to install the OHTL. Refer to Figure 18.

⁶ A significant impact of an action is an impact of major consequence having regard to: (a) the context and intensity of the impact; and (b) the sensitivity, value and quality of the environment impacted on and the duration, magnitude and geographic extent of the impact.



Figure 18. Example of installation by direct burial (Source: Neumann 2013)

Ability to avoid impacts to environmentally sensitive areas and anthropogenic structures

The undergrounding methodology would encounter various technical challenges based on the prevailing terrain, as well as existing environmental and anthropogenic structures that cannot be disturbed. In the above-mentioned areas, these include:

- Terrain variations, and possible rock formations for the entire route, which preclude trenching
- Potential for interaction with shallow groundwater during the wet season
- Waterways, wetlands and threatened species habitats
- Roads and existing utility infrastructure.

Many of these obstacles cannot be traversed using direct burial methods, which would then trigger a large directional drilling task. In contrast, an OHTL configuration can span most obstacles without any direct disturbance. Through Katherine the OHTL currently spans the Victoria Highway and the Katherine River, and therefore undergrounding in this area would trigger a substantial HDD effort. Through Pine Creek the OHTL spans the Kakadu Highway and runs alongside the existing power substation and powerline infrastructure, and therefore undergrounding in this area would trigger another HDD effort and may require re-routing if the required easement width cannot be accommodated adjacent to the existing infrastructure. From Hughes through to Murrumujuk, the OHTL currently spans numerous roads, watercourse crossings, wetlands and sensitive vegetation communities and threatened species habitats (refer Section 4 for examples), and therefore undergrounding through this area would trigger a substantial HDD effort and/or require rerouting out of the designated NTG utilities corridor.

Land access, tenure and ability to avoid impacts to existing land uses

The operational easement width required for an underground system is estimated to be 60-80 m to allow access for initial construction, future upgrades and maintenance activities, compared to approximately 60 m easement width required for the OHTL. The additional width poses challenges for obtaining land access and tenure because other land uses will be restricted in the easement, which may not be acceptable to some landowners along the alignment. For example, through Katherine, just to the north of the Victoria Highway crossing, the alignment traverses through an area under agriculture, where wider easement may not be able to be accommodated without impacting the existing land use and securing appropriate tenure. From Hughes through to Murrumujuk, as mentioned above, there are numerous environmentally sensitive areas where HDD may not be possible, which could require rerouting out of the designated NTG utilities corridor and increase impact on existing land uses and limit future land uses.

Maintenance and upgrades

The typical lifespan of an underground system is usually around one half of a comparable OHTL, and underground systems are difficult to upgrade, should that become an operational requirement after the initial construction is completed. There also tends to be higher maintenance requirements associated with post installation underground cable joint failures. Maintenance and upgrade activities for an underground system would therefore require significant ground disturbance, which would increase costs and amenity and social impacts compared to the OHTL which is easier to maintain and upgrade.

13.3.2 Summary of visual impacts

SunCable acknowledges that some people will dislike the visual disturbance caused by the OHTL. SunCable has focussed on minimising the visual impacts of the OHTL when determining the route of the transmission corridor with specific attention to environmental, cultural heritage and community amenity as it traverses near population centres. The fundamental strategy guiding the design is the collocation of transmission lines with servicing infrastructure and transport corridors, existing and proposed, and new overland greenfield sections to avoid high density settlements (such as Adelaide River), where it is possible to do so. For most of the preferred route, the OHTL utilises the AustralAsia Railway Corporation corridor. This corridor travels through large agricultural leases; however, some populations will be affected including the outer parts of Katherine, Pine Creek, and communities within Litchfield Shire. These locations are discussed below.

Through Pine Creek and the outer parts of Katherine, SunCable has proposed to align the OHTL within the existing rail corridor where possible. The rail traverses the outskirts of each township, through areas comprising a combination of rural, industrial, and commercial land uses. It is also noted that the alignment was moved out of the rail corridor at Adelaide River to reduce visual amenity impacts because the rail corridor runs through the township and suitable greenfield corridors are available to do so.

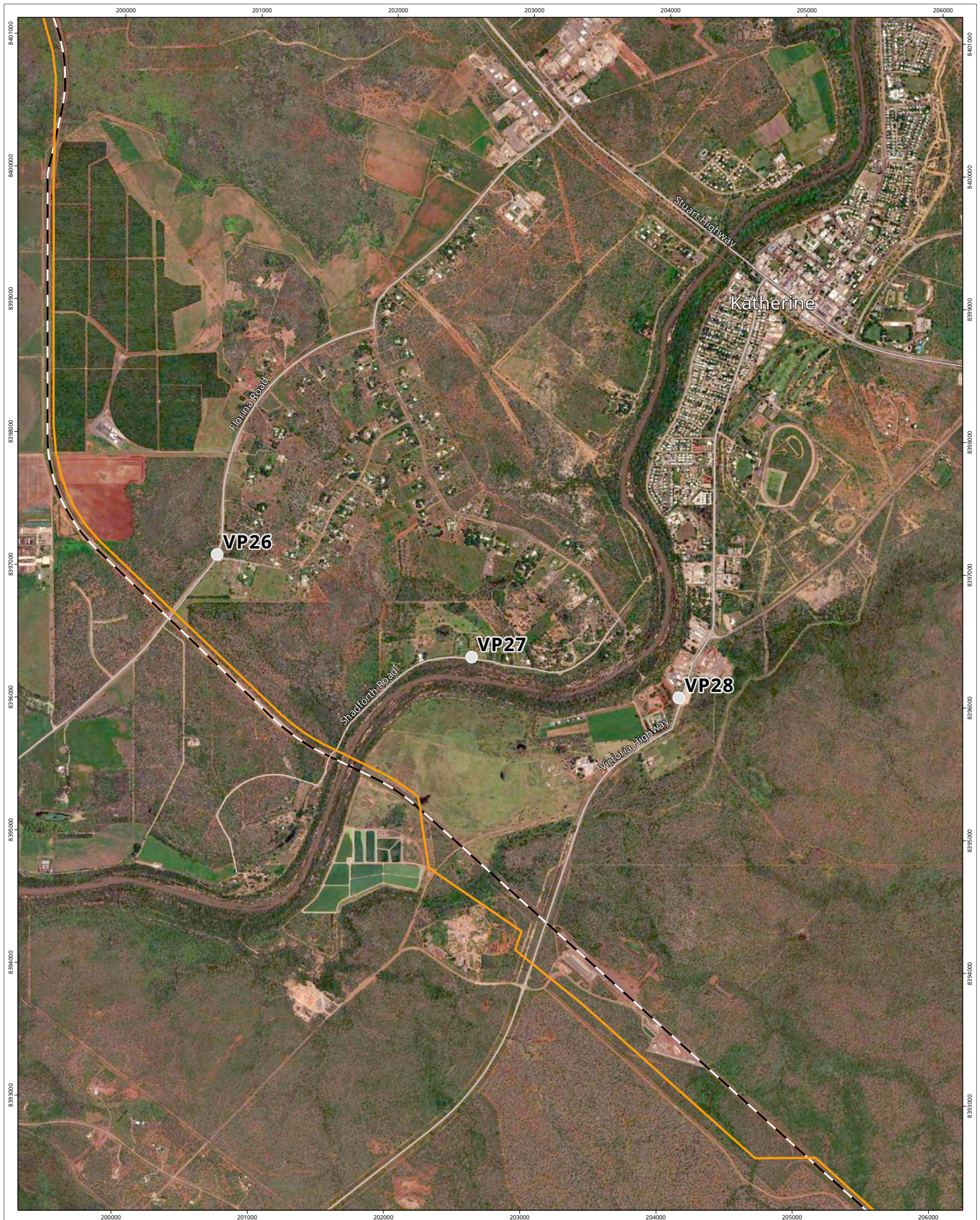
On balance, the OHTL avoids the majority of major population centres in regional Darwin thereby reducing the potential for visual impact on a significant portion of the broader community. From Hughes to Murrumujuk (near Gunn Point Beach), the OHTL is within an NT Government nominated utility corridor. Utility corridors within the Darwin region have been promoted through publicly available NTG land use planning policy documents for over two decades. Through land use policies, utility corridors were instituted to promote the development of infrastructure to support NT's economic development. Accordingly, it is reasonable to assume that a future land use in the NTG utility corridors would include a mix of infrastructure, including overhead electrical infrastructure. Furthermore, the corridor in question is flanked by a future main road corridor for the entire length, and a railway corridor as the OHTL travels into Murrumujuk and Gunn Point. On balance, the OHTL avoids major population centres in the Darwin region thereby reducing the potential for visual impact on a significant portion of the community.

