

Chapter 7 – Aquatic Ecosystems

AAP01-000-GEG-GGEN-00002

Approved Rev	Approver Position	Signature	Date
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Document revision history and tracking

Document Preparation

Rev	Status	Date	Prepared by	Position	Reviewed by	Position
A	For Review	18 Sept 2022	Beth Salt	Senior Associate Scientist - Environment	Sara Weir	Development Officer
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Revision history tracking record (Use after Rev 00)

Rev	Date	Description	Prepared by	Approved by

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7 Aquatic Ecosystems

7.1 Introduction

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 Project, which include all freshwater habitats and species that live in freshwater environments. 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 TOR issued by the NT EPA (Appendix A in the Draft EIS), issues raised by stakeholders, and professional judgement of the SEIS team (Appendix 1.5) based on their knowledge and understanding of the Project's components and activities described in Chapter 2 Project Refinement. Potential impacts were then assessed using the EIA methods described in Chapter 3 Impact Assessment of the Draft EIS. This chapter presents the findings of the EIA process undertaken for the Aquatic ecosystems factor.

The information within this chapter is based on review of additional studies, detailed in Section 7.2, that examined the ecology of the project refinements (Section 7.3) and additional ecological reporting. Desktop ecological assessments identified the locations of watercourses, springs, riparian vegetation and wetlands where present in the footprints of the project refinements. 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 WQ or hydrological processes, and therefore any aquatic ecosystems that occur are unlikely to be significantly impacted.

The location of aquatic ecosystems has been identified based on aerial imagery and data from the NTG's database, available on NR Maps (DEPWS, 2021). Additionally, the national Groundwater Dependent Ecosystem Atlas was used to collate data on GDEs within or proximate to the proposal footprint (see BoM 2021).

In order to identify potential indirect impacts to aquatic ecosystems associated with change in surface water flows and/or availability or an impact to surface WQ, this chapter draws on information presented in:

- Chapter 6 Hydrological Processes of the Draft EIS and Chapter 6 Hydrology of this SEIS
- Chapter 7 Inland Water Environmental Quality of the Draft EIS.

7.2 Information Sources

Since the Draft EIS was lodged, the following reports were prepared, which deal with the assessment of aquatic ecosystems:

- Groundwater Assessment - Solar Precinct (Appendix 6.1)
- Supplementary Ecology Report - Part 1 - Threatened Species (Appendix 5.1)
- Supplementary Ecology Report - Part 2 (Appendix 5.2)
- Memorandum – Riparian Vegetation Assessment (Appendix 5.5).

7.3 Project Refinements since Draft EIS

The following project refinements included in this SEIS have included additional footprint or impacts on aquatic ecosystems, which have been assessed in this section:

- Solar Precinct AI. The addition of AI will be located outside of the 12,000 ha Solar Precinct, representing an increase of 134 ha footprint
- OHTL Corridor (including the preferred routes at Katherine, Pine Creek, and Adelaide River). The preferred OHTL Corridor's additional footprint and potential impacts on aquatic ecosystems have been assessed in this chapter.
- The Powell Creek Electrode and DCS Electrode (including the HVDC Electrode Line Corridors and Access Tracks) (see Figure 2-11, Figure 2- 12).

Refer to Chapter 2 for further descriptions of the minor refinements listed above.

7.4 Existing Environment and Values

This section describes the aquatic ecosystems within the proposal footprint and area of influence (surround 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 of the Draft EIS, and in Chapter 6 Section 6.4.1.5 of this SEIS.

It is noted that threatened species considered in this chapter are only those that live entirely in aquatic freshwater environments. Assessment of threatened species was undertaken as part of the Supplementary Ecology Report - Part 1 - Threatened Species (Appendix 5.1). No other aquatic threatened species are likely to occur in freshwater aquatic ecosystems within any of the project refinement direct disturbance footprint or area of influence. Where identified, threatened terrestrial species within a project refinement direct disturbance footprint or area of influence are discussed in Chapter 5 Terrestrial Ecosystems of this SEIS. Any further surveys necessary for the applications of relevant Water Extraction Licences or other statutory approvals will be completed as required.

7.4.1 Solar Precinct Ancillary Infrastructure

The proposed AI covers 134 ha adjacent to the proposed Solar Precinct on Powell Creek Station (refer to Chapter 2). An understanding of the existing aquatic ecosystems' environmental quality values for the footprint of this AI was largely described in Section 8.3.1 of the Draft EIS, which describes the area between the Solar Precinct and the Stuart Highway.

There are no aquatic ecosystems present within the AI footprints, primarily because there are no surface watercourses present within their boundaries.

7.4.1.1 Watercourses and Wetlands

The understanding of environmental values of watercourses and wetlands remains largely consistent with descriptions provided in Section 8.3.1.2 of the Draft EIS and is summarised below.

