Appendix D – Environmental Risk Assessment

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D. Appendix D - Assessment Approach

This report provides information regarding potential environmental risks that may occur in relation to the installation and maintenance of the proposed INDIGO Central Cable (the cable) project in conjunction with relevant management controls for those risks. This information supports project approvals for the portion of the cable located within Australian waters, including:

1. The portion of the route from Perth to the exit of the Australian Exclusive Economic Zone (EEZ)
2. The portion of the route from the EEZ re-entrance point to Sydney

Information reported within the Environmental Assessment for the project informs which environmental features may be at risk from project activities. To complete this risk assessment, the following process has been adopted:

- Describe which project activities have potential to harm which environmental features and why
- Describe the consequences of the potential impact being realised
- Identify relevant management controls to reduce or eliminate the potential environmental risk
- Discuss overall environmental outcomes.

D.1 Environmental Hazard Identification

The cable will extend from an existing submarine pop out point (POP) within the Perth protection zone (PZ) at around 10 m water depth (WD). It will pass around Cape Leeuwin at the south-west of Australia, before heading in a south-easterly direction. The cable then leaves the EEZ approximately 430 km south of Esperance, in a WD of 5708 m.

The cable re-enters the EEZ approximately 460 km south of Kangaroo Island, in a WD of 5195 m. From there the cable traverses Bass Strait, and travels around Cape Howe at the south-east of Australia, before connecting to an existing POP within the Sydney southern protection zone (SSPZ) in a WD of 30 m.

Across all geographies the cable will be placed on open seabed in deep water. In shallow water and where required / appropriate the cable will be ploughed or water jetted into the seabed up to 1 m depth out to WD of 1000 m. The cable route has a maximum width of 10 m, with the area of actual seabed disturbance comprising a small portion of this area; exact disturbance area is dependent on cable installation method in any one location.

The cable route will transect or lie in proximity to a range of marine habitats including subtidal rocky reef, macroalgal beds, seagrasses and expanses of subtidal sand and soft sediments. Accordingly, cable installation has potential to harm these environments.

The methods to be used during the project for cable placement that have the potential to harm the environment will be:

- Cable burial by ploughing or jetting up to 1000 m WD
- Direct placement on the seabed

Vessels will be required to support the project activities, including the connection of the cable with the POPs. The risks to the environment from these activities are:

- Disturbance of seabed within the path of cable laying
- Noise and lighting pollution from vessel platforms
- Release of potential wastes, contaminants or pollutants (including hydrocarbon spills) from operational activities
- Atmospheric emissions from activities
- Interference with other users of the area affected by cable laying.

Other impacts from unplanned events may also arise from the project activities. The risks to the environment from these activities are:

- Pest introduction and proliferation
- Accidental release of solid waste
- Impacts to the seabed from dropped objects
- Marine fauna collisions
- Hydrocarbon, chemicals and other liquid waste
- Damaged fuel tank associated with vessel collision
- Seabed disturbance associated with cable maintenance activities (during operations).

The cable installation is tentatively scheduled for Q3 2018; however, is dependent upon the weather and receipt of permits.

D.2 Impact analysis

Impact analysis for each identified hazard is conducted in a systematic manner following the general process of:

- Identifying the key concerns
- Consideration of sensitive environmental features potentially affected either directly or indirectly by the activities
- Where practicable, quantification of the magnitude of the stressor, the concentration of contaminant and/or level of disturbance
- Consideration of timing, duration and other factors affecting the impact and risk (WD, temperature, tides etc.)
- Consideration of cumulative impacts.

The impact analysis is undertaken for environmental values and protected matters identified, as detailed in the Marine Ecology and Heritage reports (Appendix B and C).

It is considered that within the natural environment, some aspects have a higher value than others, and these aspects, or sensitive receptors, have been specifically considered when determining the overall environmental consequence of an impact. In determining consequence, the potential presence of the following environmental receptors has been considered:

- Benthic primary producer habitats
- Habitats that are rare or unique
- Habitat that represents a Key Ecological Feature

- Species and ecological communities
- EPBC listed threatened species
- EPBC Act migratory species
- EPBC listed threatened ecological communities
- State Protected Areas
- World Heritage Areas
- Commonwealth/National Heritage Areas
- Marine Conservation Reserves.

This report should be read in conjunction with the Marine Ecology Report (Appendix B) which provides a description of the environment within and adjacent to the cable route and those protected matters which the proposed action is likely to interact with.

The following section addresses potential impacts from planned activities. Following that, potential impacts from unplanned activities are considered.