The *Landscape and Visual Impact Assessment* provided as Appendix 10.1 to the SEIS, was prepared by professionals experienced in visual impact assessments. The report indicates that the locations where the

Project will have the greatest visual impact are generally those within 1.5 km of the OHTL, in areas that have low vegetation and are close to major transport routes, such as the Stuart Highway. The assessment considered impacts from several viewpoints near Katherine, Pine Creek and through the area from Hughes to Murrumujuk (near Gunn Point Beach) as shown in Figure 19, Figure 20, and Figure 21. The assessment evaluated the magnitude of the visual change and the sensitivity of the receiving environment, mapped the potential sensitive receptors to change and assigned an overall visual impact rating as summarised in Table 23.

In summary:

- A small portion of the population across the entire Project footprint including the length of the OHTL will experience visual impacts from the OHTL in Katherine, Pine Creek and in the area from Hughes through to Murrumujuk.
- The sensitive receptors in these areas are considered to have a low to moderate level of sensitivity to visual impacts because the population density is low, and the landscapes are modified to varying extents.
- The portion of the population affected along the NTG utilities corridor will increase if/when future residential development occurs at Murrumujuk, Noonamah Ridge, Noonamah and Weddell.
- Whilst not specifically assessed in the *Landscape and Visual Impact Assessment*, it is reasonable to assume that the sensitivity of these future land uses to visual impacts will be lower due to the fact the OHTL will already be in place and people are able to make a conscious decision about the acceptability of any visual impact prior to moving there.
- While the OHTL may be assigned a moderate impact in some areas it will be partially obscured from view from most sensitive receptors by existing vegetation and in most locations the impact is considered minor or negligible.
- In the proximity of Katherine, Pine Creek and Hughes-Murrumujuk the visual impact assessment identified three sensitive receptor locations where there will be a considerable change in the views:
 1. OHTL Stuart Highway crossing near Hughes (KP720)
 2. Cox Peninsula Road crossing (KP720)
 3. Florina Road near Katherine (KP457)
- The population density in these areas is low and therefore a small proportion of the population is potentially affected by visual impacts, which is considered acceptable given the scale of the overall project.



- Legend**
- Viewpoint
 - Roads
 - OHTL Corridor
 - Railways

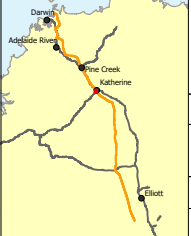
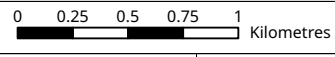


Figure 19. Locations subject to visual impact assessment near Katherine

Project: **Australia-Asia PowerLink**



Scale: 1:25,000

Datum: GDA2020

Coordinate System: MGA53

Reference #: AAPL_GNR_CTA_GEN_MAP_623
 Date: 20/10/2023 Figure: 1 of 1 Revision: A



Source: Maxar, Northern Territory Government, Esri, HERE, Garmin, FAO, NOAA, USGS

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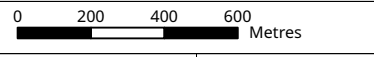


- Legend**
- Viewpoint
 - Highway
 - OHTL Corridor
 - Railways



Figure 20. Locations subject to visual impact assessment near Pine Creek

Project: **Australia-Asia PowerLink**



Scale: 1:15,000 Datum: GDA2020

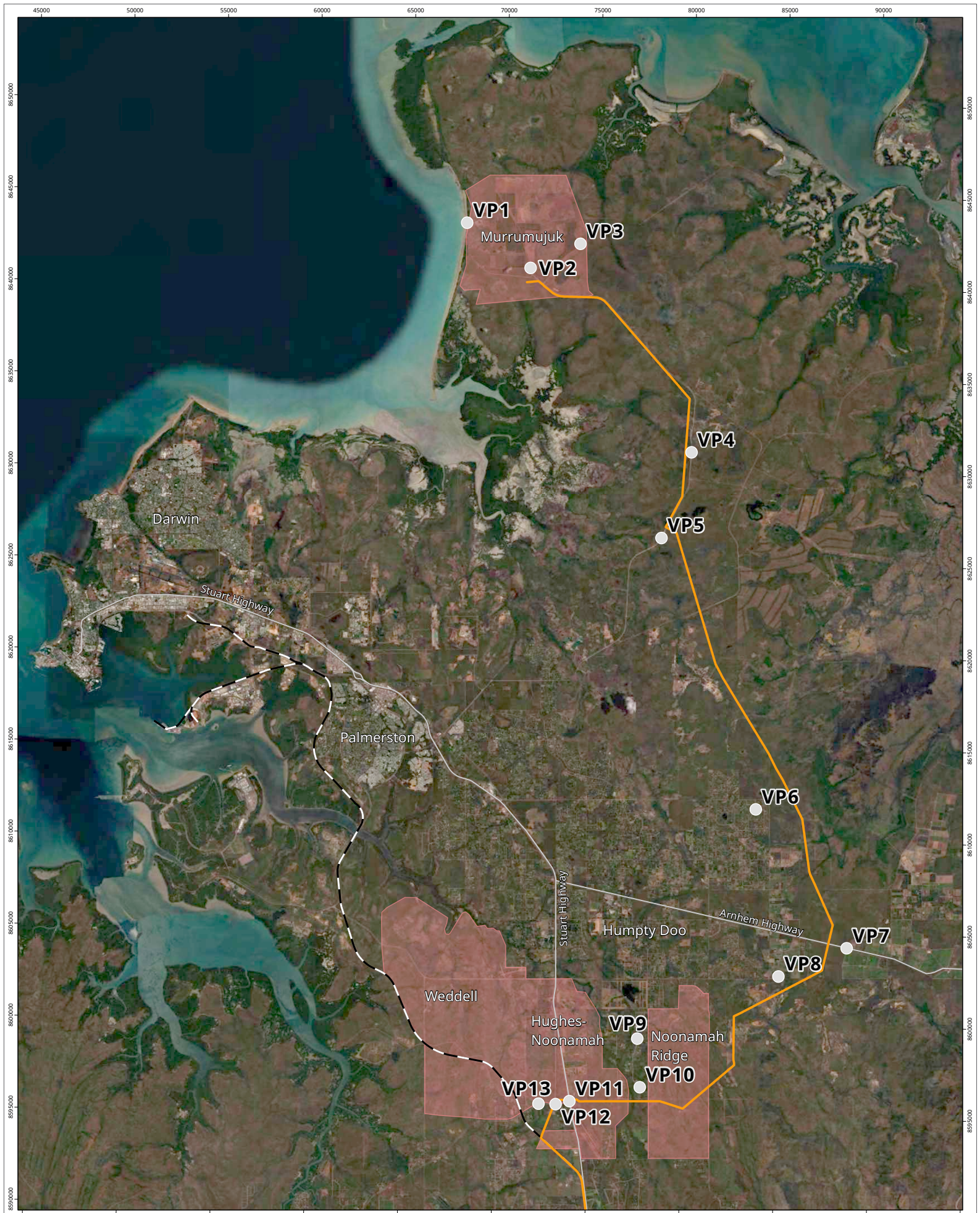
Coordinate System: MGA53 A3

Reference #: AAPL_GNR_CTA_GEN_MAP_622
 Date: 20/10/2023 Figure: 1 of 1 Revision: A



