Derby Tidal Power Project
Tidal Energy Australia
18-Jul-2014
Doc No. 60212828-000-REP-ENV-1000

Environmental Impact Statement

Derby Tidal Power Station - 2010/5544

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18-Jul-2014

Job No.: 60212828

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Quality Information

Document Environmental Impact Statement

Ref 60212828

Date 18-Jul-2014

Prepared by Linda Kirchner

Reviewed by Jamie Shaw

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
A	23-Jan-2013	Internal draft for review	Linda Kirchner Associate Director - Environment	
B	16-Jul-2013	Draft for regulator review	Linda Kirchner Associate Director - Environment	
C	22-Jul-2013	Draft for regulator review	Linda Kirchner Associate Director - Environment	
D	10-Sept-2013	Internal Review	Linda Kirchner Associate Director – Environment	
0	30-Oct-2013	Final for Issue inc. response to DOTE review	Linda Kirchner Associate Director - Environment	
1	01-Apr-2014	Final for Issue inc. response to DOTE review	Jamie Shaw Associate Director - Environment	
2	10-Jul-2014	Final for Issue inc. response to DOTE review	Jamie Shaw Associate Director - Environment	
3	18-Jul-2014	Final for Issue inc. response to DOTE review	Jamie Shaw Associate Director - Environment	

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Acronyms

^0C	Degrees Celcius
AHD	Australian Height Datum
BoM	Bureau of Meterology
$CaCO_3$	Calcium Carbonate
CALM	Department of Conservation and Land Management (now DPW)
CAMBA	China and Australia Migratory Bird Agreement
CER	Consultative Environmental Review
cm	Centimetres
DEC	Department of Environment and Conservation (now DER and DPW) WA
DER	Department of Environment Regulation WA
DEWHA	Department of Environment, Water, Heritage and Arts
DoT	Department of Transport WA
DoW	Department of Water WA
DOTE	Department of the Environment
DPW	Department of Parks and Wildlife WA
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (now DOTE)
DMAs	Decision Making Authorities
EDL	Energy Developments Limited
EHWS	Equinoctial high-water spring tide
EIS	Environmental Impact Statement
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESD	Ecologically Sustainable Development
GW	Gigawatts
Ha	Hectares
HAT	Highest astronomical tide
HGM	Halpern Glick Maunsell
HWN	High water neap tide
HWS	High water spring tide
IBRA	Interim Biogeographic Regionalisation of Australia
JAMBA	Japan and Australia Migratory Bird Agreement
KLC	Kimberley Land Council
km	Kilometres

Acronyms cont.

km/sec	Kilometres per second
km^2	Kilometres squared
kV	Kilovolts
kW	Kilowatt
LAT	Lowest astronomical tide
LESF	Lower Erskine Sandstone Formation
LLWS	Lowest low water springs
LNG	Liquefied Natural Gas
m	Metres
mg/L	Milligrams per litre
MHWN	Mean high-water neap tide
MHWS	Mean high-water spring tide
MLWN	Mean low-water neap tide
mm	Millimetre
Mm^3	Cubic mega metre
MNES	Matters of national environmental significance
MSL	Mean sea level
MW	Megawatts
ppt	Parts per thousand
RAAF	Royal Australian Air Force
ROKAMBA	Republic of Korea and Australia Migratory Bird Agreement
TEA	Tidal Energy Australia
WA	Western Australia

Executive Summary

Background

Tidal Energy Australia Pty Ltd (TEA) intends to build a 40 megawatt (MW) tidal power station (the Project) near Derby on the Kimberley coast. The Project was referred under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in 2010 with submission of an EPBC referral (2010/5544) on 25 June 2010 and guidelines for the content of a draft Environmental Impact Statement released in 2010 (Appendix A).

This project was referred to the Environmental Protection Authority (EPA) under the *Environmental Protection Act 1986* WA (EP ACT) and the final EPA report was prepared in October 2002 (Bulletin 942, 984 and 1071). At this stage the project was put on hold for some years, but the process has recently recommenced with the revision and updating of the conditions and consultation with the appropriate decision making authorities (DMAs). The Implementation Statement was issued by the Environment Minister on 22 July 2013.