D. Planned Activities

D.3 Seabed Disturbance

D.3.1 Environmental Hazard Description

Disturbance to the seabed and benthic habitats may occur during the following planned activities:

- Route clearance and pre-laying grapnel run activities
- Cable laying on seabed surface
- Water jet burial of cable by Remotely Operated Vehicles (ROVs) or divers in soft sediments
- Plough burial of cable in soft sediments.

As the project is wholly marine, with the cable corridor terminating at each of the respective existing submarine POPs, impacts to the onshore environment are not expected to be realised from planned activities. Changes to seabed bathymetry are not expected to occur due to the small footprint area and size of the cable.

D.3.2 Impact Analysis

Route clearance and pre-laying grapnel run

A seabed survey has been completed to inform cable route alignment. This has sought to avoid as far as practical any areas of hard substrate. There may, however, be need to clear marine debris from the cable route prior to installation to support burial. Should this be needed, a Pre-Lay Grapnel Run (PLGR) will be performed prior to the main cable lay operation, and will be carried out along the proposed cable route where burial is required. The PLGR operation would be to industry standards employing towed grapnels; the type of grapnel being determined by the nature of the seabed. This is not anticipated to be needed; however all survey data is still being analysed and as such the potential impact is included here for completeness and consideration of all potential impacts.

The objective of the PLGR operation is the clearance of any seabed debris, for example wires or hawsers, out of service cables, fishing equipment etc., which may have been deposited along the route. Any debris recovered during these operations would be discharged ashore on completion of the operations and disposed of in accordance with local regulations.

Soft benthic habitats and the infaunal communities within them will be disturbed by PLGR activities. Survey has aligned the cable to minimise risk of crossing any hard substrate. However small patches of hard rock veneer or similar are expected to be crossed in shallower waters. Where present, this habitat and the supported diversity may be damaged or suffer mortalities. Motile fauna are likely to re-locate away from the disturbance, however any sessile or slow moving fauna (e.g. Syngnathids) at or directly adjacent are likely to be injured or suffer mortalities. Any disturbance or damage to habitats can cause a loss of feeding grounds, breeding and nursery areas and resting areas for marine fauna such as fish and marine reptiles.

Any increase in suspended sediment is likely to cause reduced feeding capability and survival for deep sea sponges and cold-water corals (UNEP, 2007).

Plough and ROV Water Jet Cable Burial

In certain locations up to 1000 m WD, the cable will require burying within soft sediment to a target burial depth of 1 m below seabed level to support protection of the cable from potential future damage. Burial to this depth normally affords good protection against most forms of fishing activity. Burial would occur by either a plough that is dragged along the seabed behind the cable laying vessel (in <1000 m WD where geology allows), by ROVs, or by divers in shallow waters, jetting water to liquefy the sediments around the cable so it sinks into the seafloor under its own weight. If existing cables need to be crossed within these water depths, laying approach will be selected to avoid impacting upon the crossed cable. Alignment selection has taken account of known cables to minimise this risk. Ploughing operations to bury the cable are generally conducted at very low speeds, typically 0.5 knots. This low energy movement reduces the sediment suspension in the water column.

The sediment and infaunal communities within the area of this activity are expected to be disturbed. Mobile fauna within the area of disturbance have potential to be temporarily displaced from the area; however, any benthic species in the direct path of activity will be directly affected by activities. Although vessel speed and cable laying speed is very slow, this may include small, slow moving fishes like Syngnathids. Impacts may occur from collision with equipment, burial, water jetting or from sediment suspension affecting filter feeding (UNEP, 2007; Söker *et al*., 2000). This is predicted to lead to temporary loss of biodiversity from the direct cable footprint. Recolonisation of disturbed sediments from adjacent habitats is expected to occur within weeks.

As discussed by the OSPAR Commission (2009), the disturbance and habitat impacts from the construction phase of submarine cables are not likely to be detrimental to the overall quality of a region because of the localised and temporary nature of the impacts. Burying of the cable is expected to effect a width of 5 to 10 m if ploughed. The disturbance zone typically associated with ROV jetting is approximately 5 m wide (Carter et al., 2007).

Cable burial activities will be undertaken in a linear manner. As such, impacts are not expected along the entire cable route for the entire four month laying duration. Impacts will be temporary and habitat to be affected is considered to be well represented locally and regionally. As such, this activity is not expected to have a significant impact upon environmental matters.

Cable Laying

At water depths beyond 10 m (Perth) and 30 m (Sydney), the cable route crosses a variety of habitats consisting of rocky reefs, open sandy seabed, basins and ridges. Where burial is not required for cable protection the cable will be laid directly on the seabed. Lateral movement of the cable over short distances can cause localised scarring and damage. