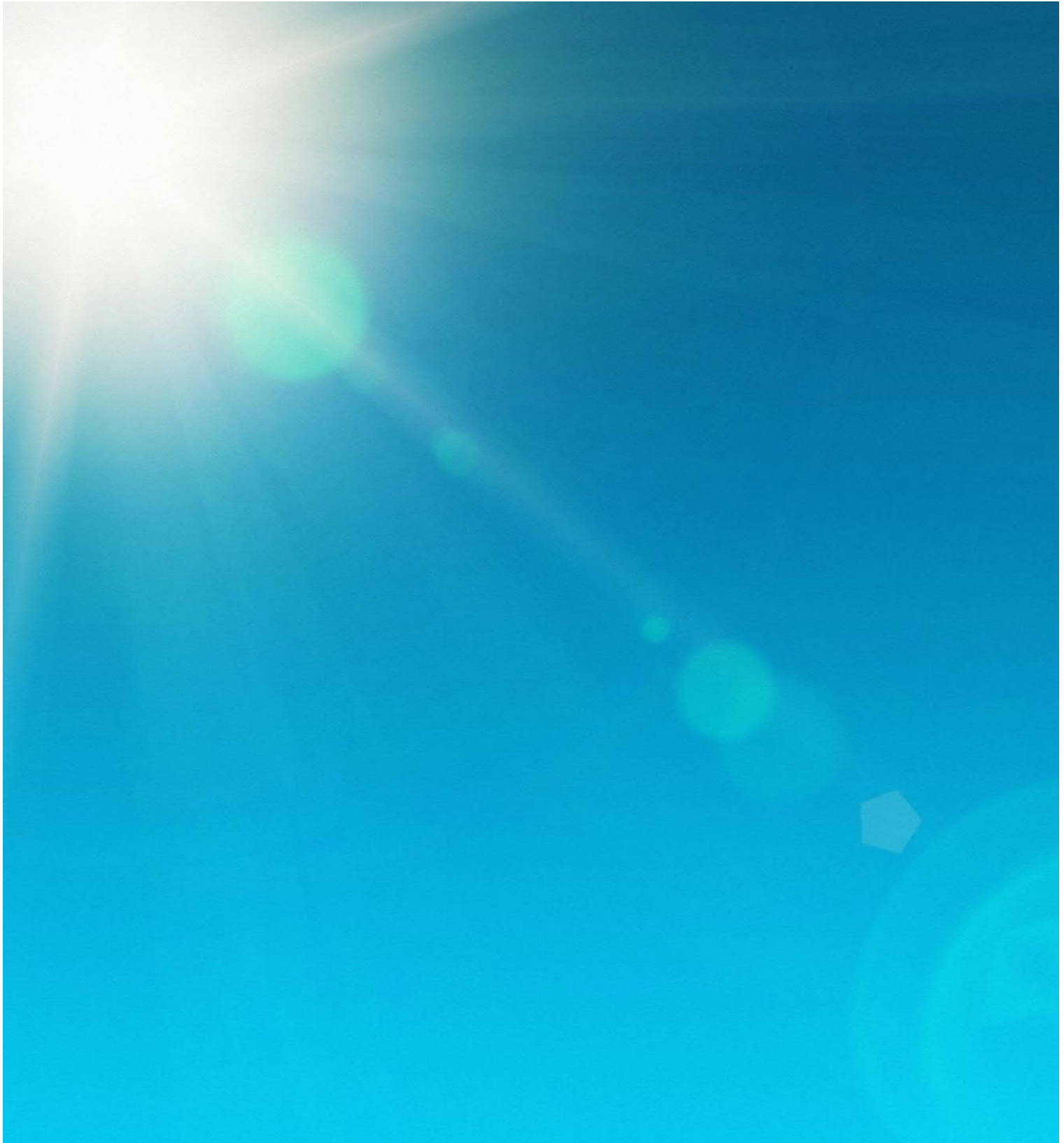


March 2022

Chapter 8 – Aquatic Ecosystems

Australia-Asia PowerLink Environmental Impact Statement

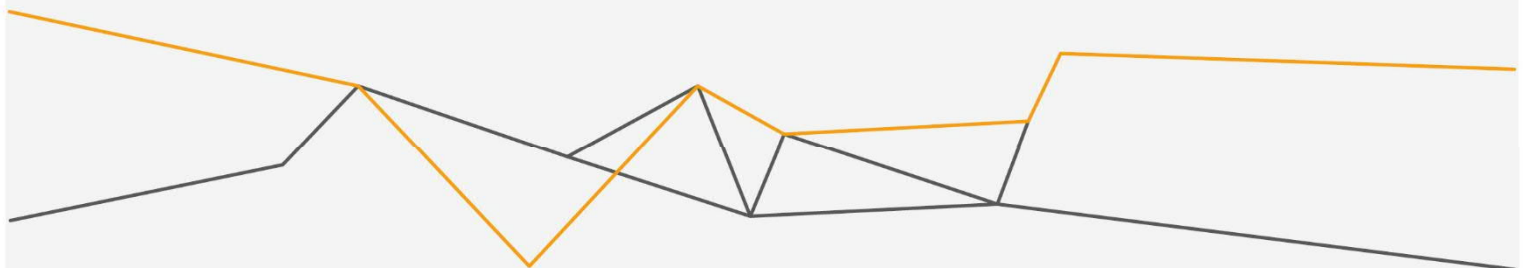


Chapter 8 – Aquatic Ecosystems

Document ID: 199004

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8 Aquatic Ecosystems

The NT EPA's objective for the Aquatic ecosystems factor is:

"Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning."

This chapter describes and assesses the significance of potential impacts to aquatic ecosystems associated with the Australia-Asia PowerLink (AAPowerLink) proposal. Aquatic ecosystems are those which depend on water flows or periods of sustained or periodic inundation or waterlogging for their ecological integrity (AETG 2012). For this EIS, aquatic ecosystems include all freshwater habitats and species that live in freshwater environments (i.e., fish). Riparian and wetland habitats are discussed where relevant and are also assessed in Chapter 5 Terrestrial Ecosystems.

The potential impacts to aquatic ecosystems considered in this chapter were identified with reference to the EIS Terms of Reference (TOR) issued by the NT Environment Protection Authority (NT EPA) (Appendix A), issues raised by stakeholders, and professional judgement of the EIS team (Appendix D) based on their knowledge and understanding of the AAPowerLink components and activities described in Chapter 2 Proposal Description. Potential impacts were then assessed using the Environmental Impact Assessment (EIA) methods described in Chapter 3 Impact Assessment. This chapter presents the findings of the EIA process undertaken for the Aquatic ecosystems factor.

Chapter 5 Terrestrial Ecosystems address potential impacts to species which inhabit both aquatic and terrestrial ecosystems, or seasonally inundated areas. Chapter 10 Marine Ecosystems addresses impacts to marine habitats and species.

8.1 Information sources

The information within this chapter is based on review of existing studies and information, and observations made during the ecology field surveys undertaken at the Solar Precinct (Appendix O), along the 66 km section of the OHTL located in the Utilities Corridor and at the Darwin Converter Site (Appendix P). The location of aquatic ecosystems has been identified based on aerial imagery and data from the Northern Territory Government's database, available on NR Maps (DEPWS 2021). Additionally, the national Groundwater Dependent Ecosystem (GDE) Atlas was used to collate data on GDEs within or proximate to the proposal footprint (see BoM 2021). Ecological field surveys confirmed the location of watercourses, springs, and drainage depressions in the surveyed areas. Specific aquatic ecosystem surveys were not considered necessary as the outcomes of the EIA indicate direct disturbance of instream habitats will be limited and the proposal is unlikely to cause significant impacts to water quality or hydrological processes, and therefore any aquatic ecosystems that occur are unlikely to be significantly impacted.

This chapter draws on information presented in Chapter 6 Hydrological Processes and Chapter 7 Inland Water Environmental Quality to identify potential indirect impacts to aquatic ecosystems associated with change in surface water flows and/or availability or an impact to surface water quality.

Journal articles and studies were used to identify the type and condition of aquatic ecosystems in the region, including studies on Lake Woods, and watercourses crossed by the OHTL. Northern Territory Government reports have been reviewed and summarised, including reports on the aquatic ecosystems within the Daly River Basin (which is traversed by the OHTL) and at Gunn Point (including, GDEs). These are referenced throughout.

8.2 Relevant policies and guidelines

The EIA for the Aquatic ecosystems factor references the following policies and guidelines:

- *Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA 2016).
- *Australian and New Zealand guidelines for fresh and marine water quality* (ANZG 2018).
- *Austrroads Guide to Road Design* (Austrroads 2021).
- *Aquatic Ecosystems Toolkit* (AETG 2012).
- *Best Practice Erosion and Sediment Control Guidelines* (IECA 2008).
- *Northern Territory Land Clearing Guidelines* (DEPWS 2021b).

Numerous other policies and guidelines were referenced to assess potential impacts associated with hydrological process and inland water quality, which have indirectly informed this chapter. Refer to Chapter 6 and Chapter 7 for those policies and guidelines.

8.3 Environmental values

This section describes the aquatic ecosystems within the proposal footprint and area of influence (surrounding and downstream areas that could be indirectly affected), and the supported values. Beneficial uses supported by surface and groundwater features have been identified and described in Chapter 6 Section 6.3 and Chapter 7 Section 7.3.

8.3.1 Solar Precinct

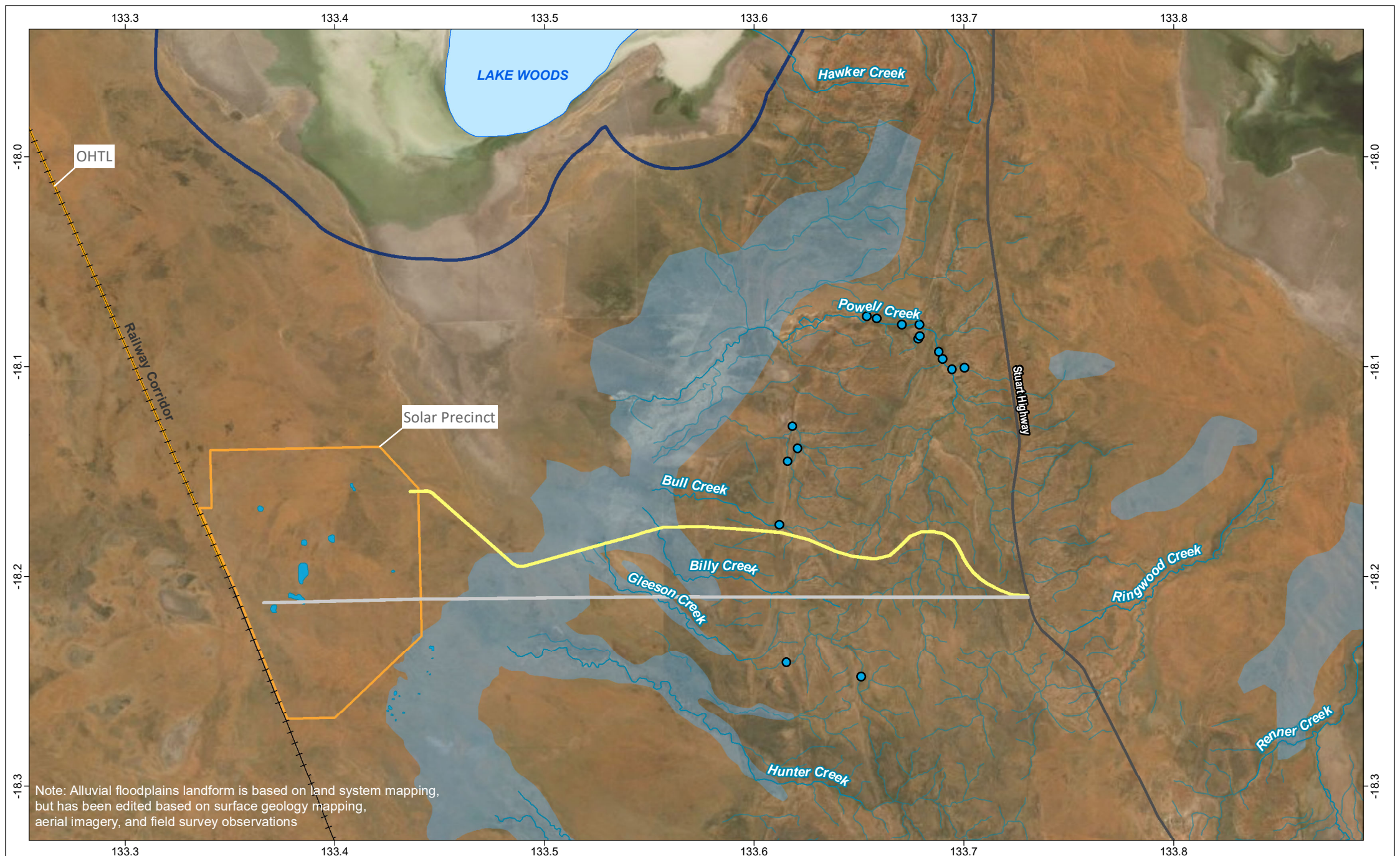
There are no aquatic ecosystems present within the Solar Precinct footprint, primarily because there are no surface watercourses present. There are several drainage depressions that hold water for periods following rainfall as shown on Figure 8-1. However, these are sandy loam soils (not clay pans) and do not support riparian vegetation, or significant aquatic habitat or ecosystems.

8.3.1.1 Watercourses and wetlands

East of the Solar Precinct (between the site and the Stuart Highway) is a large alluvial floodplain, which includes isolated drainage depressions, watercourses, and patches of black soil plain. These are temporary wetlands¹ that may hold some aquatic ecosystem value during periods of inundation or flow. The access roads into the Solar Precinct traverse the alluvial floodplain and directly intersect an isolated patch of black soil plain and several watercourses as shown on Figure 8-1. Surface water flows and/or inundation occurs during periods of rainfall, usually associated with wet season weather patterns from the northern portion of the Northern Territory. None of the features hold permanent water at the crossing locations, which limits the availability of aquatic habitats.

¹ Wetlands in the arid region are defined by Duguid et al. (2005) as areas of permanent or temporary surface water or waterlogged soil, with inundation/waterlogging to occur frequently enough, and be of sufficient duration, to support macroscopic plants and animals which require such conditions during their life cycle. In inland Australia they can be still or running water, and of any depth or size.

The ephemeral watercourses traversed by the access roads do support riparian vegetation such as large Eucalyptus trees, which is considered significant vegetation under the *NT Land Clearing Guidelines* (DEPWS 2020). Riparian vegetation fulfils critical ecological functions in aquatic ecosystems, including stabilising banks and watercourses, filtering runoff, and improving water quality in water discharging to watercourses, and providing habitat for aquatic plants and animals (DEPWS 2021b). Photographic examples of riparian vegetation along watercourses crossed by the access roads are provided in Section 6.3.1.2 of Chapter 6 Hydrological Processes.



Note: Alluvial floodplains landform is based on land system mapping, but has been edited based on surface geology mapping, aerial imagery, and field survey observations

Legend		
<ul style="list-style-type: none"> AAPowerLink infrastructure Main access road (sealed) All-weather access road (unsealed) Inferred spring locations 	Landform class <ul style="list-style-type: none"> alluvial floodplains Watercourses Shallow depressions (revised from fieldwork) 	
<ul style="list-style-type: none"> Lake Woods Lake Woods SoCS Railway Principal road 		

Figure 8-1: Map of surface water features (potential aquatic habitats) proximate to the Solar Precinct

Project: Australia-Asia PowerLink	Reference: M-Files ID 199004	Revision: 2
Projection: GDA2020	Date: 10/03/2022	
		Scale: 1:250,000

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Source: Sun Cable, EcOz, NTG (NR Maps)
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8.3.1.2 Springs

Springs are groundwater dependent ecosystems (GDEs), and are important aquatic ecosystems, particularly in arid and semi-arid zones where water is scarce as they provide refugia to many terrestrial fauna species. Several springs occur along the watercourses crossed by the Solar Precinct access roads, the locations of which are shown in Figure 8-1. Springs were identified during helicopter transects as part of the ecology surveys, undertaken by EcOz ecologists and cultural monitors (Appendix O). Following the field survey, fractional ground cover data from the driest period of the year (spring) was reviewed to identify areas which were still 'green', which may indicate presence of a spring or accessible groundwater (i.e., an aquatic or terrestrial groundwater dependent ecosystem). Aerial imagery was then used to check the 'green' spots for signs of waterholes, springs, or green vegetation.

The closest spring to the access roads is located along Bull Creek and is ~800 m downstream of the proposed access road crossing location. All other springs are located >3 km away from the access roads.

Large springs are also known to occur along Powell Creek and Newcastle Waters Creek (including the well-known Longreach Waterhole near Elliott), which are culturally significant (see Appendix V). These springs are located a significant distance from the proposal footprint; Powell Creek spring is located ~12 km north of the gravel access road corridor, while Longreach Waterhole is located north of Lake Woods and over 60 km north of the proposal footprint.

8.3.1.3 Lake Woods

The Solar Precinct is in the Lake Woods catchment. The outer boundary of the Lake Woods Site of Conservation Significance (SOCS), delineating the area of international conservation significance, is approximately 10 km to the north of the Solar Precinct site. Lake Woods is a large ephemeral lake that, during average rainfall conditions, occupies an area of approximately 350 – 500 km², however it can cover 850 – 1000 km² during periods of major flooding, and is one of the largest temporary freshwater lakes in the NT and tropical Australia (Harrison et al. 2009). The Solar Precinct footprint is greater than 10 km from the usual extent of Lake Woods and is mostly located outside of the maximum modelled flood extent, except for the north-eastern corner, which may be inundated in very rare (e.g., 1 in 1,000 year) flood events as discussed in Chapter 6 Hydrological Processes.

Lake Woods is not a RAMSAR wetland but is listed in the Directory of Important Wetlands of Australia (DAWE 2019) as a nationally important wetland. As detailed in Chapter 5 Terrestrial Ecosystems, the lake is an important habitat for migratory shorebirds and waterbirds. The lake basin supports large areas of lignum swamp, and during periods of inundation provides diverse wetland habitat, including breeding sites for waterbirds (Harrison et al. 2009). In terms of aquatic ecology, studies have concentrated on the permanent waterholes along Newcastle Creek and Newcastle Waters Creek, which are to the north of Lake Woods, and outside the AAPowerLink proposals area of influence. However, the fish species found along the permanent waterholes north of Lake Woods, including Longreach Waterhole, are likely to be representative of fish species found within Lake Woods during periods of flood and inundation. A study was undertaken by Midgley (1982) on the fish fauna in three permanent waterholes on Newcastle Creek, including observations on some invertebrate species. These waterholes were re-visited in 2014, providing some greater detail on fish species (Duguid, pers. comm. 10 February 2021). The complete list of fish species from those studies is provided in Table 8 1, all of which are commonly occurring species and were found in other inland drainage systems across the Northern Territory during Midgley's survey (Midgley 1982).

The main value of the aquatic ecosystems associated with Lake Woods is the provision of foraging habitat for migratory shorebirds and waterbirds, which are considered in Chapter 5 Terrestrial ecosystems.

Table 8-1. Aquatic life recorded from waterholes in Newcastle Creek

Fish	Invertebrate
Chanda perch (<i>Ambassis mulleri</i>)	Freshwater prawn (<i>Macrobrachium sp.</i>)
Bony bream (<i>Nematolosa erebi</i>)	Freshwater crab (<i>Austrothelphusa transversa</i>)
Hyrtyls catfish (<i>Neosilurus hyrtlii</i>)	Freshwater mussel (<i>Velesunio sp.</i>)
Rendahl's catfish (<i>Porochilus rendhali</i>)	
Silver catfish (<i>Porochilus argentus</i>)	
Spangled perch (<i>Leiopotherapon unicolor</i>)	
Desert rainbowfish (<i>Melanotaenia splendida tatei</i>)	

Note: some species names have been updated from Midgley's records (by Duguid and Hammer) to reflect contemporary taxonomic nomenclature (Hodgets, 2013)

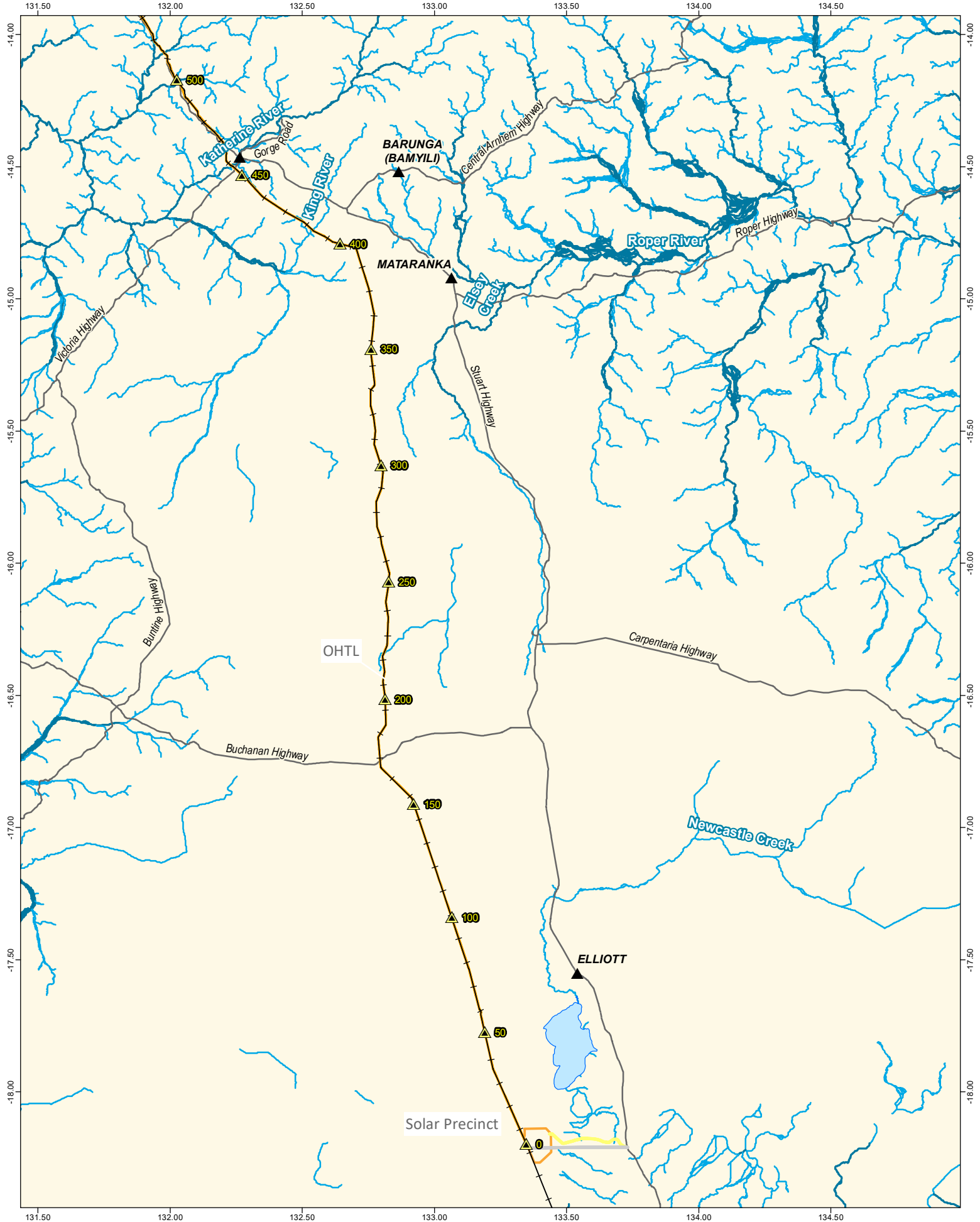
8.3.2 Overhead Transmission Line

The OHTL corridor intersects numerous watercourses and several wetland habitats, some of which are likely to support aquatic ecosystems. The location of these habitats is summarised below, noting that aquatic surveys have not been undertaken because the OHTL will span major watercourses and therefore impacts to instream aquatic habitats or riparian vegetation will be limited.

8.3.2.1 Watercourses

As detailed in Chapter 6 Hydrological Processes, the OHTL corridor crosses 154 watercourses, including four major perennial rivers, and 24 watercourses of stream orders three and four that flow for extended periods each wet season. The Katherine, Edith, Fergusson, and Adelaide are major perennial watercourses that are proposed to be crossed by the OHTL and support significant aquatic ecosystems and extensive riparian vegetation. While the level and flow in the rivers fluctuates, all hold permanent water which is important habitat for aquatic species, as well as refuge for terrestrial species. The 24 higher order (stream order three and four) watercourses traversed by the OHTL corridor include several named rivers and creeks (from south to north they are King River, Cullen River, Saunders Creek, Margaret River, Howley Creek, Bridge Creek, Burrell Creek and Elizabeth River) and unnamed watercourses, including unnamed tributaries of major rivers (for example, Eley Creek and Manton River). The creeks and watercourses of stream order three and four are likely to support aquatic ecosystems of varying richness and diversity; most cease to flow during the dry season at the crossing location but are likely to sustain pools in their reaches which would support aquatic biota and provide a dry season refuge for terrestrial fauna. The remaining 126 watercourses that are crossed by the OHTL corridor receive seasonal or episodic flows, and therefore support limited aquatic habitat. The locations of major watercourse crossings are provided in Table 6-3 of Chapter 6 and are shown on Figure 8-2 and Figure 8-3.

Watercourses traversed by the OHTL within the Utilities Corridor (i.e., north of KP 722) were inspected during ecology surveys and details of the riparian and aquatic habitats present are provided in Appendix P. The survey was undertaken in September and October 2021, and so represents late dry season conditions. No watercourses were flowing at the time of the survey. Most watercourses crossed were minor drainage lines with an indistinct or narrow channel, or a broad plain/wetland which would likely be inundated each wet season. The Elizabeth River is the only named watercourse crossed by the OHTL within the Utilities Corridor, and it is ephemeral at the crossing location (i.e., ceases to flow in the dry season), although the riparian vegetation is ~180 m. The location of watercourses and wetland features are shown on Figure 8-4 and photographs of the two most defined watercourses with riparian vegetation are provided in Section 6.3.2 of Chapter 6. Crossings along the OHTL (Railway Corridor) have not been inspected; however, ecology surveys are planned which will include assessment of watercourse crossing locations and conditions and will inform detailed design of the crossings.