The Project goal is to be Australia's first tidal power station and world first double basin tidal power station, harnessing the renewable energy of the Kimberley's tides for the benefit of the local and regional economy. The Project would improve power supply in the local and regional area of Derby, in the Kimberley. The cost of power would reduce to approximately 30 cents per kilowatt (kW) and existing mining companies, as well as the RAAF Curtin Air Base and the Curtin Detention Centre, have agreed to purchase the power at cheaper rates. It is likely that the increased availability of cheap power would promote further growth and development in the region, which, in-turn would provide more employment opportunities and growth within the region.

The Project would have a net environmental benefit, by reducing greenhouse gas emissions associated with the generation of energy, the expansion of mangroves in the high basin and potential improvements in primary productivity of Doctor's Creek.

The lifespan of the project is expected to be 120 years. This is an appropriate time scale for other industries to commence production in the area and make use of the renewable power for a long period of time.

The reduction in greenhouse gas emissions associated with generating energy for the local community from a renewable resource would assist Australia in meeting its Kyoto Protocol targets in 2020.

The Project

The Project would require the installation of barrages, levees, turbines and storage capacity to convert tidal energy to electrical power at Doctor's Creek north of Derby. Power from the Project would be made available to local industries and institutions/facilities in the area. In the long term there may be facility to supply power to the domestic market, but a steady baseload from Industrial clients is preferred initially. The power station would be connected to customers by way of a transmission line that would run from the power station along gazetted roads.

The area of the two basins comprises an area of 630 ha in the high basin and 1520 ha in the low basin (2150 ha combined) which is 0.4% of the area in King Sound (570,000 ha) and 1.7% of the area of turbid water in King Sound (128,000 ha).

Relevant Studies

Several studies have been undertaken in the area of the Project to determine the baseline conditions of the site, understand potential impacts on the physical characteristics of the area and to evaluate the potential impacts to Matters of National Environmental Significance (MNES). These studies are all included as appendices to this document and include:

- Consultative Environmental Review under the WA EP Act, completed in 1998
- Sediment and erosion modelling, completed in 2011 (Appendix C)
- Mangrove habitat mapping was completed in 1997 (Appendix D)
- A study on the cause-effect pathways of mangroves, completed in 2011 (Appendix E)
- Assessment of changes in mangroves in Doctor's Creek, completed in 2011 (Appendix F)
- Engineering design report, completed in 2012 (Appendix G)

- Geotechnical studies, completed in 1997 and 2002. (Appendix H and Appendix I)
- Preliminary sedimentation assessment of Doctor's Creek, undertaken in 2003 by HGM (Appendix L)
- A Consultative Environmental Review, completed for the Prawn Farm in Doctor's Creek by Diamond Island Pty Ltd in 1997 (Appendix M)
- An assessment of impacts on migratory shorebirds, completed in 2002 (Appendix J)
- A review on the effects of tidal turbine noise on fish hearing and tissues (Halvorsen 2011) (Appendix O)
- Dynamics of turbidity,investigated by Wolanski and Spagnol in 2003 and published in Estuarine Coastal and Shelf Science
- A review of freshwater fishes of the Kimberley region of WA, completed Morgan *et al* in 2011 and published in Zootaxa
- Supplementary information and a review of previous surveys and studies on the occurrence of Pristis (Sawfish) and Glyphis (River Shark) species in Doctor's Creek WA, undertaken in 2014 by Thorburn (Appendix P).

Matters of National Environmental Significance

The online DOTE protected matters search tool (24 May 2013) with a five km buffer (Appendix N), indicates that there are several MNES that are likely to occur in or near the project area. This report identified:

- 22 listed threatened species (13 marine, 9 terrestrial)
- One National Heritage Place (the West Kimberley)
- 27 listed migratory species.

The Protected Matters Search Tool provides indicative occurrence of species based on generalised information and distributions. The results, as well as the EIS guidelines, provide an initial screening of species relevant to the controlling provisions, with desktop and survey results also considered (Table 10). Species listed as MNES and assessed in detail in this EIS include:

- Northern River Shark
- Three Sawfish species
- Spotted Bottle nosed Dolphin and other dolphin species
- Saltwater crocodile and sea turtles
- Migratory birds.

The key habitats in the Project area consist of open, unvegetated tidal mudflats, fringing mangroves and the marine habitat. Doctor's Creek is part of extensive mangrove systems throughout King Sound.

Mangrove communities of King Sound are particularly important for the Northern River Shark (*Glyphis garricki*), which has been found in the King Sound macrotidal mangrove systems (Morgan *et al*, 2009). A study completed by Morgan *et al* (2011) suggests that the marine environment at Doctor's Creek is also suitable for sawfish species (*Pristis microdon*, *Pristis clavata* and *Pristis zijsron)* which inhabit water that may be clear to very turbid and fresh to less than 35 ppt of seawater in tidal ranges of 8 to 11m. *Pristis zijsron* has not been recorded in King Sound.