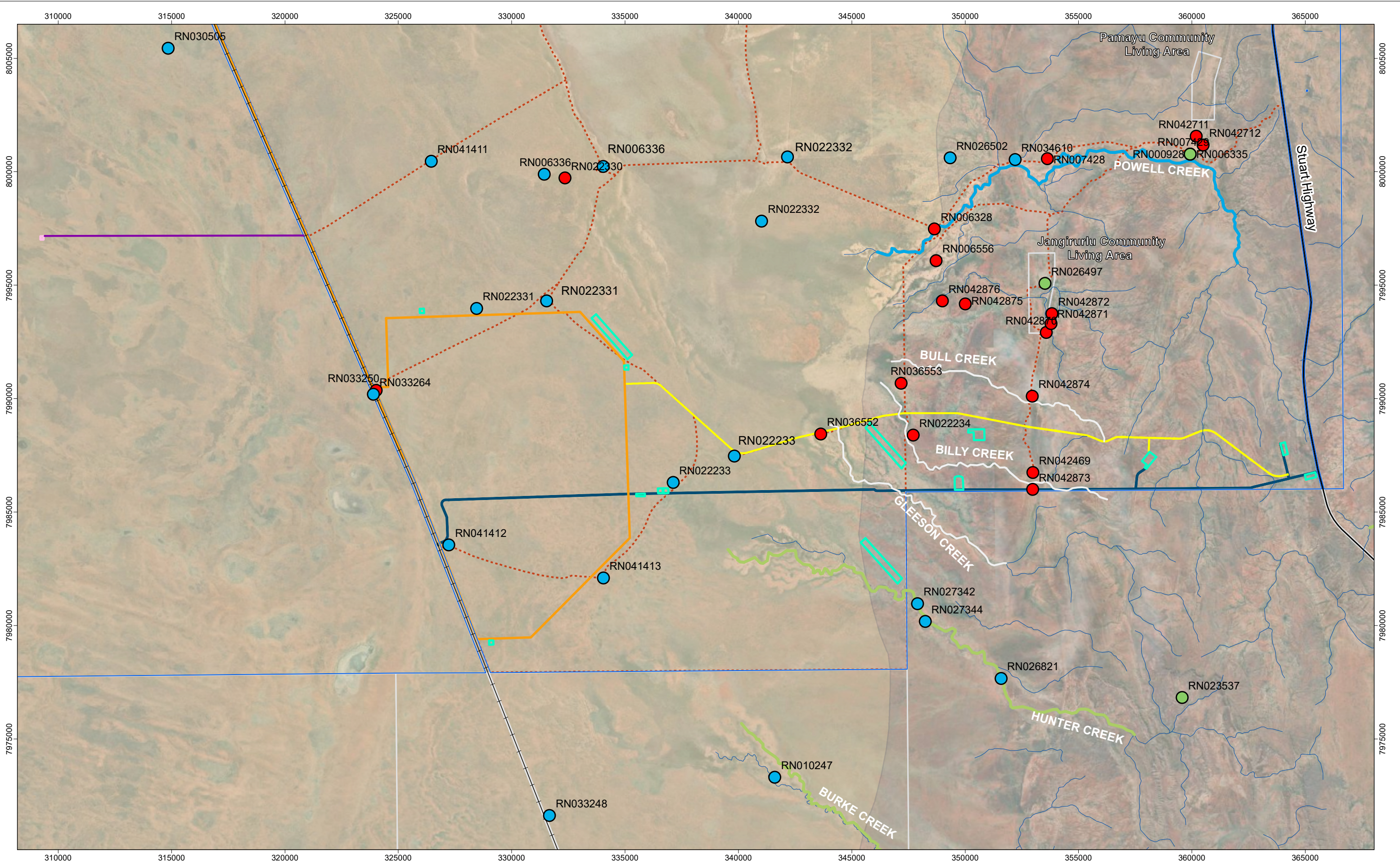
- East of the Solar Precinct (between the site and the Stuart Highway) is a large alluvial floodplain, which includes isolated drainage depressions, watercourses, and patches of black soil plain. These are temporary wetlands that may hold some aquatic ecosystem value during periods of inundation or flow.
- The Access Roads into the Solar Precinct and AI traverse the alluvial floodplain and directly intersect an isolated patch of black soil plain and several watercourses (Figure 7-1).

- Surface water flows and/or inundation occurs during periods of rainfall, usually associated with wet season weather patterns from the northern portion of the NT. None of the features hold permanent water at the crossing locations, which limits the availability of aquatic habitats.
- 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).

Further understanding of existing aquatic ecosystem environmental quality values for the AI footprint was further refined as part of the desktop assessments for the Supplementary Ecology Report - Part 2 (Appendix 5.2). Within the area east of the Solar Precinct, there are numerous ephemeral watercourses and drainage lines associated with the Ashburton Range, however these only intersect sections of the Access Roads (shown in Figure 7-1 and summarised in Table 7-1). Aerial imagery shows that some of these drainage lines may support riparian vegetation and may retain pools of water in times of low rainfall. There are 20 pastoral bores present within the footprint of the AI (Figure 7-1).

Table 7-1: Approximate number/names of key watercourses in AI footprint

Stream order	Powell Creek AI footprint
1 – Drainage lines	57 – Billy Creek, Bourke Creek, Gleeson Creek, Hunter Creek, Tomkinson Creek
2 – Intermittent streams	11 – Gleeson Creek, Billy Creek, Bull Creek
3 – Creek	4 – Hunter Creek, Billy Creek, Bull Creek
4 – Creek	2 – Powell Creek



Legend

OHTL Corridor

Gravel Access Track

Main Access Track

Existing railway line

Cadastre

Powell Creek Station

HVDC Electrode Line Corridor

Solar Precinct

Ancillary Infrastructure

Powell Creek Electrode

Montejinni Limestone Aquifer Extent

Constructed Bore and Groundwater Depth

< 5m

5 - 10m

10 - 20m

> 20m

Aquatic GDE (National Assessment)

High potential

Moderate potential

Low potential

Unclassified potential

Elliott

Figure 7-1: Surface water features (potential aquatic habitats) proximate to the Powell Creek Solar Precinct