Legend

- AAPowerLink infrastructure
- ▲ OHTL Kilometre Points
- ▲ Towns
- Roads
- + Railway
- Main access road (sealed)
- All-weather access road (unsealed)
- Major watercourse (stream order 5+)
- Minor watercourse (stream order 3-4)
- Lake Woods

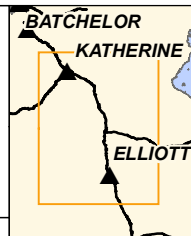


Figure 8-2: Map of major watercourses crossed by the OHTL - southern end

Project: **Australia-Asia PowerLink**

Reference: M-Files ID 199004

Date: 10/03/2022

Revision: 2

Scale: 1:2,000,000

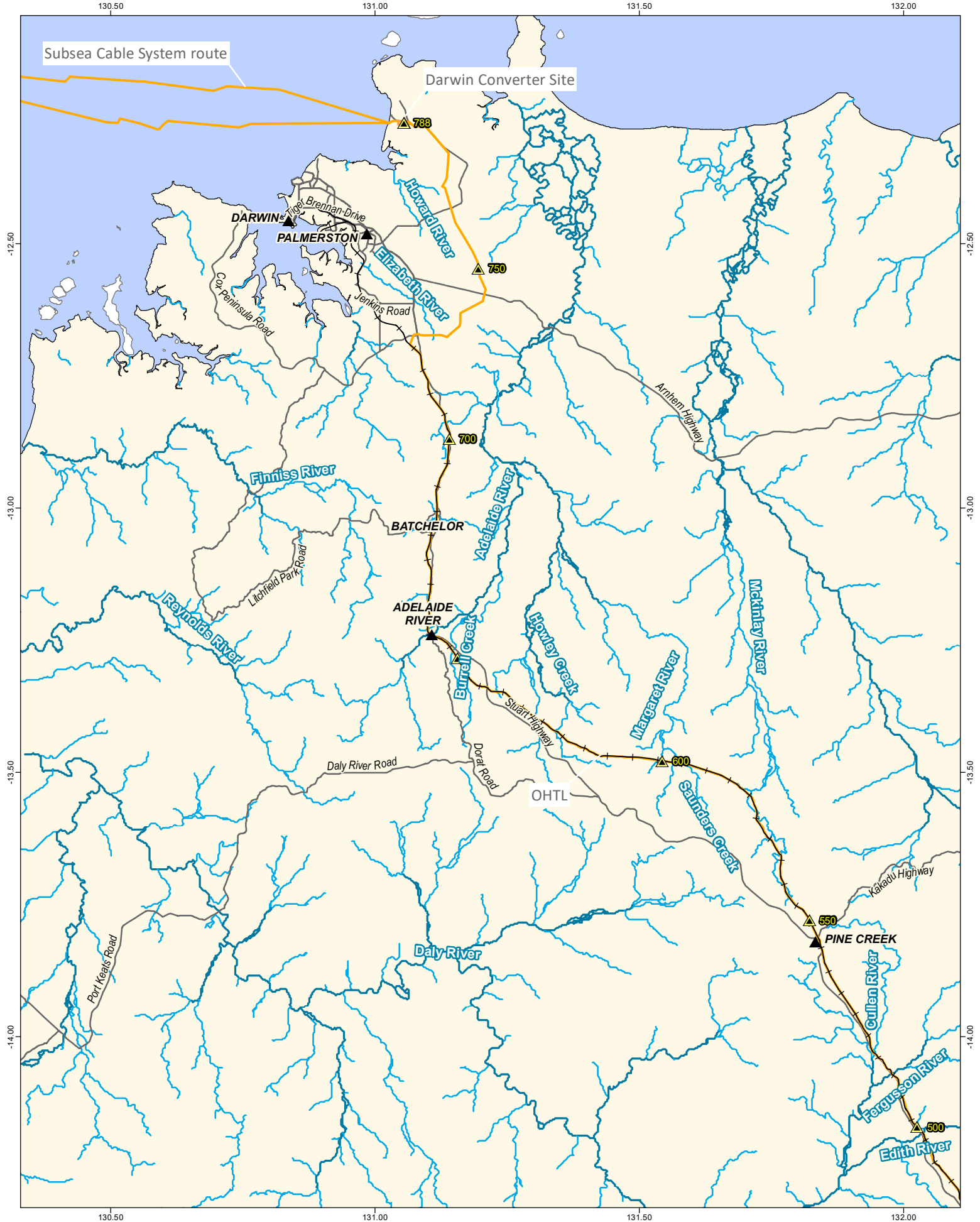
Coordinate System: GDA2020

0 20 40 60 Kilometres

A4

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Legend

- AAPowerLink infrastructure
- ▲ OHTL Kilometre Points
- ▲ Towns
- Railway
- Roads
- Watercourses (stream level 5+)
- Watercourses (stream level 3-4)



Figure 8-3: Map of major watercourses crossed by the OHTL - northern end

Project: Australia-Asia PowerLink

Reference: M-Files ID 199004

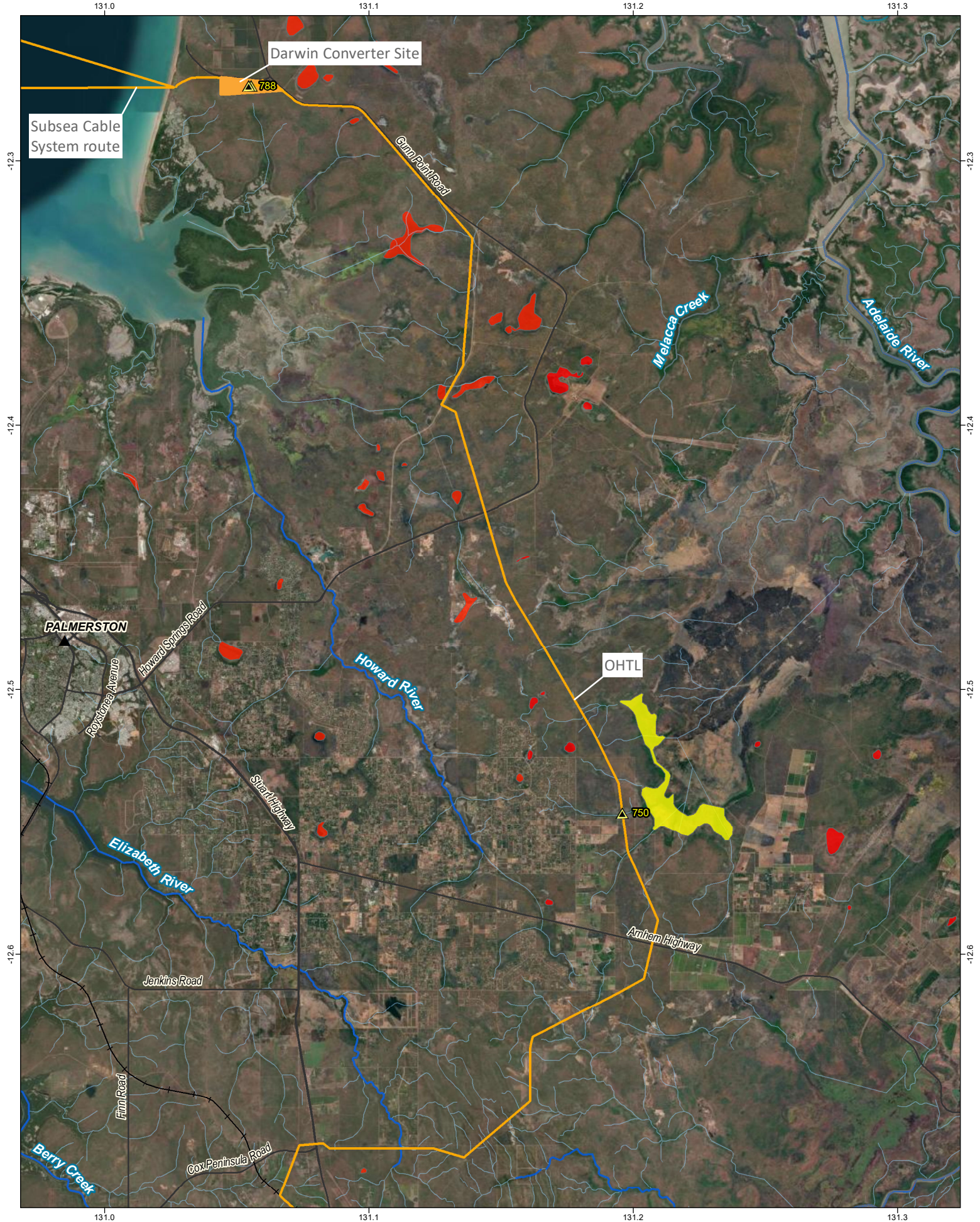
Date: 10/03/2022

Revision: 2

Scale: 1:1,000,000

Coordinate System: GDA2020

A4



Legend

- AAPowerLink infrastructure
- ▲ OHTL Kilometre Points
- ▲ Towns
- Streams
- High potential GDE - from national assessment
- Known GDE - from regional studies
- Railway
- Roads
- Major Drainage
- Minor Drainage

Aquatic GDEs

Source: Sun Cable, EcOz, NTG (NR Maps), BoM



Figure 8-4: Map of aquatic ecosystems proximate to the OHTL Utilities Corridor

Project: **Australia-Asia PowerLink**

Reference: M-Files ID 199004

Date: 10/03/2022

Revision: 2

Scale: 1:200,000

Coordinate System: GDA2020

0 5 Kilometres

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8.3.2.2 Groundwater Dependent Ecosystems

Aquatic GDEs provide important aquatic habitat as they are usually permanent or near permanent waterbodies which provide ecological functions and refuge habitat for both aquatic and terrestrial species. As detailed in Chapter 6 Hydrological Processes, there are numerous GDEs proximate to the OHTL corridor that are likely to support aquatic ecosystems with varying degrees of richness and diversity (BoM 2021). Aquatic GDEs generally align with higher order watercourses referred to above, with known GDEs mapped along the Katherine River and King River, and high potential GDEs mapped along the other major river crossings. The region surrounding the Utilities Corridor portion of the OHTL contains numerous swamps, lagoons and springs which are known or high potential GDEs (see Figure 8-4). The OHTL corridor avoids known GDEs including the significant GDEs at Black Jungle Swamp (approximately 1 km east of the corridor), and the Howard River (>6 km west of the corridor). One GDE mapped as high potential GDE is intersected by the OHTL at KP 769-770; this swamp held water at the time of the ecology survey (in the late dry season) and is connected to a larger perennial billabong to the west; see Appendix P for photographs and additional information.

There are two sinkholes within 100 m of the corridor near Katherine region which are considered subterranean GDEs, which may support aquatic habitats. These are considered to be outside the area of influence for the OHTL as proposal activities are unlikely to impact on the sinkholes.

8.3.2.3 Aquatic threatened species

The Terrestrial Ecosystems chapter (Chapter 5) considers environmental values and potential impacts to species which inhabit riparian and wetland habitats, such as the Howard River Toadlet (*Uperoleia daviesae*), Mertens' (*Varanus mertensi*) and Mitchell's (*Varanus mitchelli*) water monitors, *Utricularia dunstaniae* and *Cleome insolata*. Threatened species considered herein are only those that live entirely in aquatic freshwater environments.

Three threatened species of fish have been recorded in the inland reaches of the Adelaide River:

- Northern River Shark (*Glyphis garricki*) – Endangered (EPBC Act and TPWC Act)
- Speartooth Shark (*Glyphis glyphis*) – Critically Endangered (EPBC Act) and Vulnerable (TPWC Act)
- Freshwater Sawfish (*Pristis pristis*) – Vulnerable (EPBC Act and TPWC Act).

The two shark species have not been recorded as far inland as where the OHTL intersects the Adelaide River. Of the four *Pristis* species reported to occur in Australia, the Freshwater Sawfish is the one most often associated with freshwater and has been recorded several hundred kilometres upstream (Thorburn et al. 2003). It has a high likelihood of occurring in the Adelaide River proximate to the OHTL crossing location. Marginally suitable habitat is present in the Elizabeth River where the OHTL crosses the river (noting that suitable habitat would only be provided during periods of flow), but there are no records of any of the three species from the Elizabeth River. The fish are unlikely to be present in any of the other rivers intersected by the OHTL corridor.

No other aquatic threatened species are likely to occur in freshwater aquatic ecosystems within the proposal's direct disturbance footprint or area of influence.

8.3.3 Darwin Converter Site and Cable Transition Facilities

The Darwin Converter Site and Cable Transition Facilities footprints at Murrumujuk (Gunn Point) do not contain any defined watercourses or aquatic habitats within the direct disturbance footprint. There is a seasonal swamp immediately south-west of the proposal footprint that will receive runoff from the footprint, which then drains, via a minor drainage line, towards the floodplains and coastal creeks within the Tree Point Conservation Area. Swamps (also referred to as lagoons, billabongs, and waterholes) are common wetlands in the Darwin region, characterised as discrete rounded depressions which are seasonally inundated or contain permanent water (Lloyd 1999). All of these features have aquatic ecosystem values, including supporting macrophytes (aquatic plants), and providing habitat for numerous species including waterbirds, fish, reptiles, and macroinvertebrates (Lamche 2008, Welch and Schult 2006). Wetlands in general also provide a number of valuable functions, including reducing erosion and filtering water, improving water quality (DAWE 2021). An aquatic biota survey has not been undertaken for the seasonal swamp, but observations made during ecology surveys (see Appendix P) have informed our description of the likely supported values.

The seasonal swamp is a freshwater palustrine² system, with no open water but *Melaleuca* woodland to *Melaleuca* Forest throughout. The swamp holds water in the wet season and dries out during the dry season. No threatened species have been identified which would rely on the swamp; the transitional vegetation fringing the swamp was surveyed for *Cleome insolata* in February 2022 and none was identified (see Chapter 5). No weeds were identified during surveys, but some disturbances were noted including tracks and minor drainage alterations associated with Murrumujuk Drive. Based on previous surveys of wetlands (e.g., lagoons and swamps) in the Darwin region, the seasonal swamp is likely to support a variety of macrophytes and other vegetation, with species diversity greatest during the end of the wet season/early dry season, and diversity decreasing as the swamp dries (Lamche and Schult 2012, Lloyd 1999).

Generally, waterbodies which maintain water during the dry season provide important refuge for many aquatic and terrestrial species. Lamche (2008) developed and assessed the application of a framework for assessing the health of wetlands in the Darwin region and found that lagoons or waterbodies which are small and/or frequently dry out support less fish than larger, permanent waterbodies. The seasonal swamp is not connected to other major freshwater ecosystems (and no perennial ones) and so, while some fish may be present during periods of inundation, the swamp does not provide important dry season refuge habitat for fish. Similarly, waterbirds are known to aggregate in small freshwater wetlands at the end of the dry season, as extensive wetlands dry out (see Appendix P). The seasonal swamp dries out during the dry season, and so does not provide this important refuge function for waterbirds.

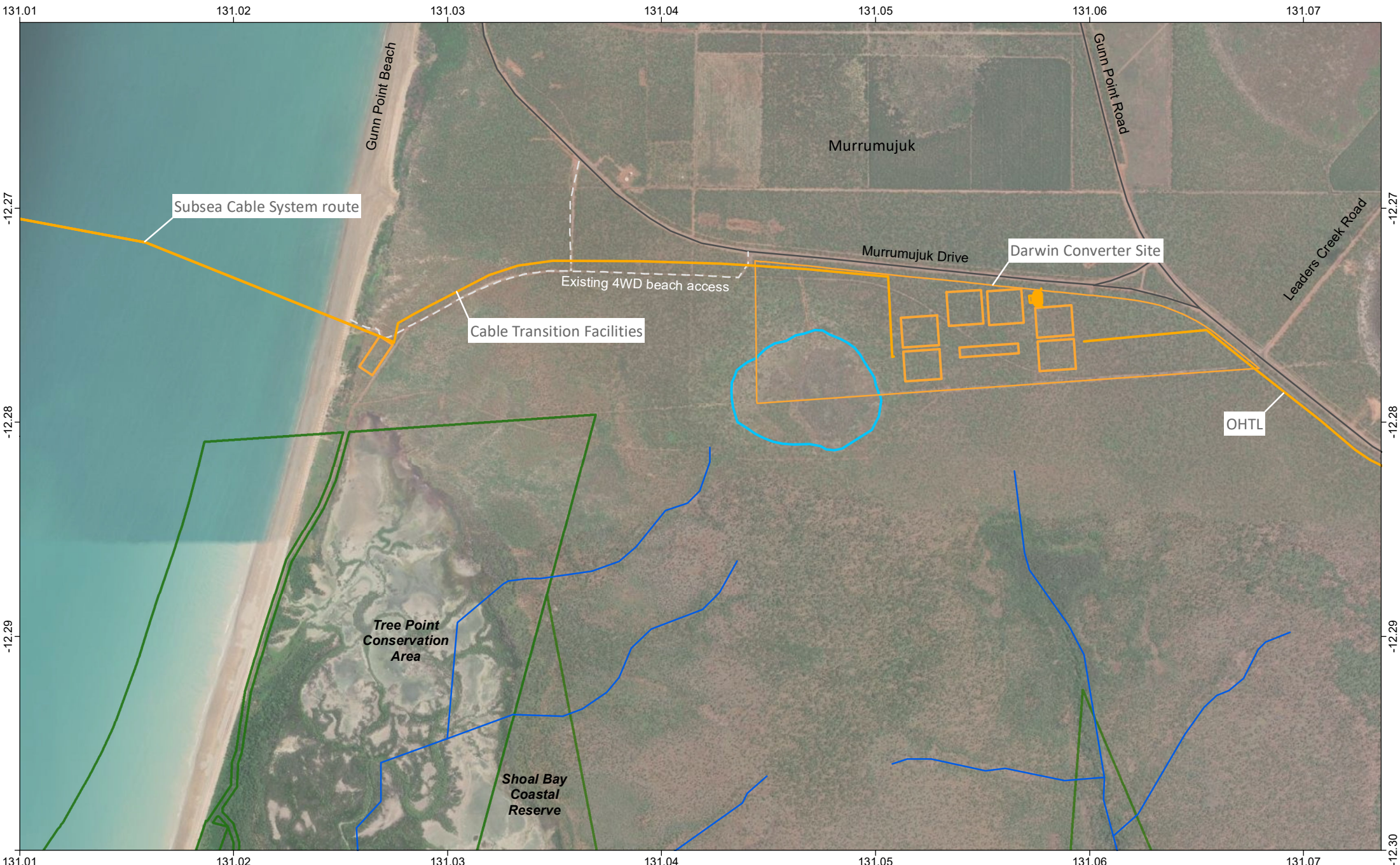
Criteria for identifying high ecological value aquatic ecosystems is provided in the Aquatic Ecosystems Toolkit, which includes aspects such as diversity, distinctiveness, vital habitat, naturalness, and representativeness (AETG 2012). Based on the Aquatic Ecosystem Task Group (ATEG) criteria, the seasonal swamp is not considered a high ecological value aquatic ecosystem; nevertheless, it does support aquatic ecosystem values and is likely to be 'healthy'. Lamche (2008) identified wetland health indicators for the Darwin region, which include catchment disturbance, physical form and process, hydrological disturbance, fringing zone, water and soil quality and biota (including species diversity and presence/absence of weeds). The seasonal swamp is likely to score highly on most criteria, although disturbance has occurred within the swamp itself, and in the catchment via Murrumujuk Road (which has altered hydrology due to the presence of the road and use of culverts and drainage). The swamp also appears to support recreational use³; tracks are visible throughout the

² Palustrine aquatic ecosystems are dominated by vegetation – trees, shrubs, emergent etc. – as opposed to open bodies of water (Aquatic Ecosystems Task Group 2012).

³Gunn Point is a popular area for recreational use; see Chapter 6, 10 and 13.

swamp and campers have been observed near the swamp during ecological surveys. Based on the criteria the swamp is considered 'slightly disturbed'.

The Darwin Converter Site is within the catchment of two conservation areas: the Tree Point Conservation Area to the south-west, and the Shoal Bay Coastal Reserve to the south. Both areas support aquatic ecosystems in the coastal floodplains and mangrove ecosystems, however these are marine ecosystems and are discussed, where relevant, in Chapter 10. Impacts to the aquatic ecosystems in Tree Point Conservation Area and Shoal Bay Coastal Reserve are not predicted to occur because of the nature of activities and distance from proposal activities.



Legend

AAPowerLink Infrastructure	Seasonal swamp	Howard Water Allocation Plan (inset)
4WD beach access	NT Parks and Reserves	
Road		
Streams		



Figure 8-5: Map of surface water features proximate to the Darwin Converter Site and Cable Transition Facilities

Project: Australia-Asia PowerLink	Reference: M-Files ID 199004	Revision: 2
Coordinate System: GDA2020	Date: 10/03/2022	

0 1 Kilometers

Scale: 1:25,000 | A4

source: Sun Cable, EcOz, NTG (NR Maps)
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8.4 Potential impacts

The potential impacts to aquatic ecosystems, including aquatic flora and fauna and terrestrial fauna that are supported by these habitats, have been assessed using the EIA methodology described in Chapter 3 – Impact Assessment. The EIA identified and assessed the following impacts that could occur during construction and/or operations:

- Loss or reduction of aquatic habitat or species caused by:
 - Direct loss of aquatic habitat
 - Water quality impacts
 - Altered hydrology or groundwater extraction (i.e., water availability), or
 - Depositional dust.
- Reduction of aquatic habitat value of Lake Woods due to increased air temperatures caused by the presence of the solar arrays (referred to as the heat island effect).

The EIA considered the impact avoidance and mitigation measures detailed in Section 8.5 below and assessed the residual impacts to aquatic ecosystems assuming these measures are effectively implemented. A residual impact rating was then assigned taking into consideration the scale, magnitude and duration of the impacts, the presence/absence of environmental values and/or sensitive receptors and the level of certainty with respect to the intensity of the impact and the effectiveness of the mitigation measures. The residual impact ratings adopted in the assessment are provided in Table 8-2.

The outcomes of the EIA are summarised in Table 8-3 and Table 8-4 from the Impact Assessment Registers provided at Appendix E and discussed in the sections below.

Table 8-2. Residual impact ratings adopted for the AAPowerLink EIA

Ratings and Description
<p>Minor: A minor residual impact is unlikely to be significant.</p> <p>A minor impact generally has two or more of the following characteristics: Scale: Limited/Localised Magnitude: Negligible/Minor Duration: Short-term/ Medium-term/Reversible.</p> <p>OR There are no sensitive receptors or land uses present, and the environment does not contain any aspects that are valuable or otherwise important or unique (i.e., Very Low/Low rating), and there is moderate to high degree of certainty about the likelihood and intensity of the impact, and the effectiveness of proposed mitigation measures.</p>
<p>Moderate: A moderate residual impact has potential to be significant. The significance depends on the acceptability of the impacts and the effectiveness of mitigation measures.</p> <p>A moderate impact generally has two or more of the following characteristics: Scale: Localised/Regional Magnitude: Moderate Duration: Medium-term/Long-term</p> <p>AND/OR There are sensitive receptors or land uses present, or environmental aspects that are valuable or otherwise important or unique (i.e., Medium-High value rating), and there is a low degree of certainty about the impact, and the effectiveness of proposed mitigation measures.</p>
<p>Major: A major residual impact is likely to be significant. The level of acceptability will depend on offsets or benefits compensating for the impact.</p> <p>Impact generally has two or more of the following characteristics: Scale: Regional/ Widespread Magnitude: Moderate/Major Duration: Long-term/Permanent</p> <p>AND There are sensitive receptors or land uses present, or environmental aspects that are valuable or otherwise important or unique (i.e., Medium-High value rating).</p>

Table 8-3. Summary of EIA results – Aquatic ecosystems – Construction

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual impact
Direct loss of aquatic habitat Section 8.4.2.1	Solar Precinct	Possible No aquatic habitats present in Solar Precinct footprint. Access roads cross watercourses.	Limited Access road crossings may remove a narrow corridor of instream habitat (10m wide).	Long-term Habitat will be lost from the corridor indefinitely.	Negligible No change to aquatic ecosystems predicted outside 10m wide corridor.	Medium Watercourses do support aquatic ecosystems during periods of flow and do hold permanent pools.	High Aquatic habitats persist up and downstream of minor road crossings elsewhere in the region.	Minor
	Overhead Transmission Line	Possible OHTL crosses 154 watercourses. Lower order watercourses and wetlands will be crossed by the access track.	Limited OHTL construction may remove narrow corridor of riparian and instream habitat (max 22 m wide).	Long-term OHTL will retain 6 m wide access track through minor seasonal surface water features.	Minor No disturbance of aquatic ecosystems in major perennial watercourses.	Medium Watercourses and wetlands in OHTL corridor support aquatic ecosystems.	High Construction design avoids disturbance of major watercourses where habitats present.	Minor
	Darwin Converter Site	Unlikely	Not assessed as impact is inherently unlikely to occur. No watercourses or aquatic ecosystems present in direct disturbance footprint.				High Ecological surveys undertaken - no habitats present.	None
	Cable Transition Facilities	Unlikely	Not assessed as impact is inherently unlikely to occur. No watercourses or aquatic ecosystems present in direct disturbance footprint.				High Ecological surveys undertaken - no habitats present.	None

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual impact
Reduction in aquatic habitat value due to water quality impacts Section 8.4.2.2	Solar Precinct	Possible No aquatic habitats in Solar Precinct footprint. Access roads will cross ephemeral watercourses where erosion and sedimentation could occur.	Limited If water quality impacts occur, they will be limited to several hundred metres downstream of crossings.	Short-term Water quality impacts would only occur for days immediately following a rainfall event.	Minor Watercourses are naturally turbid following rainfall. No permanent pools or sensitive aquatic habitats present.	Medium Watercourses support aquatic ecosystems during periods of flow and hold permanent pools.	High Water quality impact directly link to erosion hazard, which has been assessed as Low in accordance with IECA (2008).	Minor
	Overhead Transmission Line	Possible OHTL crosses 154 water courses. Minor increases in turbidity could occur at crossings.	Limited Water quality may be impacted for a several hundred metres downstream of crossings.	Short-term Water quality impacts would only occur for days immediately following a rainfall event.	Minor No disturbance of beds, banks, or riparian vegetation in major perennial watercourses.	Medium Watercourses and wetlands support aquatic ecosystems.	High Water quality impact directly link to erosion hazard, which has been assessed as Low in accordance with IECA (2008)	Minor
	Darwin Converter Site	Possible Construction works will disturb soils in an area of high seasonal rainfall, which could result in turbid runoff.	Localised Water quality impacts may occur in the proximate seasonal swamp, but not further downstream.	Short-term Water quality impacts could occur following rainfall, and last for days to weeks.	Moderate Turbidity will alter natural conditions as turbidity is naturally low in similar swamps and lagoons.	Medium Seasonal swamp supports aquatic ecosystem and is a culturally important resource area.	Low Sensitivity of the swamp to altered water quality is uncertain.	Moderate
	Cable Transition Facilities	Unlikely	Not assessed as impact is inherently unlikely to occur. No aquatic habitats present in zone of influence				High Ecological surveys undertaken - no habitats present	None

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual impact
Reduction in aquatic habitat value due to altered hydrology or groundwater extraction Section 8.4.2.3	Solar Precinct	Unlikely No watercourses present in Solar Precinct footprint. Access roads will not be constructed during periods of flow. Groundwater extraction will be located away from springs and GDEs.	Limited Any change in flows will be limited to the immediate vicinity of the crossings.	Short-term Once crossings are installed surface water flows will be unimpeded due to road and drainage design.	Negligible Watercourses are minor ephemeral drainage lines. Watercourse crossings will not be constructed during periods of flow.	Medium Watercourses do support aquatic ecosystems during periods of flow and do hold permanent pools.	High Roads and crossings will adhere to Austroads, which is proven effective in mitigating impacts. Groundwater bores and extraction will be regulated under the <i>Water Act</i> .	Minor
	Overhead Transmission Line	Unlikely OHTL crosses 154 watercourses, but no major disturbance required. Groundwater extraction of minor volumes from existing bores.	Limited Overland flow paths may be altered in direct disturbance footprint (max 22 m wide).	Short-term Minor changes to overland flow paths could occur intermittently during significant rainfall events.	Negligible Minor changes in narrow footprint unlikely to impact aquatic ecosystems.	Medium Watercourses and wetlands support aquatic ecosystems.	High Construction design avoids disturbance of major watercourses.	Minor
	Darwin Converter Site	Possible Overland flows progressively altered within direct disturbance footprint. Ground water extraction of minor volumes.	Localised No watercourses present in footprint but seasonal swamp present 150 m south-west, not fed by productive aquifer.	Long-term Surface flows to swamp may be indefinitely altered by development in the catchment.	Moderate Hydrology could be altered by swamp filling faster or slower or having reduced flows.	Medium Seasonal swamp supports aquatic ecosystem and is a culturally important resource area.	Low Extent to which discharges will be altered and sensitivity of the swamp to changes is uncertain.	Moderate

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual impact
	Cable Transition Facilities	Unlikely	Not assessed as impact is inherently unlikely to occur. No aquatic habitats present in zone of influence				High Ecological surveys undertaken - no habitats present	None
Reduction in aquatic habitat value due to dust Section 8.4.2.4	Solar Precinct	Possible Dust deposition could impact watercourses at access road crossings.	Limited Dust modelling indicates impacts up to 244 m from construction footprint (see Chapter 11).	Medium-term Dust impacts will occur periodically for duration of construction.	Negligible No aquatic ecosystems within the area of influence.	Low Watercourses do support aquatic ecosystems during periods of flow and do hold permanent pools	High Dust deposition modelling has been undertaken (see Appendix U).	Minor
	Overhead Transmission Line	Possible Dust deposition could impact watercourses at crossings.	Limited Dust modelling indicates impacts within 105-123 m of the construction footprint (see Chapter 11).	Short-term OHTL will be constructed as a rolling work front.	Negligible Short-term dust deposition is unlikely to impact aquatic ecosystems.	Medium Watercourses and wetlands support aquatic ecosystems.	High Dust deposition modelling has been undertaken (see Appendix U).	Minor
	Darwin Converter Site	Possible Depositional dust will impact areas within the Darwin Converter Site and immediate surrounds.	Localised Dust modelling indicates impacts up to 380m from footprint, which includes seasonal swamp (see Chapter 11).	Medium-term Dust impacts will occur for duration of construction.	Moderate Depositional dust concentrations at the seasonal swamp will exceed assessment criteria. Potential minor impact to water quality.	Medium Seasonal swamp supports aquatic ecosystem and is a culturally important resource area.	High Dust deposition modelling has been undertaken (see Appendix U). Dust chemical composition will reflect natural background conditions.	Minor
	Cable Transition Facilities	Unlikely	Not assessed as impact is inherently unlikely to occur. No aquatic habitats present in zone of influence				High Ecological surveys undertaken - no habitats present	None

Table 8-4. Summary of EIA results - Aquatic ecosystems – Operations

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual impact
Direct loss of aquatic habitat Section 8.4.3.1	All sites	Unlikely	Not assessed because impact is inherently unlikely to occur. No further disturbance of aquatic ecosystems beyond disturbance that occurred during construction.				High Operational activities confined to footprint.	None
Reduction in aquatic habitat value due to water quality impacts Section 8.4.3.2	Solar Precinct	Possible Minor erosion and increased turbidity could occur at access road crossings. Chemical contamination unlikely.	Limited Water quality may be impacted immediately downstream of crossings.	Short-term Erosion will be identified and rectified regularly. Water quality impacts would be short-term following rain.	Negligible Watercourses are naturally turbid, particularly following rainfall and runoff events. Short-term elevated turbidity will not affect ecosystem.	Medium Watercourses do support aquatic ecosystems during periods of flow and do hold permanent pools.	High Aust Roads design standards and IECA (2008) Guidelines proven effective for minimising erosion and water quality impacts.	Minor
	Overhead Transmission Line	Possible Minor erosion and increased turbidity could occur at access road crossings. Chemical contamination unlikely.	Limited Isolated occurrences of scour and erosion at watercourse crossings with water quality impacts immediately downstream.	Short-term Erosion will be identified and rectified regularly. Water quality impacts would be short-term following rain.	Negligible Watercourses are naturally turbid, particularly following rainfall and runoff events. Short-term elevated turbidity will not affect ecosystem.	Medium Watercourses and wetlands support aquatic ecosystems.	High IECA (2008) Guidelines proven effective for minimising erosion and water quality impacts.	
	Darwin Converter Site	Possible Erosion at the Darwin Converter Site could result in increased turbidity in seasonal swamp. Contamination of water quality with	Limited Water quality impacts may occur in the swamp, but not further downstream.	Short-term Erosion will be identified and rectified regularly. Water quality impacts would be short-term following rain.	Minor Minor erosion events could increase turbidity, which is naturally low except when water levels are low as it dries up.	Medium Seasonal swamp supports aquatic ecosystems.	High IECA (2008) Guidelines proven effective for minimising erosion and water quality impacts.	

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual impact
		fuels or chemicals is unlikely.						
	Cable Transition Facilities	Unlikely	Not assessed as impact is inherently unlikely to occur. No aquatic habitats present in zone of influence.				High Ecological surveys undertaken - no habitats present	None
Reduction in aquatic habitat value due to altered hydrology or groundwater extraction Section 8.4.3.3	Solar Precinct	Unlikely Access road crossings only location where aquatic habitat present - unlikely to have ongoing impact. Groundwater extraction will be minor (10 ML/year).	Limited Overland flows altered within direct disturbance footprint. Groundwater drawdown may occur in the direct vicinity of the bore.	Long-term Impacts will occur for duration of operations.	Negligible No discernible impact to aquatic ecosystems.	Medium Watercourses do support aquatic ecosystems during periods of flow and do hold permanent pools.	High Hydrological modelling demonstrates no catchment changes see Appendix N. Austroads design standards proven effective in mitigating impacts to water flows, fish passage etc.	Minor
	Overhead Transmission Line	Unlikely	Not assessed as impact inherently unlikely to occur. Access track across minor watercourse will not alter stream flows.				High Minor access tracks in region do not alter flows.	None
	Darwin Converter Site	Possible Development could alter discharges to seasonal swamp. Minor groundwater extraction - no impact.	Limited Potential increase or decrease in stormwater discharges seasonal located south-west.	Long-term for or in altered duration to operations. Overland flow paths will be altered for the duration of operations.	Moderate Potential for increase or decrease in swamp levels.	Medium Seasonal swamp supports aquatic ecosystem and is a culturally important resource area.	Low Extent to which discharges will be altered and sensitivity of the swamp to changes is uncertain.	Moderate

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual impact
	Cable Transition Facilities	Unlikely	Not assessed as impact is inherently unlikely to occur. No aquatic habitats present in zone of influence.				High Ecological surveys undertaken - no habitats present	None
Reduction in aquatic habitat value due to dust Section 8.4.3.4	All components	Unlikely	Not assessed as the impact is inherently unlikely to occur. The majority of construction footprints will be covered by infrastructure, hardstand, or vegetation, or reinstated.				High Minor dust emissions would not exceed background turbidity.	None
Heat Island effect on Lake Woods Section 8.4.3.5	Solar Precinct	Unlikely	Not assessed as the impact is inherently unlikely to occur. Localised heating will occur at Solar Farm may occur but will not impact Lake Woods. Studies of other Solar Farms indicate localised heating around the solar panels, within 300 m. No impact on aquatic ecosystems or Lake Woods, which is >10 km north.				High Numerous studies of other solar farms have informed assessment.	None

8.4.1 Areas of potential impact

The areas of potential direct and indirect disturbance to aquatic ecosystems are summarised below based on the predicted areas of potential impact to hydrological regimes (refer Chapter 6 Hydrological Processes) and water quality (refer Chapter 7 Inland Water Environmental Quality).

8.4.1.1 Proposal footprint (direct disturbance)

Direct disturbance of aquatic habitats during land clearing and development could occur where those features are within the direct disturbance footprint.

At the Solar Precinct the access roads cross several watercourses where aquatic habitats may occur (shown on Figure 8-1) and at these locations the area of direct disturbance will be within an approximately 10 m wide road corridor where crossings are constructed.

Along the OHTL, direct disturbance of major watercourses and adjacent riparian vegetation will be avoided. The portion of the OHTL within the Railway Corridor will use existing access tracks and watercourse crossings where available to minimise impacts to riparian vegetation and aquatic habitats. Within the OHTL Utilities Corridor there are numerous patches of currently undisturbed riparian vegetation and seasonal wetland habitat such as sandsheet heath (see Figure 8-4). Construction of the OHTL will require clearing up to 22 m wide corridor, which will be reinstated except for a 6 m wide permanent maintenance corridor. Aquatic habitats within the corridor may be impacted in the narrow construction footprint; however, infrastructure will be micro-sited to minimise disturbance of surface water features, and no construction will occur in flowing watercourses or areas of permanent surface water.

There are no watercourses or surface water features within the direct disturbance footprint of the Darwin Converter Site and Cable Transition Facilities which support aquatic ecosystems.

8.4.1.2 Area of influence (indirect disturbance)

Aquatic ecosystems in watercourses and wetlands downstream of the proposal footprint could be indirectly impacted by changes to surface water quality, flows or water availability, or by deposited dust.

At the Solar Precinct, the area of influence incorporates the alluvial floodplains and watercourses crossed by the Solar Precinct access roads (locations shown on Figure 8-1). Water quality (increased turbidity and suspended sediment) could be impacted in these aquatic ecosystems for a distance of several hundred metres downstream.

Water quality could also be impacted in watercourses and surface water features (e.g. seasonal wetlands) crossed by the OHTL (shown on Figure 8-2, Figure 8-3 and Figure 8-4). The area of influence at these surface water features is expected to be up to several hundred metres downstream.

At the Darwin Converter Site, the area of influence encompasses the seasonal swamp 150 m south-west of the proposal footprint (shown on Figure 8-5) where hydrology and water quality impacts may occur. The swamp is also within the area of influence for dust deposition during construction.

Known GDEs occur along the watercourses crossed by the OHTL and Solar Precinct access roads, however proposal activities in those locations are unlikely to impact on groundwater levels or groundwater quality, and thus on supported aquatic ecosystems.

Lake Woods is a significant aquatic ecosystem but is not considered to be within the area of influence for proposal activities. The lake is approximately 10 km north of the Solar Precinct and there are no watercourses which directly connect the proposal footprint to the lake, and therefore it is not predicted to be impacted, including from heat island effects as discussed in Section 8.4.3.5.

8.4.2 Construction

Potential impacts to aquatic ecosystems are more likely to occur during the construction phase when land clearing occurs, surface water flow paths are altered within the construction footprint, and construction activities proximate to watercourses and wetlands have potential to impact water quality (turbidity or isolated spill events). The sections below describe the direct and indirect impacts that are predicted for each proposal component.

Note that there are no watercourses or aquatic ecosystems crossed by the Cable Transition Facilities; any runoff from these areas would discharge to land adjacent to the cable corridor. Runoff from the Land Sea Joint Station may flow into the ocean at Gunn Point beach; impacts to marine water quality and ecosystems are addressed in Chapter 9 Marine Environmental Quality and Chapter 10 Marine Ecosystems respectively.

8.4.2.1 Direct loss of aquatic habitat

Solar Precinct

There are no aquatic ecosystems within the Solar Precinct footprint. There are several drainage depressions that hold water during the summer (wet season) months that are likely to be filled during construction. These are isolated features that have sandy loam soils (not clay pans) and do not support aquatic habitats. The cultural and heritage values associated with these features are discussed in Chapter 14 Culture and Heritage.

Construction of watercourse crossings along the Solar Precinct access roads could result in the direct loss of riparian vegetation and instream aquatic habitats within a narrow corridor (approximately 10 m wide) where floodways or culverts will be installed. Ecological field surveys involved helicopter inspections to conduct a high-level habitat assessment along the all-weather access road corridor and confirmed that minor ephemeral creeks and tributaries are present but there no permanent waterholes or springs that could support permanent aquatic ecosystems or provide refugia during dry periods (Appendix P). The unsealed access road corridor was not inspected; however, review of aerial imagery concluded that it traverses similar habitat types. Permanent springs are known to occur along the watercourses (shown on Figure 8-1); however, none will be directly impacted by clearing or road construction. Final route selection for the access roads will avoid springs and pools and will minimise impacts on riparian vegetation where possible.

Overhead Transmission Line

Construction of watercourse crossings along the OHTL corridor could result in the direct loss of riparian vegetation and instream aquatic habitats within a narrow corridor (maximum width of 22 m) where flows are ephemeral or episodic. The OHTL will span perennial watercourses (namely the Katherine, Fergusson, Edith, and Adelaide Rivers) with minimal impact to the riparian vegetation⁴ and no impact to instream aquatic habitats. In the Railway Corridor it is proposed that the existing watercourse crossings (constructed when the railway was built) will be utilised, which will avoid further disturbance of watercourses and associated aquatic ecosystems.

Along the OHTL Utilities Corridor, the ecological field surveys identified 10 features (watercourses or swamps) which would have surface water present during the wet season, and which support riparian vegetation or aquatic ecosystems (see Chapter 5, Section 5.3). The loss of a narrow corridor of riparian vegetation and instream habitat in seasonal watercourses or swamps is unlikely to impact the diversity or abundance of aquatic species.

⁴ Some selective pruning may be required if riparian vegetation (i.e., trees) is higher than the required clearance under the line. This will be minimised through micro-siting poles and infrastructure (see Chapter 2 Section 2.5.2.3).

Clearing and installation of the OHTL infrastructure may result in the direct loss of narrow (maximum 22 m width) corridors of seasonally inundated wetland habitat where these are traversed, particularly around Adelaide River and in Black Jungle Conservation Reserve (see Chapter 5 and Appendix P). These areas provide aquatic habitat that is utilised by aquatic and terrestrial species during the wet season. The OHTL is not predicted to alter the wetland inundation regime because the placement of poles and construction pads will avoid watercourses and wetlands and the construction pads will be reinstated post-construction. The OHTL access track and pole foundations will be inundated each year and the presence of the infrastructure is unlikely to alter aquatic habitat values.

Darwin Converter Site

There are no aquatic ecosystems within the direct disturbance footprint of the Darwin Converter Site or Cable Transition Facilities. The sections below consider potential impacts to the seasonal swamp immediately to the south-west, which provides aquatic habitat that is utilised by both aquatic and terrestrial species as described in Section 8.3.3.

8.4.2.2 Reduction in aquatic habitat value due to water quality impacts

Solar Precinct

Aquatic ecosystems in watercourses downstream of the access road crossings could be indirectly impacted by increased turbidity and sedimentation as described in Chapter 7 Inland Water Environmental Quality. Chemical contamination of watercourses is considered unlikely to occur as all storages and mobile refuelling will be located at least 200 m from a watercourse. The area within which increased turbidity and sedimentation could occur is predicted to be limited to several hundred metres downstream. The area of disturbance is a narrow 10 m wide corridor and only minor volumes of sediment would be released. Construction erosion and sediment controls will be installed in accordance with ESCPs, and disturbance to the beds and banks would be reinstated post-construction.

The key risk to water quality will be if watercourse crossing construction occurs during the wet season when storm events can cause erosion in disturbed areas and lead to pulses of increased turbidity and sedimentation in downstream watercourses. Some permanent/semi-permanent pools and springs do occur downstream of the access road crossings; however, the distance to these (minimum 800 m) means that minor impacts to water quality are unlikely to impact aquatic habitats or species.

Overhead Transmission Line

Aquatic ecosystems in watercourses downstream of the OHTL corridor could be indirectly impacted by increased turbidity and sedimentation as described in Chapter 7 Inland Water Environmental Quality. The area within which increased turbidity and sedimentation could occur is predicted to be limited to several hundred metres downstream on the basis that the area of disturbance is a narrow (maximum 22 m wide) corridor and only minor volumes of sediment would be released. Erosion and sediment controls will be installed in accordance with ESCPs, including at high erosion risk areas along the corridor as described in Chapter 4 Terrestrial Environmental Quality. Disturbance to watercourse beds and banks would be reinstated post-construction (refer Chapter 2 Section 2.5.5).

The key risk to water quality will be in the first wet seasons after construction, when erosion could occur, and cause pulses of increased turbidity around the sections of the corridor that traverse seasonally inundated wetlands and in the downstream watercourse. Minor impacts to water quality are unlikely to impact aquatic habitats or species.

Darwin Converter Site

Land clearing and development activities could cause localised changes to water quality that could indirectly impact the seasonal swamp. During construction, erosion and sediment controls will be installed in accordance with ESCPs, including at discharge points around the site boundary and in the stormwater drainage network as required to minimise erosion and remove sediments from the water prior to discharge into surrounding vegetation. Fuels and hazardous chemicals will be stored and handled in accordance with Australian Standards and spill response procedures will be addressed in an Environmental Emergency and Spill Response Plan as detailed in Chapter 17 Environmental Management.

With these measures in place, the volume of sediments and/or chemical contaminants being discharged in stormwater flows will be minimised. Due to the proximity of the swamp, if these measures are ineffective the aquatic habitat value could be reduced and therefore monitoring is proposed in Section 8.5 to allow for adaptive management if offsite impacts are detected. The aquatic habitat provided by the swamp is considered locally important (as any wetland is) but is limited by its small size and seasonal inundation regime, and therefore impacts are predicted to be localised to the swamp and are unlikely to affect aquatic habitats downstream.

8.4.2.3 Reduction in aquatic habitat value due to altered hydrology or groundwater extraction

Solar Precinct

As discussed above, the watercourses crossed by the Solar Precinct access roads do contain springs and pools, of which the closest is 800 m downstream. Watercourse crossings will be designed in accordance with Austroads Road Design Standards, which will ensure flows, drainage and fish passage are not impeded. Watercourse crossings will be constructed when the watercourses are dry, and as such there are unlikely to be impacts to aquatic ecosystems due to altered hydrology.

Surface water flow paths will be altered within the Solar Precinct, however the stormwater management system will be designed to discharge water at similar locations, and in similar volumes, to pre-disturbance conditions, and flows to the wetlands and Lake Woods are unlikely to be impacted. As outlined in Chapter 6 and Appendix N, the Solar Precinct covers ~0.3 % of the Lake Woods catchment and is unlikely to impact surface water flows into Lake Woods.

Groundwater extraction required to supply the construction water demand at the Solar Precinct is unlikely to impact the springs identified to the west of the Solar Precinct, which are GDEs. At the time of writing this EIS, the locations for groundwater extraction bores to supply water for the proposal were yet to be determined; however, it is proposed that a bore field will be located near to the Solar Precinct. As discussed in Chapter 6 Hydrological Processes, based on available aquifer mapping (DEPWS 2021) the springs are fed from different groundwater aquifers to where the Solar Precinct bores would be located. They are also > 18 km east of the boundary of the Solar Precinct and so are likely to be outside the area that would be affected by any groundwater drawdown around the bore field (assuming the bore field is located within the Solar Precinct). Subject to the approval of Traditional Owners, water quality will be analysed from the springs and representative groundwater bores to confirm that the springs are fed from a different aquifer to that targeted for water supply. Bore locations and sustainable yields (from both existing and new bores) will be determined subject to investigation and recommendations from a hydrogeologist and bore permits and extraction licences will be obtained under the *Water Act*. These measures are expected to ensure there is no impact to the springs or any other GDEs from groundwater extraction.

Overhead Transmission Line

As discussed in Chapter 6 Hydrological Processes, the construction of the OHTL is unlikely to alter hydrology. The OHTL is designed to minimise impacts to surface water features, including spanning major watercourses (with no instream works) and micro-siting poles to avoid watercourses and wetlands. Drainage will be installed

in accordance with an ESCP to control drainage and runoff within the construction footprint, and controls will be designed to avoid impacts on flows in watercourses.

Groundwater extraction required to supply the construction water demand is unlikely to lower groundwater levels because water extraction will be spread across multiple locations and will occur for a short period of time at each location. As such, construction water use is unlikely to result in groundwater drawdown which would affect other users or the environment. At the time of writing this EIS, the locations for groundwater extraction for the proposal were yet to be determined; however, it is proposed that existing bores will be used under agreement with landowners. Extraction locations and sustainable yields will be determined subject to investigation and recommendations from a hydrogeologist and extraction licences will be obtained under the *Water Act* where required. These measures are expected to ensure there is no impact to any GDEs proximate to the OHTL corridor from groundwater extraction.

Aquatic threatened species, including the sharks and sawfish known or likely to occur in the Adelaide River and Elizabeth River described earlier in Section 8.3.2.3, are unlikely to be impacted. Impacts to these species would only occur if the construction activities caused significant changes to river flows and/or water quality. By design and through mitigation – as summarised above and detailed in Chapter 6 and Chapter 7– such impacts are unlikely to manifest to such a degree as to reduce habitat quality for any threatened aquatic species.

Darwin Converter Site

Land clearing and development activities could cause localised changes to overland flows that could indirectly impact the seasonal swamp. During construction, run off from disturbed areas will occur as overland flows and/or will be captured in the site stormwater drainage channels as they are constructed. The stormwater management system will be designed to discharge runoff, via erosion and sediment controls to vegetated areas west and south of the proposal footprint, in similar volumes and locations as pre-disturbance conditions. Due to the proximity of the swamp, if these measures are ineffective the aquatic habitat value could be reduced and therefore monitoring is proposed in Section 8.5 to allow for adaptive management if offsite impacts are detected. Impacts are predicted to be localised to the swamp and are unlikely to affect aquatic habitats downstream.

As discussed in Chapter 6 Hydrological Processes extraction of groundwater to support construction of the Darwin Converter Site is unlikely to lower groundwater levels in a way that could impact the seasonal swamp. Desktop review undertaken for the hydrological processes EIA found that the swamp is likely to be fed, in part, by groundwater from the shallow lateritic aquifer. However, it is not a known spring or area of groundwater expression, and, as it is dry during the dry season, is likely to interact with the shallow groundwater only during the wet season, when the water table is high due to rainfall recharge. The shallow lateritic aquifer is not a productive aquifer, and groundwater extraction for the proposal will target the deeper Koolpinyah dolostone aquifer, which is confined underlying the Darwin Converter Site. As such it is not connected to any surface water features in the surrounding area. Therefore, groundwater extraction for the proposal will not impact on the swamp or other features which may be fed by shallow groundwater (e.g., watercourses to the south of the proposal footprint).

8.4.2.4 Reduction in aquatic habitat value due to dust

Short-term deposition of dust during construction is unlikely to impact on aquatic ecosystem health in the swamp. An Air Quality Impact Assessment was undertaken by Air Environment Consulting Pty Ltd (Appendix U). The assessment included identification of sources and types of pollutants likely to be generated by the proposal and dispersion modelling to identify the extent of any air quality impacts. Refer to Chapter 11 and Appendix U for further details. Dust is likely to deposit on vegetation surrounding the proposal footprints; the various distances from components are provided in Chapter 11 and also summarised in Table 8-3.

The only aquatic ecosystem within the area of influence for depositional dust is the seasonal swamp to the south-east of the Darwin Converter Site. Aquatic ecosystems crossed by the access roads to the Solar Precinct and the OHTL are unlikely to be impacted by depositional dust as the construction will be undertaken progressively (i.e., moving along the corridor) and in a narrow footprint. Dust will be generated for a short period of time, and any deposited dust will be washed off vegetation and aquatic habitats the following wet season.

At the Darwin Converter Site depositional dust during construction will exceed the assessment criteria of $2 \text{ mg/m}^2/\text{month}^5$ over most of the seasonal swamp (see Appendix U). The depositional dust contours show the northern half of the swamp is within the $10 \text{ mg/m}^2/\text{month}$ contour; indicating that at least half of the swamp will experience dust deposition rates equal to or $>10 \text{ mg/m}^2/\text{month}$. The impacts of dust on wetlands varies depending on the amount and frequency of dust deposition, sensitivity of plant receptors and chemical properties of dust; chemical properties are often of greater impact than the volume of dust (Farmer 1993). Dust deposition can hinder essential plant processes such as photosynthesis and respiration, hinder plant growth due to chemical induced changes (e.g., to soil pH) and impact aquatic ecosystem health (e.g., due to introduction of nutrients or heavy metals in dust) (Creuzer 2016).

The Darwin Converter Site is a greenfield site, and the chemical composition of the deposited dust will be representative of natural surface soils in the area (i.e., will not be contaminated from previous site uses). As such, the chemical properties of the depositional dust are unlikely to impact the swamp, and impacts would only occur from physical deposition (i.e., covering leaves and hindering plant processes). Any deposited dust will be washed off vegetation each wet season, and volumes of deposited dust are unlikely to have sedimentation impacts. Construction will occur over several years, after which depositional dust will be significantly reduced.

8.4.3 Operations

Once the infrastructure is installed, during operations potential impacts to aquatic ecosystems will be reduced. At the Darwin Converter Site there could be ongoing localised changes to surface water flows and water quality that have potential to impact the seasonal swamp proximate to the site, but for the remainder of the footprint the results of the EIA indicate there are no operational activities that will significantly alter water availability, flows or water quality which would impact on aquatic ecosystems.

⁵ See NSW EPA 2016

8.4.3.1 Direct loss of aquatic habitat

Operational activities will not result in direct disturbance of aquatic ecosystems, other than those areas disturbed during construction; namely the access roads to the Solar Precinct, and the watercourse crossings along the OHTL.

Along the Solar Precinct access roads, watercourse crossings will be retained which will result in the long-term direct loss of riparian vegetation in a narrow (10 m wide) corridor where floodways or culverts will be installed. Permanent springs are known to occur along the watercourses; however, none will be directly impacted by clearing or road construction. The loss of a narrow corridor of riparian vegetation in minor ephemeral drainage lines is unlikely to impact aquatic ecosystems.

Following construction, the majority of the OHTL corridor will be reinstated, with no permanent footprint retained within watercourses or wetland features that support aquatic habitats, excepting a 6 m wide maintenance access track across the lower order watercourses. The loss of a narrow corridor of riparian vegetation in minor ephemeral drainage lines is unlikely to impact aquatic ecosystems.

8.4.3.2 Reduction in aquatic habitat value due to water quality impacts

During operations water quality may be impacted in isolated areas due to erosion, resulting in elevated turbidity.

Minor volumes of fuels and hazardous chemicals will be stored at the Solar Precinct and Darwin Converter Site during operations. Storage and handling will be in accordance with Australian Standards and spill response procedures will be addressed in an Environmental Emergency and Spill Response Plan as detailed in Chapter 17 Environmental Management. Implementation of these controls means that it is unlikely that a chemical or hazardous substance spill will impact water quality and supported aquatic ecosystems.

Solar Precinct

Operation of the Solar Precinct access roads could result in minor, short-term and limited impacts to water quality due to erosion and increased turbidity. This is unlikely to impact aquatic ecosystem health because of the predicted scale, duration, and magnitude of impacts, and also because the watercourses are naturally turbid following rainfall.

Crossings will be designed in accordance with Austroads Road Design Standards and there are not expected to be long-term scour and erosion issues that could lead to sustained water quality impacts. The key risk to water quality will be in the first wet seasons after construction, when erosion could occur at the recently completed crossings, and cause pulses of increased turbidity in the downstream watercourse. Scour and erosion issues at the crossings would be detected by routine post wet season inspections and remediated. Some permanent/semi-permanent pools and springs do occur downstream of the access road crossings; however, the distance to these (minimum 800 m) means that short-term elevated turbidity is unlikely to impact aquatic habitats or species in those pools.

Overhead Transmission Line

It is unlikely that the operation of the OHTL will result in impacts to aquatic ecosystems. The key risk to water quality will be in the first wet seasons after construction, when erosion could occur at the watercourse crossings and along the wetland crossing areas, and cause pulses of increased turbidity. Drainage and erosion and sediment controls will be maintained along the corridor in areas of high erosion risk as described in Chapter 4 Terrestrial Environmental Quality, and any emerging erosion issues would be detected by routine post wet season inspections and remediated. These measures are expected to be effective in minimising erosion and water quality impacts and supported aquatic ecosystems.

Darwin Converter Site

As discussed in Chapter 7 Inland Water Environmental Quality, it is possible that minor volumes of sediments will be mobilised in stormwater discharges from the Darwin Converter Site, which could lead to water quality impacts and sedimentation in the seasonal swamp. Erosion and sediment controls will be installed at discharge points around the site boundary and in the stormwater drainage network as required to minimise erosion and remove sediments from the water prior to discharge into surrounding vegetation. With these measures in place, the volume of sediments being discharged in stormwater flows will be minimised and it is predicted that water quality impacts will be minor and short-term.

Due to the proximity of the seasonal swamp to the site and its potential sensitivity to altered water quality, it is possible that the aquatic habitat value of the swamp could be reduced if the design and mitigation measures described for water quality controls are not effective. Acknowledging this risk, monitoring is proposed in Section 8.5 to allow for adaptive management if offsite impacts are detected. The aquatic habitat provided by the swamp is considered locally important (as any wetland is) but is limited by its small size and seasonal inundation regime. Impacts are predicted to be localised to the swamp and are unlikely to affect aquatic habitats downstream.

8.4.3.3 Reduction in aquatic habitat value due to altered hydrology or groundwater extraction

Solar Precinct

Operation of the Solar Precinct access roads is unlikely to impact hydrology or supported aquatic ecosystems. Crossings will be designed in accordance with Austroads Road Design Standards, which ensures minimal impact on flows, flooding, or fish passage. Hydrological regimes downstream of crossings are expected to be unchanged. Some permanent/semi-permanent pools and springs do occur downstream of the access road crossings. Hydrological regimes in these aquatic ecosystems are not expected to be impacted by road construction and operation, and they are located >800 m from proposed crossing locations, which further reduces the risks associated with altered flows.

Groundwater extraction required to supply the operational water demand at the Solar Precinct is unlikely to impact the springs identified to the west of the Solar Precinct. Operational water demand is significantly less than during construction (10 ML/year). As discussed above, bore locations and sustainable yields (from both existing and new bores) will be determined subject to investigation and recommendations from a hydrogeologist and bore permits and extraction licences will be obtained under the *Water Act*. These measures are expected to ensure there is no impact to the springs or any other GDEs from groundwater extraction.

Overhead Transmission Line

It is unlikely that the operation of the OHTL will result in impacts to aquatic ecosystems as a result of altered hydrology or groundwater extraction. Water use is not proposed for operation of the OHTL, except perhaps some minor values to support maintenance activities. The majority of the OHTL will be reinstated, with drainage and erosion and sediment controls installed to minimise impacts to surface water flow regimes.

Darwin Converter Site

As discussed in Chapter 6 Hydrological Processes, it is possible that the seasonal swamp proximate to the Darwin Converter Site could be affected by localised changes to surface water flow pathways as flows are diverted around the proposal footprint and/or concentrated at discharge points from the stormwater drainage system.

The change in the catchment could lead to the swamp filling faster or slower than under pre-development conditions. Stormwater will be discharged to the south and west of the site, via erosion controls and level spreaders, such that surface water runoff reports to surrounding vegetated areas as overland flows. The design criteria are for discharges from the area to be similar to pre-construction conditions. These measures are expected to minimise impacts to the hydrological regime of the swamp; however, the likelihood and magnitude of change is uncertain until the drainage design is finalised.

Extraction of groundwater for operation of the Darwin Converter Site is unlikely to lower groundwater levels in a way that could impact the seasonal swamp. The bores used during construction described above would also supply operational water demand (0.05 ML/year). The bores would target the productive Koolpinyah dolostone aquifer, which is confined under the proposal footprint. The shallow lateritic aquifer may have connection to the swamp but will be unimpacted from extraction from the Koolpinyah aquifer.

As discussed in Section 8.4.3.2 above, due to the proximity of the seasonal swamp to the site and its potential sensitivity to altered hydrology, it is possible that the aquatic habitat value of the swamp could be reduced if the design and mitigation measures described for stormwater management are not effective. Acknowledging this risk, monitoring is proposed in Section 8.5 to allow for adaptive management if offsite impacts are detected. Impacts are predicted to be localised to the swamp and are unlikely to affect aquatic habitats downstream.

8.4.3.4 Reduction in aquatic habitat due to dust

Operational activities are unlikely to generate depositional dust which would impact aquatic ecosystems. The majority of construction footprints will be covered by infrastructure, hardstand, or vegetation, or reinstated. Vehicle movements and minor ground disturbances may occur, but these would be unlikely to impact on aquatic ecosystems, including the seasonal swamp south-west of the Darwin Converter Site.

8.4.3.5 Heat island effect

A *heat island* is an area (often urban or industrial) where structures and materials absorb, store and radiate/re-emit heat more than natural landscapes (see DPIE 2021). This is often associated with urban areas where there are few trees or green spaces, and significant areas of bitumen, concrete and metal structures which absorb, store and radiate heat, significantly increasing temperatures. The risk of creating a heat island was assessed for the Solar Precinct, where the natural landscape will be replaced with a large area (~12,000ha) of solar panels.

Studies have been conducted on the impacts of large-scale solar array projects on the ambient temperature surrounding the area (Armstrong et al. 2016; Barron-Gafford et al. 2016; Fthenakis & Yu 2013; Yang et al. 2017). These studies typically monitored the temperature at several locations within the solar arrays and surrounding area. The findings from these studies indicate that temperatures in the centre of the solar arrays are slightly higher than ambient temperature, ranging from 0.7 – 4 °C on average. Temperatures returned to ambient several metres above the solar panels and dropped quickly within 100 m from the perimeter of the solar precinct. Temperatures gradually return to ambient with increased distance from the solar arrays and reached within 0.3 °C of ambient at 300 m from the perimeter (Fthenakis & Yu 2013). It was also found that soil temperatures underneath the solar precinct at a depth of 5 – 10 cm were lower than the surrounding region (Yang et al. 2017).

The studies reviewed above indicate that air temperatures at ground level (underneath the solar panels) are likely to be cooler than ambient during summer months, but air temperatures directly above the solar panels, and within the Solar Precinct and immediate surrounds, are likely to be above ambient temperature, particularly during the summer months. Temperatures within and surrounding the Solar Precinct may remain elevated at night, particularly during the summer months when daytime temperatures are hotter. The heat island effect is likely to affect areas within a few hundred meters of the solar arrays.

The Solar Precinct is remote and not near any sensitive receptors. There are no sensitive terrestrial habitats or aquatic ecosystems within or proximate to the Solar Precinct. Therefore, it is unlikely that there would be any heat island impacts. The EIS TOR requires consideration of heat island effects on aquatic ecosystems associated with Lake Woods; however, at approximately 10 km away from the Solar Precinct it is well outside the area affected by heat radiating from the solar panels.

8.5 Avoidance, Mitigation and Monitoring

Sun Cable is committed to applying the environmental decision-making hierarchy. Consistent with section 26 of the *EP Act* this involves applying the following approaches in order of priority:

1. Avoid – Ensure that actions are designed to avoid adverse impacts on the environment
2. Mitigate – Identify management options to mitigate adverse impacts on the environment to the greatest extent practicable.
3. Offset – if appropriate, provide for environmental offsets for residual adverse impacts on the environment that cannot be avoided or mitigated.

The environmental management framework that will be adopted for the construction and operation of the AAPowerLink is detailed in Chapter 17 Environmental Management. The framework comprises a Construction Environmental Management Plan (CEMP) and Operations Environmental Management Plan (OEMP) that sit within an overarching Environmental Management System (EMS).

For each of the potential impacts to aquatic ecosystems discussed in this chapter, Table 8-5 summarises the actions that will be taken to avoid environmental impacts (through site selection and design) and actions proposed to minimise impacts during construction, operation and decommissioning of the proposal. Relevant measures have been referred to in the above discussion of the of potential impacts at each project component. The proposed controls are routine for land development and industrial operations and, assuming proper implementation and adaptive management, should be effective in ensuring no unacceptable impacts to aquatic ecosystems. The measures provided in this chapter, along with any additional measures required to address conditions of approvals, permits and licences, will be integrated into the CEMP and OEMP prepared for the AAPowerLink.

Table 8-5. Aquatic Ecosystems – Commitments

Impact	Avoidance	Mitigation	Monitoring	Reporting
Direct loss of aquatic habitat	<p>Solar Precinct and Darwin Converter Site selection process included avoidance of major watercourses; neither site has aquatic ecosystems within the direct disturbance footprint.</p> <p>The final route selection process for the Solar Precinct access roads will avoid crossing locations that hold water for extended periods, riparian vegetation, and aquatic vegetation, where possible.</p> <p>OHTL pole placement will avoid watercourses or wetlands in accordance with micro-siting criteria provided in Chapter 2 Section 2.5.2.3.</p> <p>Clearing of significant riparian vegetation (e.g., large trees) will be avoided wherever practical by spanning the powerline across riparian zones associated with higher order watercourses.</p> <p>Only minor drainage lines will be crossed by the OHTL access track. Major drainages will be approached from either side to avoid the need for constructing crossings.</p>	<p>Minimise the disturbance footprint within waterways or wetlands to the smallest practicable area.</p> <p>Watercourse crossings along Solar Precinct access roads and OHTL installed in the dry season when no flow is present.</p>	<p>Monitoring during clearing to ensure clearing remains within approved boundaries, and at approved watercourse crossing locations.</p>	<p>Internal reporting on environmental performance.</p> <p>External reporting in accordance with environmental approval conditions.</p>

Impact	Avoidance	Mitigation	Monitoring	Reporting
<p>Reduction in aquatic habitat value due to water quality impacts</p>	<p>Solar Precinct and Darwin Converter Site footprints avoid watercourses.</p> <p>Clearing will be undertaken progressively.</p> <p>Dangerous Goods and Hazardous Substances will be stored and handled in accordance with regulated standards and codes of practice, and manufacturer's directions.</p> <p>Dangerous Goods and Hazardous Substances will not be stored within 200 m of a watercourse or groundwater bore, and mobile refuelling will not occur within 50 m of a watercourse or groundwater bore.</p>	<p>Watercourse crossings along access roads and OHTL installed during the dry season when no flow present.</p> <p>Drainage, erosion, and sediment controls installed and maintained in accordance with Erosion and Sediment Control Plans (ESCP) that align with the Best Practice Erosion and Sediment Control Guidelines (IECA, 2008).</p> <p>Develop and implement a Reinstatement Plan for post-construction reinstatement of works areas to stabilise soils and promote regrowth of native vegetation.</p> <p>Rectification of emerging erosion issues after each wet season.</p> <p>Dangerous Goods and Hazardous Substances Registers maintained at all storage and handling locations.</p> <p>An Environmental Emergency and Spill Response Plan will be in place and equipment provided at all storage and handling locations.</p> <p>Construction and operations staff trained in spill response.</p>	<p>During construction, visual inspections of disturbed areas and erosion and sediment controls as per ESCP (after significant rainfall events, at a minimum).</p> <p>Annual post wet season monitoring of rehabilitation success until disturbed areas are stabilised.</p> <p>Visual inspections of drainage structures, discharge points and site boundaries following rain events.</p> <p>Post-wet season inspections of all project locations and rectification of emerging erosion issues.</p>	<p>Reporting in accordance with EMPs as described in Chapter 17.</p> <p>Internal records of ESCP inspections, as stipulated in ESCPs.</p> <p>External reporting in accordance with environmental approval conditions.</p> <p>Internal records of water quality monitoring.</p> <p>Internal records of volumes used and stored in accordance with Workplace Health and Safety Regulations.</p> <p>Incidents of off-site pollution or nuisance reported to the NT EPA within 24 hours.</p>

Impact	Avoidance	Mitigation	Monitoring	Reporting
<p>Reduction in aquatic habitat value due to altered hydrology or groundwater extraction</p>	<p>Solar Precinct and Darwin Converter Site footprints located on flat land above the maximum modelled flood extent (1 %AEP/1-in-1000-year flood event) and outside of mapped storm surge zones.</p> <p>Solar Precinct and Darwin Converter Site do not have watercourses within direct disturbance footprint.</p> <p>Roadside drainage and culverts will be designed in accordance with accepted AustRoads standards.</p> <p>Groundwater used as water supply – no surface water extraction.</p> <p>Groundwater extraction sites will be located away from springs or GDEs.</p> <p>Engagement with landowners at Solar Precinct and along OHTL to identify bores that can be used as a water source without affecting other uses.</p>	<p>Design criteria for engineered stormwater management systems installed at the Solar Precinct and Darwin Converter Site is to discharge water to similar locations and at similar volumes to pre-development conditions.</p> <p>Implementation of ESCPs which will manage drainage and minimise erosion.</p> <p>Watercourse crossings along Solar Precinct access roads and OHTL installed in the dry season when no flow is present.</p> <p>Bore locations and sustainable yields to be determined subject to investigation and recommendations from a hydrogeologist.</p> <p>Bore permits and water extraction licence obtained under the <i>Water Act 1992</i>.</p>	<p>Visual inspection of discharge points and monitoring of water levels in seasonal swamp at Darwin Converter Site - monthly during the wet season.</p> <p>Monitoring of standing water levels and water extraction volumes, as required under water extraction licence conditions.</p> <p>Water quality sampling and analysis of springs near Solar Precinct and aquifer targeted for groundwater extraction to ensure there is no connectivity.</p>	<p>Reporting in accordance with EMPs as described in Chapter 17.</p> <p>Internal records of water usage and water extraction.</p> <p>External reporting of water extraction in accordance with water extraction licence and environmental approval conditions.</p>
<p>Reduction in aquatic habitat value due to dust</p>	<p>Solar Precinct site, which is largest continuous footprint, is located away from sensitive receptors and aquatic ecosystems</p> <p>Operational footprint will cover soil with infrastructure, hardstand, or vegetation to minimise wind erosion and dust</p> <p>Locate site access roads, laydown areas and stationary equipment (e.g., generators) as far away as possible from sensitive receivers.</p> <p>Limit the amount of time between completion of road base and any paved areas to minimize exposure of unpaved surface.</p>	<p>Water carts will be used across the project footprint to minimise dust emissions in areas of high risk at regular intervals. Other dust suppressants will be used if water ineffective.</p> <p>Implement on-site vehicle restrictions (e.g., limit the speed of vehicles travelling on unsealed access roads).</p> <p>Provide tyre wash facilities to minimize tracking of mud or dirt onto sealed roads.</p> <p>Cover or dampen any stockpiles where practical.</p>	<p>Visual observations for fugitive emissions of dust</p> <p>Conduct regular inspections of construction areas and roads to identify potential sources of dust emissions</p> <p>Develop 'watching brief' on 'nuisance' impacts to ensure quick responses to any detriment and emerging issues.</p> <p>Implement complaints procedure</p>	<p>Reporting in accordance with EMPs as described in Chapter 17.</p>

Impact	Avoidance	Mitigation	Monitoring	Reporting
		Notify and engage with residences and businesses who could be affected ahead of the construction front and implement complaints procedure.		
Heat effect	island Solar Precinct site selection process involved selecting remote area away from sensitive receptors and >10 km from Lake Woods	None required	None required	None required

8.6 Residual impact

As stated at the start of this chapter, the NT EPAs objective for the Aquatic ecosystems factor is to:

‘Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning’.

The residual impact of the AAPowerLink to Aquatic ecosystems is summarised below, assuming the adoption of the impact avoidance, mitigation and monitoring measures described in this chapter.

Each impact to aquatic ecosystems was assigned a residual impact rating taking into consideration the scale, magnitude and duration of the impacts, the presence/absence of environmental values and/or sensitive receptors and the level of certainty with respect to the intensity of the impact and the effectiveness of the mitigation measures. The residual impact ratings adopted in the assessment were provided earlier in Table 8-2. The combined residual impact to aquatic ecosystems from all components of the AAPowerLink construction and operations is summarised in Table 8-6.

Table 8-6. Residual impact ratings for impacts to Aquatic ecosystems

Impacts	Residual Impact Rating
Construction	
Direct loss of aquatic habitat	Minor
Reduction in aquatic habitat value due to water quality impacts	Moderate
Reduction in aquatic habitat value due to altered hydrology or groundwater extraction	Moderate
Reduction in aquatic habitat value due to dust	Minor
Operations	
Direct loss of aquatic habitat	None
Reduction in aquatic habitat value due to water quality impacts	Minor
Reduction in aquatic habitat value due to altered hydrology or groundwater extraction	Minor-Moderate
Reduction in aquatic habitat value due to dust	Minor
Heat island effect on Lake Woods	None

The results of the EIA undertaken for the Aquatic ecosystems factor indicate that the proposal could have a Moderate residual impact on aquatic habitat values in the seasonal swamp at the Darwin Converter Site if the hydrological regime is altered or sediments are discharged in stormwater that enters the swamp. The impact avoidance, mitigation and monitoring measures described in this chapter are expected to significantly reduce or eliminate the likelihood of such impacts eventuating. However, as there is some uncertainty in relation to changes in discharges that will occur and the subsequent response of the swamp, the residual impact has been rated as Moderate; this could be reduced if the stormwater management system design can demonstrate no significant change to discharges. The aquatic habitat provided by the swamp is considered locally important (as any wetland is) but is limited by its small size and seasonal inundation regime, and impacts are predicted to be localised to the swamp and are unlikely to affect aquatic habitats downstream.

Over the remainder of the proposal footprint, the residual impacts to aquatic ecosystems were assessed as None to Minor, associated with limited areas of direct disturbance, or short-term and/or minor or negligible occurrences of increased turbidity or altered hydrology at watercourse and wetland crossings along the Solar Precinct access roads and OHTL corridor.

The predicted magnitude, scale, and duration of impacts to aquatic ecosystems are such that they are unlikely to affect the surrounding and downstream aquatic ecosystems, nor impact the biodiversity, ecological integrity, or ecological function within the impacted habitats.

8.7 Cumulative impacts

The framework used to assess cumulative impacts is described in Chapter 3 Impact Assessment. The process involves considering the cumulative or combined impacts to terrestrial ecosystems associated with the residual impacts from the AAPowerLink, residual impacts from existing activities, and impacts associated with reasonably foreseeable developments described in Chapter 3. Through the EIA process, the following area of potential cumulative impact to aquatic ecosystems was identified:

- Combined land clearing and development at Murrumujuk, Gunn Point, from the AAPowerLink Darwin Converter Site and Sea Dragon Hatchery, will alter surface water flows, discharges, and infiltration to the shallow aquifer across approximately 200 ha of land within the catchment of the coastal swamps and floodplains of the Tree Point Conservation Area and Shoal Bay Coastal Reserve. The sub-catchment area south of Murrumujuk Drive reporting to the Tree Point Conservation Area is ~7 km² and the combined construction footprint for the Darwin Converter Site and Sea Dragon Hatchery is ~2 km², which is ~30% of the sub-catchment area. Note that this assumes the entire land parcels will be cleared, when in fact a portion of each parcel will be cleared and developed, and so the actual development footprint will be less than 200 ha. At a local level, most of the catchment area that feeds the seasonal swamp that lies between the AAPowerLink, and Sea Dragon Hatchery site will be cleared and replaced with impermeable surfaces, and it is possible that this could affect the hydrological regimes of the swamp. More broadly, surface water flow regimes into the Tree Point Conservation Area are unlikely to be affected assuming stormwater drainage systems on both sites are designed to replicate pre-development flows off-site.

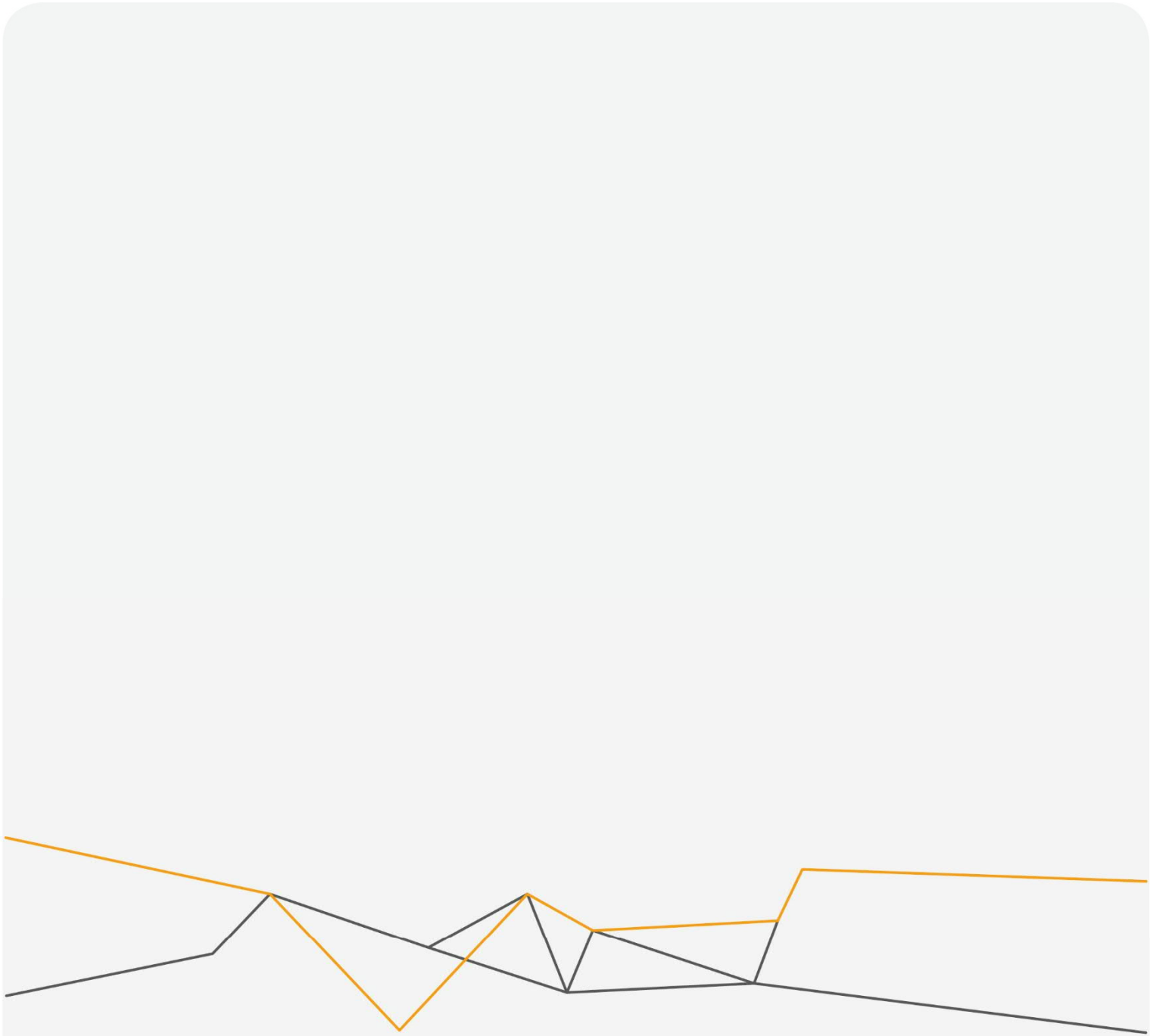
8.8 Offsets

The EIA did not identify any significant residual impacts to aquatic ecosystems that require offsets.

8.9 References

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