Source: Maxar, Northern Territory Government, Esri, HERE, Garmin, FAO, NOAA, USGS

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- Legend**
- OHTL Corridor
 - Viewpoint
 - Highway
 - - - Railways
 - Future Urban / Peri-Urban Areas

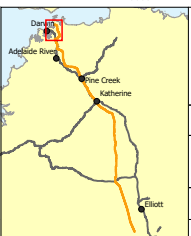


Figure 21. Locations subject to visual impact assessment from Hughes to Murrumujuk

Project: Australia-Asia PowerLink		Reference #: AAPL_GNR_CTA_GEN_MAP_621	
		Date: 20/10/2023	Figure: 1 of 1
Scale: 1:180,000		Datum: GDA2020	
Coordinate System: MGA53			A3

Source: Earthstar Geographics, Northern Territory Government, Esri, HERE, Garmin, FAO, NOAA, USGS

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Table 23. Summary of visual impact assessment results for locations near Katherine, Pine Creek and Hughes-Murrumujuk (Source: SMEC, 2023)

Area	Viewpoint (VP)	Location	Sensitivity	Magnitude of change	Overall visual impact	Comments
Hughes to Murrumujuk	1	Gunn Point campsite, near Murrumujuk	Medium	Barely perceptible	Negligible to Minor	Gunn Point Campsite is a locally important recreation area with a moderate number of visitors. The Project is not expected to be visible. If it were visible, it would be barely noticeable.
	2	Gunn Point Road, near Murrumujuk	Low (currently) Medium (future) ⁷	Noticeable change	Minor to Moderate	Gunn Point Road currently has a low number of visitors with a passing interest in their surroundings. Sensitivity would increase if Murrumujuk is developed for residential land use in the future. The Project is expected to blend in with the existing view to a moderate extent as it would be partially screened by the existing vegetation.
	6	Beddington Road, Herbert	Medium	Barely perceptible	Negligible to Minor	The main land use is rural living. The Project is not expected to be visible. If it were visible, it would be barely noticeable.
	7	Arnhem Highway, near Lambells Lagoon	Medium	Noticeable change	Minor to Moderate	The main land uses are farming and with rural living. Residents and visitors accessing Kakadu and Arnhemland use the road. The Project would be visible crossing the Arnhem Highway, however it would represent a minor change in the view.
	8	Buckly Rd, Humpty Doo	Medium	Barely perceptible	Negligible to Minor	The main land use is rural living. The Project is expected to be mostly concealed from view due to existing vegetation in the foreground.
	9	Elizabeth Valley Road, Noonamah	Medium	Barely perceptible	Negligible to Minor	The main land use is rural living. The Project is most likely to be concealed from view behind existing vegetation in the foreground and middle distance.
	10	Horsnell Rd, near the future Noonamah Ridge rural residential development	Medium	Noticeable change	Minor to Moderate	The main land use is farming and rural living. The Project may be visible in the middle distance however is likely to be partially concealed by existing shrubby vegetation.
	11	Stuart Highway, Hughes	Medium	Considerable change	Moderate	The main land use is rural living. The Project would be a visually dominant element and would cross the road at right angles in the middle distance in this view.
	12	Cox Peninsula Rd, Hughes	Medium	Considerable change	Moderate	The main land use is rural living. The Project would constitute a clearly perceptible change.
	13	Cox Peninsula Rd	Medium	Noticeable	Minor to	The main land use is farming and rural living. The Project would

⁷ The Visual Impact Assessment (SMEC 2023) assessed sensitivity based on current land use. Using the sensitivity classification criteria in Table 2-1 of the report, the sensitivity will increase to medium if the area is developed for residential land use in the future.

Area	Viewpoint (VP)	Location	Sensitivity	Magnitude of change	Overall visual impact	Comments
		intersection with Middle Arm Rd		change	Moderate	be visible but is likely to be partially concealed by vegetation.
Pine Creek	21	Kakadu Highway near Pine Creek	Negligible	Barely perceptible	Negligible	This viewpoint has a number of infrastructure elements already present. The Project would not appear dissimilar to the many transmission towers and other similar elements already present in the view.
	22	Pine Creek township	Medium	Barely perceptible	Negligible to Minor	The Project may be visible through a gap in the vegetation at the centre of the view. However, its appearance would not be dissimilar to the numerous transmission towers that are already visible at this location.
Katherine	26	Florina Road, near Katherine	Medium	Considerable change	Moderate	The main land use is farming and rural living. The Project would represent a considerable change to the view; however, it is not expected to be more visually dominant than the existing transmission line in the view.
	27	Victoria Highway near Katherine	Medium	Barely perceptible	Negligible to Minor	The main land uses are industrial, agricultural and tourist accommodation. The OHTL is 1.9km from this location. The Project is not likely to be discernibly visible through the existing foreground vegetation.
	28	Shadforth Rd near Katherine	Medium	Barely perceptible	Negligible to Minor	The main land use is rural living. The OHTL is 1.3km from this location. The Project is not likely to be discernibly visible through the existing foreground vegetation.

13.3.3 Conclusion

Undergrounding transmission lines is a legitimate way to avoid visual impacts and should be considered in areas that are highly sensitive to visual impact. But undergrounding comes with substantial disadvantages for a Project that must be considered when weighing up the costs and benefits of this option. Undergrounding through Katherine, Pine Creek and from Hughes through to Murrumujuk would affect approximately 100 km of the transmission line, or 13% of the total alignment length from Powell Creek through to Murrumujuk. For the reasons explained above, pursuing an underground system through these areas will require extended planning and approvals timeframes, extended construction timeframes, introduce potentially greater environmental impacts, and will cost substantially more (estimates at 10 times more than an equivalent section of OHTL). These considerations will impact the feasibility of the AAPowerLink Project, or future transmission line projects that are expected to follow this precedent. Given the economic, environmental, and social costs associated with undergrounding, it is Sun Cable's view that it is not economically feasible and not justified to pursue an underground design given the moderate residual impact rating for visual impacts from the Project.

14 IMPACTS FROM NOISE AND VIBRATION

14.1 Context provided by the NT EPA

The TOR required that noise and vibration during construction and operation of all components of the proposed action need to be addressed.

The EIS included a prediction of the average level of audible noise for the OHTL based on the Chartier method produced by CIGRÉ (20091). The estimated average sound power (75 dBa, single band, 125 Hz), was compared to the Northern Territory Noise Management Framework Guideline (2018) night time noise criteria for residential land uses to identify predicted impacts. However, the EIS assessment is not in accordance with section 3.2 – Commercial and Industrial Noise of the framework (including use of averages rather than (LAeq (15 minute))), and it is not clear if intrusive noise and tonal adjustments were accounted for).

The EIS states that the noise estimate considered worst-case scenario (all equipment operating at one once in the worst-case climatic conditions). It is not clear whether other operational configurations have been accounted for, and whether the noise emissions from those scenarios may be worst-case and what the potential significant impacts are associated with those. Noise generation from transmission lines is dependent on conductor bundle design and operating configuration and each of these scenarios should be discussed separately.

The EIS indicates operational noise criteria will not be met at several sensitive receptors. No mitigation has been suggested for the identified residual impacts to residential receptors.