It is expected that the Australian Snubfin Dolphin (*Orcaella heinsohni),* Spotted Bottlenose Dolphin (*Tursiops aduncus)* and Indo-Pacific Humpback Dolphin (*Sousa chinensis)* may be present in King Sound, but they have not been recorded in Doctor's Creek.

Turtles may forage in the project area, but are unlikely to use the area for breeding due to the steep slopes of the tidal creek and lack of sandy areas above the shoreline. Crocodiles (*Crocodylus porosus*), sea snakes, turtles, and Dugongs (*Dugong dugon*) have been recorded in the intertidal areas of King Sound, but only crocodiles have been recorded in Doctor's Creek.

The intertidal mudflats of North West Australia also provide feeding grounds for shorebirds arriving in Australia after migratory flights from Siberia and Northern China through the East Asian Australasian Flyway. The intertidal area of Doctor's Creek is considered part of this flyway (HGM, 1998). The fauna survey of 1997 completed by HGM (1998) identified 16 migratory shorebird species as using the intertidal area for foraging purposes. The 2013 protected matters search lists 12 migratory avifauna species and two vulnerable terrestrial species that may occur in the area. Species which are found in habitat similar to Doctor's Creek include Great Egret (*Ardea modesta*), Cattle Egret (*Ardea ibis*), Oriental Plover *(Charadrius veredus),* White-bellied Sea-Eagle (*Haliaeetus leucogaster),* Oriental Pratincole (*Glareola maldivarum),* Rainbow Bee-eater (*Merops ornatus),* Derby White-browed Robin (*Poecilodryas superciliosa cerviniventris)* and the little tern *(Sterna albifrons).*

Expected likely and Potential Impacts on Matters of National Environmental Significance

The Project involves the harvesting of tidal energy to provide a clean power supply. This means that there are particular aspects of the proposal that cannot be altered. This is particularly true for the engineering design of the project, which has been designed to maximise power generation and minimise environmental impacts. No dredging would be required and the tidal movements in the high basin would remain similar to current tidal movements with the operation of sluice gates.

An assessment of alternatives was completed and focussed on alternative locations for tidal energy projects. These were based on criteria that were established based on the prerequisites of a tidal power project. Three alternative locations were identified, none of which was evaluated as being able to host a double-basin scheme as environmentally acceptable as the Project (van Walsum, 2004) and capable of producing consistent power.

The Northern River shark (*Glyphis garriki*) was captured in Doctor's Creek but, many more, in the order of 5:1 were caught in the area to the south of Derby (Thorburn 2014). This suggests that while Doctor's Creek does provide habitat there are areas nearby that are preferred habitat for the Northern River Shark.

Very low numbers of *Pristis clavata,* (Dwarf Sawfish) and *Pristus pristus* (formerly *microdon*), (Largetooth Sawfish) have been recorded in Doctor's Creek and in King Sound in general. Preferred habitat appears to be the riverine habitat of the Fitzroy River and other large rivers and areas of the Pilbara coast. *Pristus zijsron*, (Green Sawfish) has not been captured in King Sound or Doctor's creek. Doctor's Creek is saltwater and is likely to provide foraging habitat, but not breeding habitat for these species (Thorburn 2014).

The Australian Snubfin Dolphin frequents a long stretch of northern Australia's coastline and has been recorded close to river and creek mouths and upstream in some tidal rivers (Parra, 2006), it is therefore likely to enter Doctor's Creek during high tides. Due to its tolerance for turbid waters and preference for shallow waters is possible that the Indo-Pacific Humpback Dolphin may forage in the Doctor's Creek area, but sightings have not been recorded. Anecdotal information from CALM officers (now DPW) based in the Kimberly region indicate that Bottlenose Dolphins are reported to be the most common dolphin species seen in the King Sound area (Mike Lapwood, CALM, *pers.comm*, November 2002). These anecdotal reports suggest that this species is likely to frequent the area of Doctor's Creek although they are not known to use the area for breeding purposes.

Turtles potentially forage in the area, but are infrequent visitors due to turbidity and less than ideal habitat. Crocodiles were recorded in quite large numbers during the survey and are expected to be resident in Doctor's Creek.

There is expected to be some short term disturbance during construction, but marine fauna will be isolated from the construction area by a bund wall.

Marine fauna will maintain access to the tidal creek when the gates are open and are expected to thrive in the basins when the gates are closed. The low basin will retain water in existing pools and deep spots and water will always be entering the low basin via the turbines. Sharks, sawfish and dolphins are large strong swimmers and will have no difficultly swimming against the tidal current and there are locations behind the gate supports where the currents are reduced. There will be some scouring in the area near the gates, but as there will be periods of time when the water is still, there will be opportunities for sediment to settle. Turbidity in King Sound is periodically very high, particularly when it rains and sediment is washed down the main freshwater rivers including the Fitzroy. No impacts on local populations are expected. It is possible that there may be increased predation of animals trapped in the high basin, but if this is noted then predator control will be implemented.

Migratory bird species are likely to use the mudflats and mangrove areas as foraging habitat, but none of the listed species are known to use this area as breeding habitat, due to the extreme tidal range and lack of fresh water and / or shelter.

The alterations in water levels in the west branch (high basin) of Doctor's Creek may cause decreased feeding opportunities as the creek bed would not be exposed. The alterations in water levels in the east branch (low basin) of Doctor's Creek are likely to provide longer foraging opportunities for shorebirds in their preferred areas of the creek bed due to slower filling of the east branch, provided the abundance of prey remains consistent with previous numbers (Hassell, 2002). After construction it is likely that there would be sediment build up on the seawater side and on the edges of the channel that would form as water drains from the low basin. This may increase the bird foraging area provided that benthos is able to survive (Hassell, 2002).

While roosting and foraging mangrove habitat would be lost in the short term, it would also have the opportunity to increase in comparison to current levels (1500ha lost – 2300ha gained). This amounts to a loss of approximately 10% of a mudflat area of approximately12000ha. The remaining extensive mudflat area is constantly changing (SKM 2011) and it is expected that the decrease in open mudflat in the high basin will be compensated by the drop in water levels in the low basin. These areas are difficult to quantify as they change with tides and seasons and while the maximum depths of the basins will change, they are still within the natural variations of the tidal system.

The masking effect of noise on migratory waders depends on the pre-existing level of ambient noise. Dooling *et al* (2007) concluded that, given an existing ambient noise environment of 50 to 55 dB(A), anthropogenic noise levels of 55 to 60 dB(A) can reasonably be assumed to begin to interfere with bird acoustic communication. This interference may lead to behavioural responses, potentially leading to abandonment of a roosting site. Project noise is likely to be masked by the sound of the current and will not impact upon roosting birds (AECOM 2009). Lighting may also change bird behaviours and this will be addressed by the use of shielding on outdoor lighting.

Potential terrestrial fauna in the transmission line areas include the Northern Quoll, Greater Bilby, Northern Marsupial Mole, Bar-rumped Sheathtail Bat and Water Mouse. None of these species have been recorded in the area and impacts on their habitat will be restricted to a previously cleared corridor. It is not expected that there will be impacts on these species or their habitat to the level where populations would be threatened.

A risk assessment process was undertaken to rate the likelihood and consequences of each activity and to consider management and/or mitigation to reduce risks that rated as medium or higher. Current policies and procedures were discussed in relation to specific risks to evaluate whether changes were required. All environmental risks identified were classified after mitigation as either Low or Very Low. The only aspect of the Project that has a Medium risk is associated with the sluice gates. The sluice gates, once operational (opening and closing for 6 hour periods), would impact tidal movement and water levels within the basins and restrict fauna movement in the short term. These impacts are unavoidable as they are an integral component of the Project.

After mitigation measures were applied all risks were reduced to low or very low and it is considered unlikely that the Project will have a significant impact on MNES provided management and mitigation measures are undertaken as planned.

Measures to avoid impacts on MNES include:

- excavation of mudflats to be undertaken when the tide is out so dredging equipment and the impacts on marine fauna due to the addition of large amounts of sediment into the water column are avoided
- the banks of Doctor's Creek will largely remain unmodified to maintain the natural shape of the tidal inlet
- a bunded area will be created on the point for the construction of the sluice gates and turbine housing. This will isolate construction activity from marine fauna particularly in terms of exposure to noise and electric currents. The bun will be removed after construction fir operations
- the tidal fluctuations and periodic filling of the basins will be maintained to avoid removing the habitat from use by marine fauna
- the road to the power station will be constructed along the levee between the high and low basin on the high ground between the basins to avoid building another structure within the marine MNES habitat
- designing the transmission line to be constructed in a previously disturbed area along road verges to avoid impacts to terrestrial fauna

- electromagnetic (EMF) cables will not be introduced to the marine environment avoiding impact to marine fauna from EMF.

Measures to minimise impacts on MNES include:

- restricting excavation in the mudflats to the low basin to minimise disturbance to foraging habitat for shorebirds
- compensate for the loss of intertidal habitat in the high basin due to the tide not dropping below half full by the maintenance of lower water levels in the low basin increasing the area of intertidal habitat for shorebirds.
- control water flow onto the turbines using wicket gates, also preventing larger fauna from coming into contact with turbines
- open sluice gates for several hours twice per day to allow movement of the tides and to allow ingress and egress of fauna into the tidal creek system
- maintain existing pools in the low basin to prevent fauna becoming stranded
- maintain water levels to the same high water level in the high water basin, minimising impacts to mangroves in this basin
- maintain current tidal pattern to maintain access to habitat as per current level
- provide areas of calmer water behind gate/sluice pillars to assist fauna to swim against tidal currents
- minimise the external noise level by improving the acoustic isolation of the powerhouse and turbine, controlling vibrations of the ventilation system, improving hydrodynamic design of hydraulic structures and by using non-reflecting and sound absorbing materials such as fibreglass mat, false ceiling and heavy mass trap doors
- minimising lighting to that required to meet safety levels
- monitoring of shorebirds, mangroves and marine species to determine any changes to populations and to increase knowledge of how alterations to habitat affect these species and communities.

Conclusions

Due to the avoidance, minimisation and mitigation actions, it is considered unlikely that there would be a significant impact of the Project on MNES. There is likely to be a short term significant impact on mangroves, however, mangroves are a dynamic ecosystem of Doctor's Creek, and are constantly changing (SKM 2011). It is considered tidal movements would potentially increase the total area of mangroves within Doctor's Creek in the medium to long term. This would have positive implications for migratory shorebirds that use the tidal flats and mangroves as feeding areas.

The location of the transmission line has been sited where it causes minimal environmental impact within the existing Main Roads reserve. Clearing is not expected and as a result, terrestrial MNES are not expected to be disturbed.

Habitat of the Northern River Shark and sawfish species will be altered, but given the constantly changing natural system and extreme tidal movements it is considered that habitat changes due to the project will not be detrimental to the species, which will continue to use the area for foraging. Entrapment in the creek system may occur for a short time when sluice gates are closed, however sluice gates are open twice per day for 6 out of 12 hours to allow water and fauna movement and foraging in the high basin will be abundant. Water flow into turbines is directed by wicket gates, and studies have shown that large marine species are unable to move through the turbines.

It is unlikely that the Derby Tidal Power Project would cause irreversible impacts on Matters of National Environmental Significance. There would be long term changes to the distribution of mangroves and changes to water levels in Doctor's Creek, but these would not be significantly different to naturally occurring variations. The intertidal creek systems in the Kimberley are dynamic ecosystems that exist in volatile environments where conditions change rapidly with weather and offshore conditions.

Impacts on roosting sites of migratory birds and shorebirds are considered unlikely as no roosting sites were located during the surveys (Hassell, 1997) and it is likely that shorebirds roost in open areas of the supra-tidal flats. Foraging areas on the mud flats would remain virtually unchanged.

Hassell (2002) states that based on data and information available, construction activities are unlikely to impact directly on shorebirds. In addition, while there would be a loss of exposure of the creek floor in the high basin, this may be offset by an increase in the time of exposure of the creek bottom in the low basin and a potential increase in foraging habitat due to sediment build-up adjacent to barrages and from bank slumping (Hassell, 2002). The Hassell (2002) report is provided in its entirety in Appendix H.

Although potential direct impacts of the Project on water quality have been identified, indirect beneficial impacts of an improvement in water quality remain less clear. The increase in organic matter from decomposition of mangroves may improve food availability for migratory shorebirds. Reduced sediment load may also allow more sunlight to filter through the water column, improving primary production and providing more food for migratory shorebirds. Short term increases in turbidity during construction of the barrages would result in increased sediment load, reduced light penetration and primary productivity would also be reduced during this time. Impacts of reduced flushing of the upper reaches of the creek are uncertain. None of these potential impacts would be irreversible and if the tidal power station was removed after installation, the creek is likely to return to equilibrium similar to that which currently exists.