Project: Australia-Asia PowerLink

Reference #: AAPL_GNR_CTA_GEN_MAP_0416

Figure: 1 of 1

Revision: A

Coordinate System: MGA Zone 53

Datum: GDA2020

Date: 15/11/2022

0 2 4 6 8 10

Kilometre

Scale: 1:150,000

A4

PowerLink

Source: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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7.4.1.2 Springs

Springs are 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. The understanding of environmental values of springs remains largely consistent with descriptions provided in Section 8.3.1.2 of the Draft EIS and is summarised below:

- Several inferred springs occur along the watercourses crossed by the Solar Precinct Access Tracks, the locations of which are shown in
- Figure 7-1. A combination of field survey data (via helicopter transects), fractional ground cover data and aerial imagery was used to infer the locations of springs.
- The closest inferred spring to the Access Tracks is located along Bull Creek and is approximately 800 m downstream of the proposed Access Tracks crossing location. All other springs are located >3 km away from the Access Tracks.
- Large springs are also known to occur along Powell Creek and Newcastle Waters Creek (including the well-known Longreach Waterhole near Elliott).

Environmental receptors were further explored in the Solar Precinct Groundwater Study (Appendix 6.1), which identified potential GDEs (Figure 4 in Appendix 6.1). A high potential for aquatic GDEs is mapped along Powell Creek, north of the Solar Precinct and a low potential along Hunter Creek and Burke Creek to the south. Billy Creek, Gleeson Creek, and Bull Creek, located around the proposed Access Tracks, are identified in the aquatic GDE layer but are unclassified. The presence of aquatic GDEs along the eastern extents of these drainage lines is consistent with the location of inferred springs identified in the Draft EIS. All springs identified in the field mapping occur in the Proterozoic basement rocks. Groundwater levels in the spring areas are shallow (< 5 m), which supports the presence of potential terrestrial and aquatic GDEs in these areas. Permanent waterholes along Gleeson Creek, Powell Creek and nearby drainage lines have also been recorded. Water extraction for the Project from the Proterozoic basement rock aquifers is not proposed.

7.4.1.3 Lake Woods

Lake Woods Site of Conservation Significance (SOCS) 2.5 km to the north of the closest AI footprint. 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 – 1,000 km² (Harrison *et al.* 2009).

Section 8.3.1.3 of the Draft EIS notes that the north-eastern corner of the Solar Precinct may be inundated by Lake Woods flood extents in very rare (e.g., 1 in 1,000 year) flood events. By extension, the northern parts of the AI (Aerodrome) may therefore become inundated by Lake Woods extreme flood extents and will be designed in accordance with relevant legislative standards.

The understanding of environmental values of Lake Woods remains unchanged as described in Section 8.3.1.3 of the Draft EIS and is summarised below:

- Lake Woods is not a Ramsar protect wetland but is listed in the Directory of Important Wetlands of Australia as a Nationally Important Wetland
- The lake basin supports large areas of lignum swamp, and during periods of inundation provides diverse wetland habitat, including breeding sites for waterbirds
- 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
- 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 of the Draft EIS and Chapter 5 Terrestrial Ecosystems of the SEIS.

7.4.2 OHTL Corridor

An alternatives assessment for the preferred OHTL Corridor was undertaken with preferred route options identified at Adelaide River, Pine Creek, and Katherine. All three areas are included in this chapter's assessment.

The OHTL Corridor will pass the town of Katherine and will involve crossing both Tindal Creek and Katherine River. Katherine is known to be contaminated due to the use of substances containing PFAS at the RAAF Base Tindal, specifically AFFF used for firefighting. A PFAS Management Area has been declared for the Katherine region within which there is known contamination of groundwater, surface water and soils and sediments. This is discussed at length in Chapters 4 and 6 of this SEIS. Receptors of PFAS contamination include aquatic ecosystems and biota, plants, birds and mammals, and humans (through interaction with PFAS contaminated water, consumption of PFAS contaminated water, or consumption of PFAS contaminated food). Potential impacts associated with construction of the OHTL through the Katherine PFAS Management Area are:

- Spread of contaminated soil or sediment to areas outside of the PFAS Management Area
- Spread of contamination via the use of contaminated groundwater or surface water
- Increased contamination in Tindal Creek or Katherine River due to erosion of contaminated soils or sediments from the OHTL Corridor.

These impacts are assessed in Chapter 6.

7.4.2.1 Watercourses

The revised OHTL Corridor crosses 128 watercourses over the entire 783 km length. The majority of these are minor intermittent streams or drainage lines of stream order 1 and 2 (see Table 7-2). The remainder are intermittent creeks of stream orders 3 and 4, and rivers of stream order 5 and above (Appendix 5.5).

Table 7-2: Number of watercourses crossed by the OHTL, ranked by stream order

Stream order	Number of Watercourse Crossings
1 – Drainage line	61
2 – Intermittent stream	31
3 – Intermittent Creek	13
4 – Creek	11
5 – River	11
6 – River	1

The watercourses that are crossed in the Draft EIS OHTL Corridor are the same for the refinements at Katherine, north of Katherine, and north of Pine Creek. The watercourses crossed at the refinement north of Cosmo are different to those crossed in the Draft EIS OHTL and include nine first order, six second order, two fourth order, and nine fifth order watercourses. Adelaide River is crossed throughout this section of the OHTL over 30 km upstream of the Draft EIS OHTL Corridor crossing.

7.4.2.2 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) refer to 'natural ecosystems that require access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis,

so as to maintain their communities of plants and animals, ecosystem processes and ecosystem services' (Richardson et al. 2011).

GDE's include landscape features typically referred to as wetlands or riparian areas/vegetation – aquatic GDE. However, they may also include ecosystems dominated by native plant species that require groundwater resources for survival (often limited to aquifers < 20 mBGL) – terrestrial GDE. The national GDE Atlas (BoM, 2021) classes each mapped GDE according to the degree of certainty that it is, indeed, a GDE (i.e., high, medium, low, unknown).

The national GDE Atlas (BoM, 2021) was used to identify potential GDE's within or in close proximity to each of the project refinements. As project activities are not accessing groundwater resources, impacts to groundwater are limited to those associated with land clearing through the removal of vegetation.

7.4.2.3 Aquatic threatened species

As detailed in the Draft EIS (Section 8.2.3.2), there are three threatened species of fish that 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 Draft EIS stated that the two shark species have not been recorded as far inland as where the OHTL from the Draft EIS intersects the Adelaide River. The refinement north of Cosmo where the OHTL crosses the Adelaide River is approximately 30 km more inland than the OHTL crossing presented in the Draft EIS, therefore these shark species are even more unlikely to be found further upstream. The Draft EIS also stated that the Freshwater Sawfish has been recorded several hundred kilometres upstream of the Draft EIS OHTL crossing. The OHTL crossing of the Adelaide River is approximately 30 km upstream, therefore should not be upstream enough for this species to be encountered.

Threatened species considered in this chapter are only those that live entirely in aquatic freshwater environments. No other aquatic threatened species are likely to occur in freshwater aquatic ecosystems within the Project's direct disturbance footprint or area of influence. Where identified, assessment of threatened terrestrial species within the Project's direct disturbance footprint or area of influence is discussed in Chapter 5 Terrestrial Ecosystems of this SEIS.

7.4.2.4 Springs

The OHTL Corridor project refinements do not intersect and are not proximate to any springs.

7.4.3 Powell Creek Electrode

There are no aquatic ecosystems present within the footprint of the Powell Creek Electrode and HVDC Electrode Line Corridor, primarily because there are no surface watercourses present.

7.4.4 DCS Electrode

Desktop and field assessments were undertaken by EcOz for the Supplementary Ecology Reports (Part 1 and Part 2) (Appendix 5.1 and 5.2) of the proposed DCS Electrode and HVDC Electrode Line Corridor. A summary of relevant environmental values are provided below.

7.4.4.1 Watercourses

The DCS Electrode and HVDC Electrode Line Corridor is within the Leaders Creek and Fly Creek catchments, both drain north to the ocean. The HVDC Electrode Line Corridor crosses the second order Leaders Creek and the first order drainages of Fly Creek. At the time of EcOz's field visit in July 2022, all creeks had flowing water, indicating the drainages may retain water throughout the dry season.

7.5 Potential Impacts

The potential impacts to aquatic ecosystems and relevant environmental values, particularly around the project refinements and the additional knowledge gained from the relevant studies (Section 7.2) have been assessed using the EIA methodology described in Chapter 3 of the Draft EIS, and as summarised in Chapter 1 of this SEIS. The following impacts were identified and assessed as possibly occurring during construction and/or operations for the Solar Precinct AI, OHTL Corridor and disturbance footprint, and Electrodes (Powell Creek and DCS):

- Direct loss of aquatic habitat
- Reduction in aquatic habitat value due to WQ impacts
- Reduction in aquatic habitat value due to altered hydrology or groundwater extraction

7.5.1 Areas of potential impact

The areas of potential direct and indirect disturbance to aquatic ecosystems are summarised based on the predicted areas of potential impact to hydrology and WQ.

As stated in the Draft EIS, direct disturbance of aquatic habitats during land clearing and development could occur where those features are within the direct disturbance footprint. Aquatic ecosystems in watercourses and wetlands downstream of the proposal footprint could be indirectly impacted by changes to surface WQ, flows and water availability, or by deposited dust.

As stated in the Draft EIS, along the OHTL, direct disturbance of major watercourses and adjacent riparian vegetation will be avoided during construction. The portion of the OHTL Corridor within the railway corridor will use existing Access Tracks and watercourse crossings where available to minimise impacts to riparian vegetation and aquatic habitats. WQ may also be impacted in watercourses and surface water features crossed by the OHTL. The area of influence at these surface water features is expected to be up to several hundred metres downstream.

Known GDEs occur along the watercourses cross by the OHTL Corridor and Solar Precinct Access Tracks. However, project activities in those locations are unlikely to impact on groundwater levels or groundwater quality, and thus on supported aquatic ecosystems. The Project area is within the Leaders Creek and Fry Creek catchments, both draining north to the ocean. The HVDC Electrode Line Corridor crosses the second order Leaders Creek and the first order drainages of Fly Creek (Figure 3-1 in Appendix 5.2). At the time of the field visit in July 2022, all creeks had flowing water, including the drainages may retain water throughout the dry season.

7.5.2 Construction

The potential impacts to aquatic ecosystems will be greatest during the construction phase, when surface water flow paths are altered by land clearing and development within the construction footprint. Construction activities proximate to watercourses and wetlands have potential to impact WQ.

7.5.2.1 Direct loss of aquatic habitat

Direct loss of aquatic habitat was assessed as part of the Draft EIS and similar conclusions can be drawn for the project refinements. This impact has not changed significantly from the Draft EIS.

- Watercourse crossings along the OHTL Corridor could result in the direct loss of riparian vegetation and instream aquatic habitats within a narrow corridor where flows are ephemeral and episodic
- Watercourses crossings for perennial watercourses will have a minimal impact to the riparian vegetation and no impact to instream aquatic habitats.

It is anticipated that the footprint of the watercourse crossings will be 22 m in lower order minor watercourses and higher order watercourses. The Proponent commitment in the Draft EIS is to span the watercourse with no disturbance to levee banks and riparian habitat will be upheld. Therefore, no impacts to macroinvertebrates were concluded in the Draft EIS. The same conclusion is made in this SEIS.

The Electrodes at Powell Creek and the DCS do not have watercourses within their footprints. Therefore, there is unlikely to be any direct loss of aquatic habitat. The Project area in the northern part of the project is within the Leaders Creek and Fry Creek catchments, both draining north to the ocean. The HVDC Electrode Line Corridor crosses the second order Leaders Creek and the first order drainages of Fly Creek (Figure 3-1 in Appendix 5.2). At the time of the field visit in July 2022, all creeks had flowing water, including the drainages may retain water throughout the dry season.

7.5.2.2 Reduction in aquatic habitat value due to WQ impacts

The potential impact of reducing aquatic habitat value due to WQ impacts was assessed as part of the Draft EIS. Consistent conclusions are drawn for the project refinements in that aquatic ecosystems in minor watercourses downstream of the OHTL Corridor could be indirectly impacted by increased turbidity and sedimentation up 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. ESC measures will be installed in accordance with the ESCP. The key risk to WQ will be the first wet season 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 WQ are unlikely to impact aquatic habitats or species.

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

The potential impact of reducing aquatic habitat value due to altered hydrology or groundwater extraction was assessed as part of the Draft EIS. Consistent conclusions are drawn for the project refinements in that the OHTL will be designed to minimise impacts to surface water features, including spanning major watercourses (with no instream works) and siting poles to avoid watercourses and wetlands, as per the Constraints Planning and Field Development Procedure (Appendix 4.1). 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.

Aquatic threatened species, including the sharks and sawfish known or likely to occur in the Adelaide River described in Section 7.4.2.3 above, are unlikely to be impacted as the crossing changes are further away from where they have been sighted or further away from their known range.

Impacts from construction of the two Electrodes will not reduce aquatic habitat as there are no watercourses intersecting or proximate to each footprint.

7.5.3 Operations

Once the infrastructure is installed in the construction phase, there is not predicted to be any ongoing impacts to the aquatic ecosystems within the OHTL Corridor.

7.6 Avoidance, Mitigation, and Monitoring

Impact mitigation was undertaken in accordance with the environmental decision-making hierarchy consistent with Section 26 of the *EP Act*. The decision-making hierarchy sets the following priorities when addressing impacts which have been considered in developing Table 7-3:

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.

Table 7-3: Surface Water Flow, Quality, and Aquatic Ecosystems - Commitments

Impact	Avoidance	Mitigation	Monitoring	Reporting
Flow regimes of surface water	Solar Precinct and DCS located on flat land above the maximum modelled flood extent (0.1 % AEP/1-in-1000-year flood event) and outside of mapped storm surge zones. Site selection process for Solar Precinct and DCS included avoidance of major watercourses. OHTL structures will not be placed in watercourses or drainage lines. 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. Roadside drainage and culverts will be designed and installed in accordance with acceptance Austroads standards. Avoid extracting groundwater to an extent that there are adverse impacts to aquatic habitats.	Watercourse crossing along access roads and OHTL installed during the dry season when no flow present. Drainage, erosion, and sediment controls installed and maintained in accordance with ESCPs that align with IECA 2008. Reinstatement of footprints for construction of OHTL Corridor and Cable Transition Facilities post-construction. Design criteria for engineered stormwater management systems installed at the Solar Precinct and DCS is to discharge water to similar locations and at similar volumes to pre-development conditions.	During construction, visual inspections of disturbed areas and ESCs as per ESCP (after significant rainfall events, at a minimum). Annual post wet season monitoring of revegetation success until disturbed areas are stabilised. Visual inspections of drainage structures, discharge points and site boundaries following rain events. Post-wet season inspections of all project locations and rectification of emerging erosion issues.	Internal records of ESCP inspections, as stipulated in ESCPs. Internal reporting on environmental performance. External reporting in accordance with environmental approval conditions.
Surface WQ	Solar Precinct and DCS located on flat land above the maximum modelled flood extent (0.1 % AEP/1-in-1000-year flood event)	Watercourse crossings along access roads and OHTL will be installed during the dry season when no flow present.	During construction, visual inspections will be undertaken of disturbed areas and ESCs as per ESCP (after significant rainfall events, at a minimum).	Internal records of ESCP inspections, as stipulated in ESCPs.

Impact	Avoidance	Mitigation	Monitoring	Reporting
	and outside of mapped storm surge zones. Solar Precinct and DCS avoid watercourses. Progressive clearing, construction and reinstatement will be undertaken. OHTL poles will not be placed in watercourses or drainage lines. 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. Stormwater drainage will be installed to capture and manage runoff. Stormwater captured within facilities will discharge to land, via ESCs. Roadside drainage and culverts will be installed in accordance with Austroads standards. During operations, solar power will be used as a power source, hence no requirement for bulk fuel storages. Dangerous Goods and Hazardous Substances will be stored and handled in accordance with regulated standards and codes of	Drainage, ESCs will be installed and maintained in accordance with ESCP that align with IECA 2008. Develop and implement a Reinstatement Plan for post-construction reinstatement of works areas to stabilise soils and promote regrowth of native vegetation. Rectification of emerging erosion issues after each wet season. Dangerous Goods and Hazardous Substances Registers will be maintained at all storage and handling locations. An Environmental Emergency and Spill Response Plan will be in place and equipment provided at all storage and handling locations. Construction and operations staff will be trained in spill response.	Annual post wet season monitoring of reinstatement success until disturbed areas are stabilised. Visual inspections of drainage structures, discharge points and site boundaries following rain events. Visual inspections of seasonal swamp at DCS for evidence of sedimentation. Implement WQ monitoring if required. Post-wet season inspections of all project locations and rectification of emerging erosion issues. Routine visual inspections around storage locations and work areas.	Internal records of volumes used and stored in accordance with WHS Regulations. Internal reporting on environmental performance. Internal inspection records and notes. Internal records of WQ monitoring. External reporting in accordance with environmental approval conditions. Incidents of off-site pollution or nuisance reported to the NT EPA within 24 hours.

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

7.7 Residual Impact

All residual impacts have a rating of 'minor' showing no change to the residual impact conclusions reached in the Draft EIS. Any identified uncertainties are addressed within monitoring and mitigation measures. All residual impacts are considered not significant. See other relevant residuals impacts on hydrology detailed in Section 6.7 in Chapter 6.

Table 7-4: Summary of SEIA results – Aquatic Ecosystems Factor – Construction

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual Impact
Direct loss of aquatic habitat.	OHTL Corridor	Possible OHTL crosses 128 watercourses. Lower order watercourses and wetlands will be crossed by the Access Track and Construction Corridor.	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
	Electrode – Power Creek	Unlikely There are no aquatic habitats present within the electrode footprint.	Limited The Electrode area is 2 ha and HVDC Electrode Line Corridor is narrow and follows an existing station track	Long Term The Electrode is permanent infrastructure required for the Project.	Minor N/A	Low The environment is intact but there are no sensitive receptors.	High Desktop surveys conducted.	Minor
	Electrode – DCS	Unlikely The HVDC Electrode line corridor crossed one intermittent stream with aquatic habitat.	Limited The Electrode area is 2 ha and HVDC Electrode Line Corridor is narrow and adjacent to existing road corridor	Long Term Electrode and the HVDC Electrode Line is permanent infrastructure required for the Project.	Minor No disturbance of aquatic ecosystems in major perennial watercourses.	Medium HVDC Electrode Line Corridor crosses an intermittent stream	High Desktop surveys conducted.	Minor

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual Impact
Reduction in aquatic habitat value due to WQ impacts.	OHTL Corridor	Possible OHTL crosses 128 watercourses. Minor increases in turbidity could occur at crossings.	Limited WQ may be impacted for a several hundred metres downstream of crossings.	Short Term WQ 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 WQ impact directly link to erosion hazard, would remain consistent with Draft EIS assessment, which was Low in accordance with IECA 2008.	Minor
	Power Creek Electrode	Unlikely There are no aquatic habitats present within the electrode footprint and HVDC Electrode Line Corridor.	Limited There are no watercourses within or proximate to the footprints.	Short Term N/A	Minor N/A	Low The environment is intact but there are not sensitive receptors.	High WQ impact directly link to erosion hazard, which has been assessed as Low in accordance with IECA 2008.	Minor
	DCS Electrode.	Unlikely Construction works will disturb soils, which could result in runoff into watercourse crossed by the HVDC Electrode Line Corridor.	Limited WQ may be impacted within watercourses.	Short Term WQ impacts would only occur for days immediately following a rainfall event.	Minor The ocean is naturally turbid following rainfall. No permanent pools or sensitive aquatic habitats present.	Medium Site is located in proximity to watercourses and the shoreline.	High WQ impact directly link to erosion hazard, which has been assessed as Low in accordance with IECA 2008.	Minor

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual Impact
Reduction in aquatic habitat value due to altered hydrology or groundwater extraction.	OHTL Corridor	Unlikely OHTL crosses 128 watercourses, but no major disturbance is required.	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
	Power Creek Electrode	Unlikely Hydrology will not be altered with the HVDC Electrode line corridor. No groundwater extraction.	Limited There are no watercourses within or proximate to the footprints.	Short Term N/A	Minor N/A	Low The environment is intact but there are not sensitive receptors.	High WQ impact directly link to erosion hazard, which has been assessed as Low in accordance with IECA 2008.	Minor
	DCS Electrode.	Unlikely Hydrology will not be altered with the HVDC Electrode line corridor. No groundwater extraction.	Limited The Electrode area is 2 ha and HVDC Electrode Line Corridor is narrow and adjacent to existing road corridor.	Long Term Electrode and the HVDC Electrode Line is permanent infrastructure required for the Project.	Minor No disturbance of aquatic ecosystems in major perennial watercourses.	Medium HVDC Electrode Line Corridor crosses an intermittent stream	High Desktop surveys conducted.	Minor

Table 7-5: Summary of SEIA results – Aquatic ecosystems factor – Operations

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual Impact
Direct loss of aquatic habitat	OHTL Corridor	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
	Powell Creek Electrode	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
	DCS Electrode	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 WQ impacts	OHTL Corridor	Possible Minor erosion and increased turbidity could occur at Access Track crossings.	Limited Isolated occurrences of scour and erosion at watercourse crossings with WQ impacts immediately downstream.	Short Term Erosion will be identified and rectified regularly. WQ 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 proven effective for minimising erosion and WQ impacts.	Minor

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual Impact
	Powell Creek Electrode	Unlikely Electrode and HVDC Electrode Line Corridor does not cross any watercourses. No groundwater extraction.	Negligible N/A	Negligible N/A	Negligible N/A	Negligible N/A	High IECA 2008 proven effective for minimising erosion and WQ impacts.	Minor
	Electrode – DCS	Possible Minor erosion and increased turbidity could occur at HVDC Electrode Line Corridor/ Access Track watercourse crossing.	Localised WQ may be impacted immediately downstream of crossing.	Short Term Erosion will be identified and rectified regularly. WQ 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 proven effective for minimising erosion and WQ impacts.	Minor

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual Impact
Reduction in aquatic habitat value due to altered hydrology or groundwater extraction	OHTL Corridor	Unlikely Not assessed as impact is unlikely to occur during the operational phase.					High Minor Access Tracks in region do not alter flows.	None
	Power Creek Electrode	Unlikely Not assessed as impact is inherently unlikely to occur. No aquatic habitats present within the footprint or area of potential impact.					High Minor Access Tracks in region do not alter flows.	None
	DCS Electrode	Unlikely Not assessed as impact is unlikely to occur during the operational phase.					High Minor Access Tracks in region do not alter flows.	None

7.8 Cumulative Impact Assessment

The overall 'Minor' residual impact to aquatic ecosystems associated with the project refinements is consistent with the assessment conclusion ratings from the Draft EIS. Potential cumulative impacts conclusions associated with Draft EIS are the same for the project refinements.

7.9 Conclusion

Three submissions were received relating to aquatic ecosystems during the public submissions period (Section 7.10), one from the NT EPA Direction (Section 7.11), one from DEPWS and one from the ECNT.

A review of the project refinements identified in Chapter 2 has not identified any new significant impacts. All residual impacts have a rating of 'minor' and any identified uncertainties are addressed with avoidance, monitoring and mitigating measures. Thus, the Project is able to achieve the NT EPA's objective of:

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

The Proponent's responses to the submissions received are provided in 7.10.1 and 7.10.2.

7.10 Submission Response

During the Draft EIS Public Submissions period, DEPWS and the ECNT made comments relating to aquatic ecosystems.

7.10.1 DEPWS Submission

7.10.1.1 GDEs

The potential impact of hydrological changes on vegetation communities and threatened species due to construction has not been assessed. The Flora and Fauna Division recommends including an assessment of the impact of hydrological changes on groundwater-dependent ecosystems and threatened species.

7.10.1.2 Response

Potential GDEs in the Solar Precinct have been identified and can be found in Section 3.2 of Appendix 6.1. Based on the amount of groundwater proposed to be extracted:

- Groundwater resources hosted in the Montejinni Limestone aquifer have the potential to meet the construction water requirement of the Solar Precinct.
- Drawdown impacts on environmental receptors are not expected as these occur in separate aquifer systems.

Groundwater has not been assessed at the other project components are groundwater extraction will be minimal if at all.

Further detail for this comment can be found in Chapter 5 Terrestrial Ecosystems. GDEs are also discussed throughout Chapter 6 and 7 of this SEIS, and in particular, within Section 7.4.2.2.

7.10.2 ECNT Submission

7.10.2.1 Coastal Erosion and Sea Level Rise

Whilst modelling has been undertaken for the possibility of flooding at Lake Woods, similar modelling should be undertaken for coastal erosion and sea level rise at the Darwin Converter site at Murrumujuk. It is mentioned that ESC Plans will be implemented; these plans should include climate modelling. Sun Cable should be aware that coastal erosion is intensifying in Shoal Bay with the large sand spit at Tree Point being washed away earlier this year, now Tree Point would more accurately be called Tree Island. Dozens of large Casuarina trees were also washed away at nearby Lee Point in February 2022 and five metres of beach front was lost. Further evidence of coastal erosion can be seen within Hope Inlet (behind the proposed converter site) as the mangrove fringe is steadily collapsing. These impacts occurred during a period of no tropical cyclone activity. The storm surge modelling developed in 2010 and presented in appendix S, 3.7.2, is out of date and needs to be remodelled on current sea level observations. For a project expecting to operate until 2070 serious consideration will need to be given as to whether Murrumujuk is an appropriate site.

7.10.2.2 Response

Table 17-4 of the Draft EIS has 'Drainage, ESC installed and maintained in accordance with ESCP that align with the Best Practice ESC Guidelines' as an avoidance and mitigation measure and post-wet season inspections of all project locations and rectification of emerging erosion issues for monitoring. As stated in the Draft EIS a Surface and Groundwater Management Plan will be developed as part of the CEMP to manage and mitigate any impacts to inland water environmental quality during the construction phase. Consideration of climate change and its impacts will be included in the ESC Plans and CEMP.

7.11 NT EPA Direction Responses

The NT EPA's Direction included a comment regarding the impact to surface water, WQ and aquatic ecosystems at the Solar Precinct. The Direction and the Proponent's response to this direction is provided in below in Section 7.11.1.

7.11.1 Hydrological processes, inland water environmental quality and aquatic ecosystems – Comment 25

Section 6.3.1 of the draft EIS identifies that watershed changes from infrastructure at the Solar Precinct, due to land clearing and installation of solar panels, would not impact surface water flow regimes due to the design criteria for the Solar Precinct drainage network. These criteria provide for discharge at similar rates to preconstruction condition with no expected reduction in water volumes to the alluvial and flood plains surrounding Lake Woods.

The draft EIS states that construction activity and changes during operation (access tracks and pole pads) may cause changes to the structure of minor waterways and wetlands with residual changes to surface water flows.

Commitments are made in the draft EIS to:

- *Locate pole pads to avoid watercourses and wetlands;*
- *Avoid access tracks on major waterways;*
- *Stormwater discharges being similar to pre-development conditions; and*
- *Consider avoidance measures about riparian vegetation and semi-permanent and permanent pools.*

The draft EIS does not provide ground truthed location and extent of land clearing required of riparian vegetation nor information about any trenching works near minor waterways and wetlands.

7.11.2 Information required in the Supplement

Provide information consistent with the scope of the action to address the Environmental decision-making hierarchy (Part 2 of EP Act) for road, infrastructure, drainage structures and trench construction, include measures and commitments to protect:

1. *Flow regimes of surface water*
2. *Quality of surface water*
3. *Aquatic ecosystems.*

7.11.3 Response

Powell Creek Solar Precinct

Surface water runoff will generally move, via overland flow, towards drainage depressions locally. More broadly, drainage across the Solar Precinct is towards the east and north, discharging to the floodplains around Lake Woods. There are no watercourses within the Solar Precinct. Within the Ashburton Ranges and alluvial flats adjacent to the Solar Precinct, there are several watercourses that flow north-east and discharge to the floodplains around Lake Woods. Within the Solar Precinct, earthworks will occur and where necessary, drainage will be installed to manage surface water. Drainage will be installed where required for the AI footprints and Access Roads, and flow paths will follow similar paths as pre-construction. All drainage will be constructed and maintained using the Best Practice ESC Guidelines (IECA, 2008).

There are no watercourses located within the footprint of either Electrodes. The HVDC Electrode Line Corridor adjacent to the DCS Electrode crosses the second order Leaders Creek and the first order drainages of Fly Creek (Figure 3-1 in Appendix 5.2). Commitments including avoidance, mitigation, monitoring and reporting and residual impact is assessed in Sections 7.6 and 7.7 above. Earthworks and construct will need to occur and where necessary drainage will be installed at both of the Electrode sites.

The Electrodes at Powell Creek and the DCS do not have watercourses within their footprints. Therefore, there is unlikely to be any direct loss of aquatic habitat. The Project area is within the Leaders Creek and Fry Creek catchments, both draining north to the ocean.

The impacts to surface WQ is well detailed in Chapter 7 of the Draft EIS.

Our full list of commitments to protect surface water flow regimes, surface WQ and aquatic ecosystems are listed in Table 7-3.

OHTL Corridor

The revised OHTL crosses 128 watercourses. The Draft EIS states that OHTL structures (poles and/or lattice towers) will not be placed in or near any watercourses to avoid permanent disturbances of hydrological flows. Disturbance at lower order (minor) watercourse crossings is up to 22 m wide and at higher order (major) watercourses the commitment is not to disturb the levee banks and riparian edges of the watercourses by spanning them. Trenching of watercourses will not occur as part of the construction of the OHTL.

The WQ of each of the 128 watercourses crossed by the OHTL would vary due to differences in their supply sources, catchment inputs, flow regimes and ecosystem, processes and most watercourses have little WQ data available. Across most of the Project's footprint there are limited industrial land uses that are likely to affect WQ. Around the Katherine regions WQ is areas are impacted by PFAS contamination from the Tindal RAAF Base. This is discussed in detail within Chapter 6 of this SEIS.

Impacts to riparian vegetation have been assessed in Chapter 5 Terrestrial Ecosystems. As part of the assessment, the following studies were prepared to identify areas of Riparian Vegetation that are likely to be impacted by the Project:

- Supplementary Ecology Report – Part 2 (Appendix 5.2)
- Memorandum – Riparian Vegetation Assessment (Appendix 5.5).

Operational management of vegetation for the OHTL is detailed in Section 7.4.3.1 of the Draft EIS.

Our full list of commitments to protect surface water flow regimes, surface WQ and aquatic ecosystems are listed in Table 7-3.

DCS

Within the DCS there are no defined watercourses within the footprint. Earthworks during construction will need to occur and where necessary drainage will be installed at the site. Drainage from the DCS will flow, via overland flow, to the south into adjacent vegetated areas, and towards the seasonal swamp located to the south-west of the footprint.

There are no watercourses located within the footprint of either the Powell Creek Electrode or the DCS Electrode. However, earthworks and construction will need to occur and where necessary drainage will be installed at the site.

It is possible that land disturbance during construction of the DCS will result in impacts to WQ in the seasonal swamp due to erosion and sedimentation, although ESCPS's will be implemented to mitigate this risk (detailed in the Draft EIS in Section 7.4.2.1). There is no WQ data available for the seasonal swamp. However, studies have been undertaken on seasonal and perennial wetlands in the Darwin Rural Area. In general, WQ in the wetlands of the Darwin Region is good during the wet season and early dry season and deteriorates over the dry season. This is further detailed in Chapter 7, Section 7.3.3.1 in the Draft EIS.

Our full list of commitments to protect surface water flow regimes, surface WQ and aquatic ecosystems are listed in Table 7-3.

Further details can be found in Appendix 4.2 which describes the objectives, purpose, and application of the Constraints Planning and Field Development Protocols.



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