14.2 Additional information required by the NT EPA

1. Provide a noise impact assessment in accordance with the Northern Territory Noise Management Framework Guideline for the following operational configurations of the OHTL:
 - a. Both bipoles in operation
 - b. One bipole in operation
 - c. Monopolar operation – various permutations
 - d. Unbalance operation due to differential sag on conductor
2. The noise impact assessment is to address cumulative impacts of operational noise e.g. noise from the converter site combined with the OHTL noise on future Murrumujuk residential development.
3. Identify mitigation measures for operational noise emission exceedances from the proposed action. Discuss the consideration of alternatives (available technologies, best practicable mitigation technology, methods such as underground in proximity to residences) and reasons for either selecting or not selecting the option. If the option is not selected because it was considered not economically feasible, a comparison of the environmental / effectiveness of the options should still be included.
4. Identify the total number of land parcels (include NT Portion numbers or section numbers and maps at an appropriate / local scale) where the operational noise is predicted to exceed/not meet the noise limit (at sensitive receptors).

14.3 Response

An operational noise assessment report is provided at Appendix D *Community Operational Noise Technical Assessment* (Hatch 2023). The report provides the additional information requested by the NT EPA.

14.3.1 Methods overview

The *Northern Territory Noise Management Framework Guideline* (NT EPA 2018) *Section 3.2 Commercial and Industrial Noise* provides the framework for the assessment and management of commercial and industrial noise from the AAPowerLink Project. The operational noise assessment report adopts noise assessment criteria that are consistent with the Guideline as described in Section 3.2 of the report.

The comments received from the NT EPA stated that “*the EIS assessment is not in accordance with section 3.2 – Commercial and Industrial Noise of the framework (including use of averages rather than (LAeq (15 minute))), and it is not clear if intrusive noise and tonal adjustments were accounted for.*” The operational noise assessment addresses these concerns as follows:

- Project intrusiveness noise levels, using LAeq (15 minute), are provided for residential receptors in Section 3.2.2 of the report.
- Tonal adjustments are accounted for by conservatively applying a 5 dB correction to the predicted noise levels at the receptors. This approach is considered conservative because the noise modelling predicts a 6 dB tone in the 315 Hz band for the OHTL audibles noise, which is below the level that requires a tonal adjustment to be applied according to *NSW Noise Policy for Industry Fact Sheet C* (NSW EPA 2017) and the *ISO1996.2-2007 method tonality*.

The methods used in the operational noise assessment now align with the Guideline.

14.3.2 Modelled configurations

As per the additional information request from the NT EPA, noise is assessed for the following operational configurations of the OHTL:

- a. Two bipoles in operation
- b. One bipole in operation

The base-case configuration of the OHTL is two bipoles in operation (except during maintenance when only one bi-pole is in operation). The ‘one bipole in operation’ (maintenance conditions) is the louder of both. On average the maintenance condition is 3 dB louder than the normal operating conditions represented by the ‘two-bipole in operation’ configuration.

Four modelling scenarios (variants) were completed. Each modelling scenario accounts for all noise sources that would contribute to cumulative noise impacts at all sites under normal and worst-case operating conditions, and under dry and wet seasonal conditions. Variant 1 models the OHTL with both bipoles operating and Variant 2 models only one bipole operating. Each variant considers temporal conditions for operation during the rainy season “A” and dry season “B”.

14.3.3 Other configurations

It is noted that the NT EPA requested an additional two scenarios:

- c. Monopolar operation – various permutations
- d. Differential sag on conductor due to unbalanced operation

These scenarios are not modelled for the reasons explained below. The approach to the identification of the scenarios and configurations modelled is consistent with the approach taken for proposals for similar energy transmission projects, where standard practice is generally to model impact based on the worst-case normal operating conditions. Accordingly, the results of this assessment provide a high degree of confidence that the predicted noise levels are a conservative representation of the potential noise impacts associated with the OHTL operation, including assessment of worst-case scenario.

Monopolar operation

This scenario was not modelled because the scenario occurs rarely and there is a high level of confidence that the noise is less than modelled worst-case 'one bipole in operation' scenario.

Monopolar operation occurs when only one pole of a bi-pole configuration is operating, which typically is immediately following system faults (or for operational reasons) when an individual pole needs to be taken out of service. Based on professional experience and benchmarked against typical industry data, the AAPowerLink engineering design team estimates, that outages such as this are infrequent (i.e., 5 x's per year with a total average duration of 18hrs, or less than 1% of the year).

During monopolar operation mode, the total capacity of the bipole is reduced by 50% (and the overall system by 25%), which generates less noise. There are two main permutations of monopolar operations:

1. Monopolar bipole using negative pole – this scenario is expected to generate the same noise levels as a single bipole in operation (because noise emissions from a negative pole are minimal)
2. Monopolar bipole using positive pole – this scenario is anticipated to generate the same noise as the scenario when both bipoles are operating normally (which modelling has shown to generate less noise than the single bipole in operation scenario).

Differential sag on conductor due to unbalanced operation

This scenario was not modelled because there is a high level of confidence that the noise is less than the modelled worst-case 'one bipole in operation' scenario. Differential sag on conductors due to unbalanced operation occurs when bipole 1 and bipole 2 are not equally loaded. This results in a variation of distance between the upper bi-pole and lower bi-pole, which results in a change to noise cancellation properties of the configuration. As the impact of differential sag is a change in possible cancellation of noise only (and not an increase of maximum noise emitted), the noise generated in this scenario would not exceed the worst-case scenario modelled (one bi-pole operational where there is no second bipole to cancel noise properties).

14.3.4 Cumulative operational noise impacts

The cumulative impacts of operational noise are presented and discussed in Section 3.4 of the report at Appendix D. The assessment modelled cumulative noise from the Powell Creek Solar Precinct, OHTL and Darwin Converter Site (DCS) operations. Impacts were assessed at a total of 129 sensitive receptors up to 5 km away from the Project including existing and future residential land uses. All receptors have been assessed for potential impact in line with the Project Specific Assigned Noise level of 35 dBA consistent with the *NT Noise Management Framework Guideline*.

Exceedances of the Project Specific Assigned Noise level are identified at two potential sensitive receptor locations within the proposed future Murrumujuk township as identified in the Litchfield Subregional Land Use Plan 2016 (Version 6, March 2023). No impacts are expected at any of the other 127 receptors for any of the other modelling configurations assessed at the Powell Creek Solar Precinct, or at any locations along the OHTL.

The exceedances identified at Murrumujuk are caused by noise generated by the proposed Darwin Converter Site (DCS) and are not found to be related or contributed towards by the operation of the OHTL.

Figure 22 provides an overlay of the Project Specific Assigned Noise Level (35dB) contour over the proposed future Murrumujuk township without any noise mitigation measures applied. The overlay shows that the area where the noise levels may be exceeded extends approximately 3,600 m North, 2,400 m East, 3,600 m South, and 2,800 m West from the DCS and 100 m from the OHTL.

Within this area, further mitigation is required to ensure noise impact on future sensitive receptors is minimised. There are various opportunities for avoiding and reducing the extent of the potential impact through mitigation and further assessment. These are discussed in Section 14.3.5 below.

14.3.5 Avoidance and mitigation measures

It is noted that the proposed Murrumujuk Township would form part of a long term and larger planning vision for the region that would initially include the opportunity to encourage future industrial development and strategic industry. The Litchfield Subregional Land Use Plan 2016 (Version 6, March 2023) notes that the establishment of the proposed township would be because of this industry growth and largely contingent and subject to substantial demand for housing for these industry workforces. This demand is not anticipated within the near term but may be a possibility in the medium to long term. As the land at Murrumujuk has been identified for both industrial and residential uses, the NT Government will need to make decisions about the types of land use that can be supported at Murrumujuk now and into the future, to ensure that those land uses are compatible.

To limit the impact of the DCS on future land uses in surrounding areas, SunCable will apply all reasonable and feasible mitigation measures to reduce noise emission from the facility. Mitigation measures that have been deemed feasible during the concept design stage are proposed below:

- A 12m tall berm sloped 2:1 on the north side of the DCS can mitigate noise levels up to 3 dB at the proposed residential development receptor's locations to the north (space permitting).
- Enclosing the inverters and working with the battery supplier to reduce the noise output of the batteries can result in a 15 dB reduction to the overall sound power of these sources. This will reduce the noise levels by 2-3 dB for proposed future developments to the Northeast of the converter site.
- Absorptive noise barrier walls blocking the line of site between the future developments and the battery yard (Space permitting). A 12 m tall wall will only lower the noise levels by 1-2 dB and may not be economically feasible.
- Limit the DCS substation transformer noise to 100 dBA. The transformer sound power of 110 dBA has been estimated based on the National Electrical Manufacturers Association Standards (NEMA, 2019) and is conservative compared to Hatch's repository of transformer sound power data. Working with the suppliers, the final design and specification for the 500 MVA transformers are anticipated to have a sound power of 100 dBA which is more representative of transformer noise collected by Hatch.

Accounting for the above noise controls, the noise level from the DCS is modelled to be 11 to 15 dB lower than without mitigation. SunCable will undertake a detailed consideration of alternative mitigation measures during the detail design phase of the project, with the objective of limiting DCS noise to as low as reasonably practicable.

14.3.6 Residual impacts

The operational noise modelling predicts that the Project Specific Assigned Noise Level (35dB) will be met for residential receptors at all Project locations, excepting at Murrumujuk. At this location, even with noise mitigation described above for the DCS, there is a minor exceedance of the Project Specific Assigned Noise Level for residential receptors. It is noted that there are currently no sensitive land uses in the affected area;

however, the modelling indicates that the presence of the DCS will reduce the area of land available for future residential development at Murrumujuk.

An overlay of the Project Specific Assigned Noise Level (35dB) contour, with noise mitigation measures implemented for the DCS, is provided in

Figure 23. The overlay shows that the area where the noise levels for residential receptors may be exceeded (under worst-case modelled scenarios) extends approximately 1,800 m North, 825 m East, 2,450m South, and 1,700 m West from the DCS. Parts of the following land parcels with future residential zoning are within the affected area:

- NT Portion 2626 Hundred of Bagot – Crown Lease Perpetual
- Portion 2203 Hundred of Bagot – Freehold
- NT Portion 6166 – Vacant Crown Land
- Portion 2727 Hundred of Bagot – Vacant Crown Land
- NT Portion 4476 – Koolpinyah – Perpetual Pastoral Lease

To protect the amenity of future residential land uses there may need to be a buffer between the DCS and future residential development. The actual buffer requirement will be determined during detailed design when the noise levels from the DCS can be modelled with greater certainty and baseline monitoring can be undertaken to re-establish a Rating Background Level based Project Specific Assigned Noise Level. The acceptability of the required buffer area, in terms of impacts on the land available for future residential development, would then be assessed as part of the future development application for the site made under the *Planning Act*.

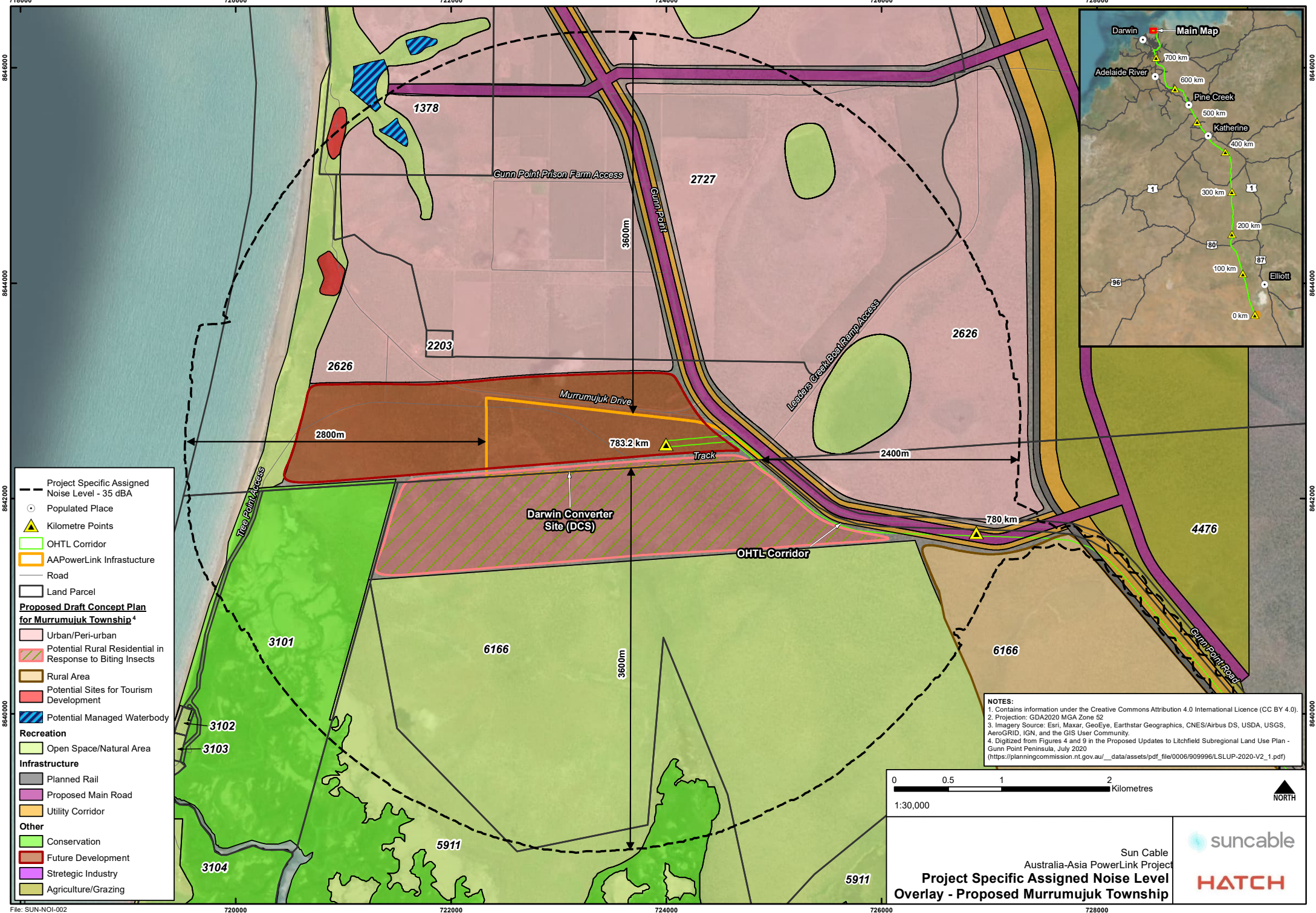


Figure 22. Project specific assigned noise level overlay - Murrumujuk township - no mitigation

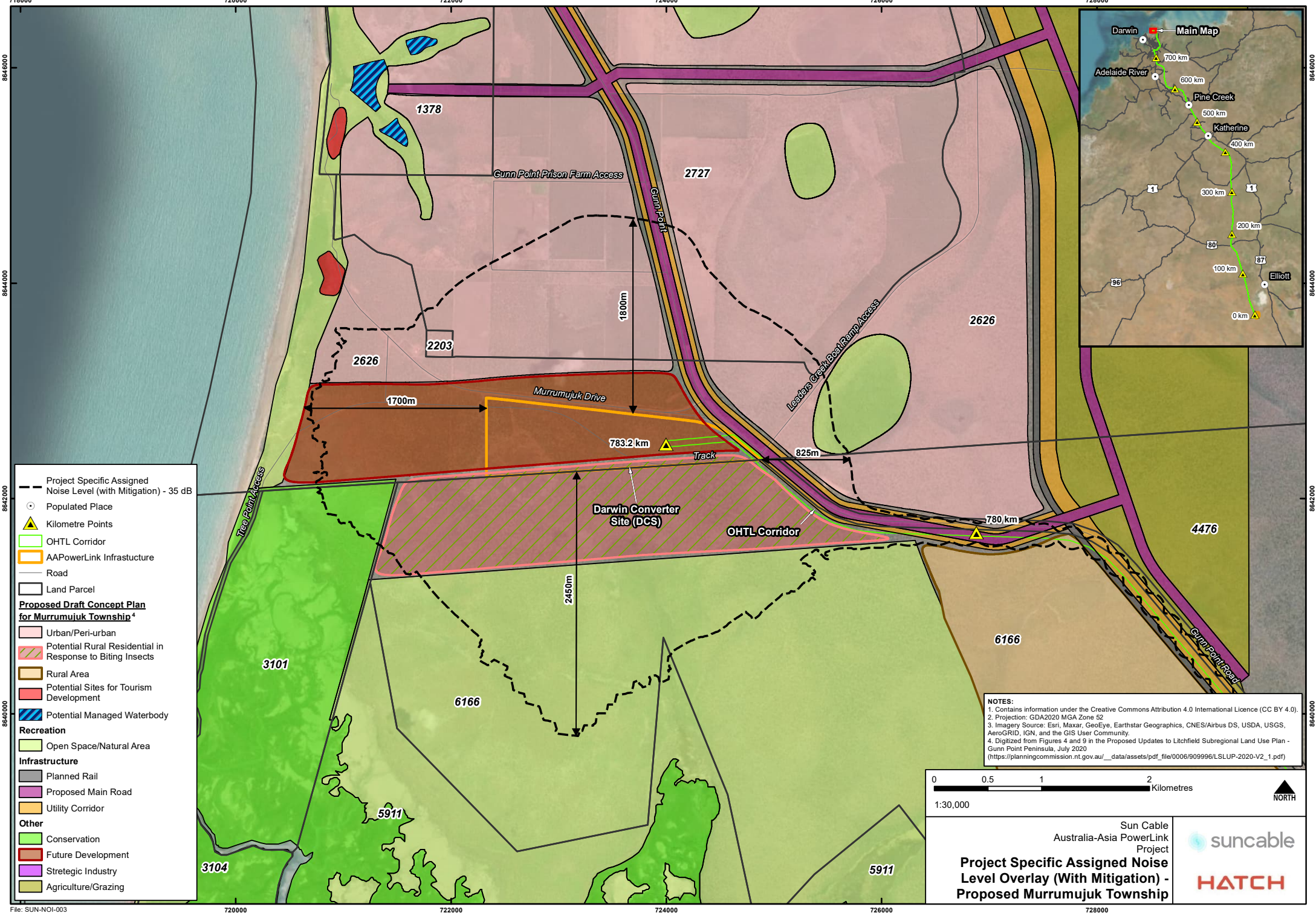


Figure 23. Project specific assigned noise level - Murrumujuk township - with mitigation

15 IMPACTS ON MARINE SPECIES FROM EMF

15.1 Context provided by the NT EPA

The Supplement refers to a review of studies of EMF (Electromagnetic Field) impacts on marine species produced by the International Cable Protection Committee (ICPC 2021) (Section 9.5.3.2) and asserts that the review indicates a lack of evidence for positive or negative effects of cable EMF on the species studied, with studies finding no change in biological assemblages along energised cables.

The report was not provided and does not appear to be publicly available.

15.2 Additional information required by the NT EPA

1. Provide evidence of the outcomes of studies of EMF exposure/impacts on marine species.
2. Provide a copy of the International Cable Protection Committee (ICPC 2021) study on EMF impacts on marine species.
3. Demonstrate that EMF in proximity to the subsea cable is not predicted to be above a level which may result in behavioural changes in elasmobranchs (sharks and rays).
4. Provide detail about how the proposed method of installing cables (laid on the seafloor, trenched into the seabed generally to a depth between 0.3 – 1 m or protected with armouring) would mitigate potential EMF impacts on marine fauna, and what post-installation verification is proposed.

15.3 Response

A memorandum has been prepared by Hatch Ltd that provides detailed information about EMF in the marine environment in response to Item 15 above (see Appendix E). Relevant components are summarised below, in response to items 1-4 listed in Section 15.2 above. Appendix E should be referred to for detail.

15.3.1 Evidence of study outcomes

A literature review was undertaken to provide evidence of the outcomes of studies undertaken on the potential impacts of EMF exposure on marine species. The review included the six scientific papers referenced by the International Cable Protection Committee (ICPC, 2021) report (that was previously referenced in the Draft EIS and SEIS), as well as an additional 12 papers published between 2016 and 2023. The literature review is presented in Section 3 of Appendix E.

15.3.2 ICPC Report

A copy of the ICPC (2021) *Environment Update* prepared by Dr Mike Clare (December 2021) (as referenced in the Draft EIS and SEIS) is provided as Appendix 1 of the memorandum at Appendix E.

15.3.3 Assessment of EMF impacts on marine fauna

Hatch assessed the potential impacts to several groups of magnetosensitive marine species, including cetaceans, turtles, sea snakes, crocodiles, bony fishes and Elasmobranchs. The section below summarises the results relevant to elasmobranchs as requested by the NT EPA (refer Item 3 in Section 15.2 above). Impacts to all marine species are discussed in Section 6 of Appendix E.

Predicted magnetic fields

Subsea Cable System EMF calculations were performed by Notman (2022) at 21 marker locations along the route from Murrumujuk to Singapore, including marker locations 1-5 in Australian waters as shown on Figure 24. The calculations considered spaced and bundled cable configurations, and assumed cables would be buried to -1m depth in nearshore NT waters but in offshore Commonwealth waters could either be buried or laid on the seabed. Further, details of the modelled configurations are provided in Section 4.4 of Appendix E.

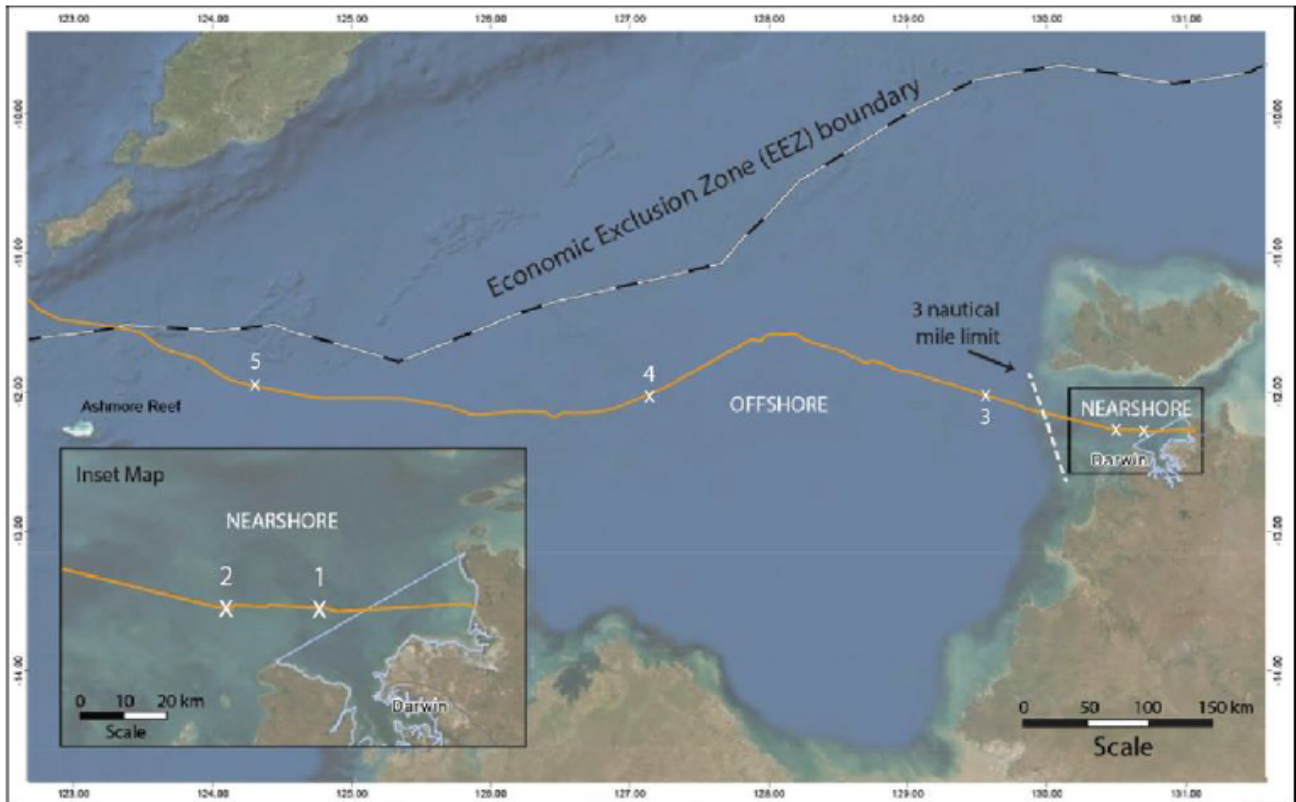


Figure 24. Locations along Subsea Cable System route where EMF modelling was undertaken

Table 24 shows the maximum total magnetic field intensities modelled (i.e., the combined geomagnetic and cable-generated magnetic fields) for cables laid directly on the seabed or buried in the seabed to -1 m, compared to the background geomagnetic fields.

The EMF calculations for Marker 1 within nearshore NT waters (Beagle Gulf), and for Marker 5 within offshore Commonwealth waters (Timor Sea) were used to assess the impacts of EMF on marine fauna. Three scenarios were selected and considered for the purposes of this assessment. They are as follows:

Nearshore NT waters

- Scenario 1 – bundled HVDC/metallic return cable buried to -1 m depth at Marker 1 in the Beagle Gulf
- Scenario 2 – spaced HVDC cable buried to -1 m depth at Marker 1 in the Beagle Gulf

Offshore waters

- Scenario 3 – spaced HVDC cable laid on the seabed at Marker 5 in the Timor Sea

These scenarios were selected as they are considered representative of potential system configuration at each marker location. The EMF calculations for these scenarios are highlighted blue in Table 24 from Notman (2022).

Table 24. Background geomagnetic field and maximum combined total magnetic intensities

Marker	Background Geomagnetic field (µT)	Cable on seabed surface				Cable buried to 1 m			
		Cable surface	Difference (%)	1 m above cable	Difference (%)	Seabed surface	Difference (%)	1 m above seabed	Difference (%)
Bundled cable configuration:									
1	46.158	1,726.5	3640.4	62.8	36.1	62.8	36.1	50.6	9.6
3	46.062	1,726.1	3647.3	62.7	36.1	62.7	36.1	50.5	9.6
4	46.137	1,726.0	3641.0	62.7	35.9	62.7	35.9	50.6	9.7
Spaced cable configuration:									
1	46.158	4,880.5	10473.5	398.5	763.3	398.5	763.3	226.4	390.5
3	46.062	4,880.7	10495.9	398.7	765.6	398.7	765.6	226.5	391.7
4	46.137	4,880.9	10479.1	398.8	764.4	398.8	764.4	226.7	391.4
5	46.372	4,881.0	10425.7	398.9	760.2	–		–	

Source: Notman (2022). Note marker 2 is not shown as the cable burial depth is -2m at that location due to the presence of sand mega ripples and therefore is not representative of the route. The light blue shaded cells were adopted to assess EMF impacts on marine fauna.

The modelling results indicate that the magnetic field is expected to return to baseline within approximately 3 m of the cable for Scenario 1, approximately 7.45 m for Scenario 2, and approximately 8 m of the cable for Scenario 3 (i.e. spaced HVDC cable laid on the seabed (see Table 4-7 of Appendix E). This distance applies to both the vertical and horizontal planes, noting that vertical distances were not reported by Notman (2022) but have been approximated to be similar to horizontal distances.

Predicted induced electric fields

Induced electric fields (which are more relevant to elasmobranchs, as described below) were calculated using the modelled magnetic fields generated by the various cable configurations and current speeds (see Section 4.5 of Appendix E). The calculations are summarised in Table 25 below.

Table 25. Summary of Predicted Proposal Induced Electric Fields

Scenario	Description	Predicted Induced Electric Fields ($\mu\text{V}/\text{m}$)	Natural Background Induced Electric Fields ($\mu\text{V}/\text{m}$)
Scenario 1	At the seabed	11.9 $\mu\text{V}/\text{m}$ and 63.4 $\mu\text{V}/\text{m}$	8.76 $\mu\text{V}/\text{m}$ to 46.72 $\mu\text{V}/\text{m}$
Scenario 1	1 m above the seabed	9.5 $\mu\text{V}/\text{m}$ and 51.0 $\mu\text{V}/\text{m}$	8.76 $\mu\text{V}/\text{m}$ to 46.72 $\mu\text{V}/\text{m}$
Scenario 2	At the seabed	75.3 $\mu\text{V}/\text{m}$ and 401.6 $\mu\text{V}/\text{m}$	8.76 $\mu\text{V}/\text{m}$ to 46.72 $\mu\text{V}/\text{m}$
Scenario 2	1 m above the seabed	42.8 $\mu\text{V}/\text{m}$ and 228.20 $\mu\text{V}/\text{m}$	8.76 $\mu\text{V}/\text{m}$ to 46.72 $\mu\text{V}/\text{m}$
Scenario 3	At the seabed	1,537 $\mu\text{V}/\text{m}$	14.5 $\mu\text{V}/\text{m}$
Scenario 3	1 m above the seabed	125.6 $\mu\text{V}/\text{m}$	14.5 $\mu\text{V}/\text{m}$

Note: Scenario 1 and 2 use seawater flows of 0.3 and 1.6 m/s (Williams et al., 2006). Scenario 3 uses a seawater flow of 0.5 m/s (SKM, 2002).

In summary:

- Scenario 1 (bundled HVDC cable buried to -1 m depth at Marker 1, shown on Figure 15 1) the induced electric fields at the seabed and at 1 m above the seabed are of a similar magnitude to background electric fields.
- Scenario 2 (spaced HVDC cable buried to -1 m depth at Marker 1, shown on Figure 15 1) - the induced electric fields at the seabed and 1 m above the seabed are the same order of magnitude as the natural background induced electric fields for the lower current flow of 0.3 m/s, but are predicted to be an order of magnitude higher for the higher current flow of 1.6 m/s.
- Scenario 3 (spaced HVDC cable laid on the seabed at Marker 5, shown on Figure 15 1) - the induced electric fields are significantly higher than the calculated background electric field at the seabed (i.e., directly at the cable), but are much closer to natural background within 1 m of the cable:
 - a. Assuming a current speed of 0.5 m/s, the induced electric field at the seabed is 1,537 $\mu\text{V}/\text{m}$, which is 106-fold higher than the natural background electric field of 14.5 $\mu\text{V}/\text{m}$ at the same location.
 - b. At 1 m above the cable, the induced electric field reduces to 125.6 $\mu\text{V}/\text{m}$, which is 8.6-fold higher than the natural background.

Potential impacts to Elasmobranchs

Elasmobranchs are cartilaginous fish that include rays, sharks and sawfish. As presented in Table 2.1 of Appendix E, a Protected Matters Search Tool search identified 14 species of elasmobranchs which may occur within the region surrounding the Subsea Cable System:

- Whale Shark (*Rhincodon typus*)
- Largetooth Sawfish (*Pristis pristis*)
- Green Sawfish (*Pristis zijsron*)
- Dwarf Sawfish (*Pristis clavate*)
- Narrow Sawfish (*Anoxypristis cuspidata*)
- Shortfin Mako (*Isurus oxyrinchus*)
- Longfin Mako (*Isurus paucus*)
- Oceanic Whitetip Shark (*Carcharhinus longimanus*)
- Speartooth Shark (*Glyphis glyphis*)
- Northern River Shark (*Glyphis garricki*)
- White Shark (*Carcharodon carcharias*)
- Scalloped Hammerhead (*Sphyrna lewini*)
- Reef Manta Ray (*Manta alfredi*)
- Giant Manta Ray (*Manta birostris*)

Elasmobranchs have electroreceptors which they use to detect electric fields, including their direction and intensity. Elasmobranchs use their electroreceptors to sense prey, and it is therefore an important mechanism for feeding. Elasmobranchs are not known to possess mechanisms or structures that can directly detect magnetic fields, but they can indirectly sense geomagnetic fields by processing electrosensory information and may use this for navigation.

Marine animals generate electric fields (Crampton 2019), which elasmobranchs use to detect prey and feed. A review of electric field sensitivities on a number of elasmobranchs identified that the electrosense of elasmobranchs is used as a close-quarter sensory system, mainly within the range of 15 to 50 cm (Bedore and Kijura 2013). At greater distances (e.g. > 1 m) elasmobranchs are most unlikely to be capable of detecting the bioelectric potentials surrounding prey organisms (e.g., fishes or marine invertebrates partially buried in sandy seabed).

The EMF modelling indicates that where cables are buried to 1 m below the seafloor and bundled, the induced electric field from the cable is within the range of natural variability for background electric fields in the marine environment, and therefore impacts to elasmobranchs from this induced electric field are unlikely to occur.

Where cables are spaced and buried to 1 m below the seafloor, the induced electric field is one magnitude higher than the natural background electric field for the higher current flow. However, elasmobranchs electroreceptors rapidly become insensitive (or desensitise) to an unchanging static DC electric field such as the AAPowerLink's HVDC cable-generated induced electric fields, which are relatively constant during power transmission (except when ramping power transmission up or down, typically as 30 MW steps). Even in the presence of the induced electric fields which are higher than the natural background electric field, elasmobranchs electroreceptors can readily detect a rapid change in the static electric field (e.g., from a prey) as well as oscillating AC electric fields that are generated by a prey organism's bioelectric fields. Therefore, impacts from this induced electric field are not likely to occur.

Where cables are spaced and not buried (e.g. in some small sections of the route in offshore waters of the Timor Sea) the induced electric field is predicted to be higher than background, which may be detectable by elasmobranchs which occur in deeper offshore waters. However, the induced electric field is predicted to dissipate rapidly with distance from the cable (e.g. it reduced from 1,573 $\mu\text{V}/\text{m}$ at the seabed to 125.6 $\mu\text{V}/\text{m}$ within 1 m of the cable). The induced electric field is generated by seawater currents interacting with the cables magnetic field, and therefore induced electric fields will dissipate as the magnetic field dissipates (i.e.

within 8-9 m of the cable where it is unbundled and unburied). In the offshore waters, water depth varies but is generally around 60-130 m deep (see Section 4.2 of the Marine Ecology Report – Appendix T of the Draft EIS), and therefore the vertical distance where induced electric fields may be detectable is narrow compared to the depth of the water column.

Elasmobranchs likely to occur in the deeper offshore waters surrounding the Subsea Cable System include Whale Sharks, sharks (e.g. Shortfin Mako, Longfin Mako and Oceanic Whitetip) and Manta Rays. All of these species are mostly pelagic (i.e. they are not bottom dwellers or exclusively benthic feeders) and are migratory and/or transient (refer to Section 11 above). Therefore, while an individual animal may dive deep and interact with the area near the seabed where induced electric fields are higher than the background (within 8-9 m of the cable), this is unlikely to significantly impact on their behaviour due to the scale and duration of the potential impact (i.e. narrow footprint which would be detected for a short period of time as the animal swims past). The habitat within the offshore area surrounding the Subsea Cable System is vast and the cable route does not cross any particularly unique or important habitat which is not also provided in the surrounding region.

Even if elasmobranchs detected the EMF generated by the Subsea Cable System, the literature review found that elasmobranchs assessed either appeared to habituate to the artificial EMFs (induced electric fields) or learn that they were not produced by an accessible food source (Orr, 2016), and that with habituation and the lack of a food source, bottom-living elasmobranchs were anticipated to move on to other foraging areas, with no consequential biological impacts (Hutchinson et. al., 2020). The various studies undertaken and reported on in the literature did not identify any impacts to elasmobranchs with other (currently operating) subsea HVDC cables locations (e.g., Whitehead, 2002).

15.3.4 EMF avoidance and mitigation measures

Section 5 of Appendix E discusses how the cable design and configuration will reduce EMF. The principal measures include:

- Direct mitigation by design (e.g., selecting modern cable designs).
- Direct mitigation by cable circuit configuration (e.g. bundling of HVDC cables).
- Indirect incidental mitigation by cable protection (e.g. burial in soft seabed or rock covers on hard seabed).

Direct mitigation by design

The AAPowerLink intends to use modern cross-linked polyethylene (XLPE) cables, which have shielding and insulation to maximise cable efficiency and minimise the EMF generated. Industry standards for subsea cables require shielding to block the electric field emitted using conductive sheathing (Boehlert and Gill, 2010). Due to improved insulation technology, high-voltage subsea power cables require less current to supply power than a cable of lower voltage, resulting in a reduction in their magnetic field emissions. With these modern cables there is no direct electric field emitted outside the cable, but some magnetic field is still generated outside the cable which in turn induces electric current.

Direct mitigation by configuration

Bundling cables where suitable and appropriate will minimise EMF. Bundling cables results in a reduction in magnetic field generation because the currents flowing in opposite directions have a cancelling effect on EMF.

Indirect mitigation by cable installation depth

A beneficial side effect of cable burial is a reduction the maximum EMF at the seabed overlying the cable than would be the case of a cable laid directly on the seabed (i.e., unburied). The AAPowerLink subsea

cables are proposed to be buried in nearshore areas to protect them from accidental potential hook-ups by ships' anchors and/or bottom-trawled fishing gear. Whilst this will reduce the EMF, cable burial is not regarded as a direct EMF mitigation measure and is generally only considered for technical reasons (e.g., to avoid anchor hook-ups in busy shipping areas). To date and based on the updated EMF literature review in Section 3, no proponents or operators of HVDC subsea cables have been required to bury cables for the primary purpose of reducing maximum EMFs at the seabed-water interface as a direct mitigation measure.

Indirect mitigation by rock cover of cables laid on the seabed

Burying cables (for cable protection) minimises EMF. Where cable burial is not possible (e.g., hard seabed), cables may be laid directly on the seabed. Protection of the unburied cables using rock cover or concrete mattresses will also reduce EMF.

15.3.5 Post-installation verification

Once cables are laid, a post-installation survey will be undertaken to ensure that the cables are in the correct location and buried (or protected with rock armouring) to the correct depth. AAPowerLink consider the need for undertaking a one-off magnetometer survey of the nearshore (Beagle Gulf) and offshore (Timor Sea) areas around the laid Subsea Cable System, during early operations (i.e. when the cables are in use) to validate and confirm the accuracy of the predicted magnetic fields if required.

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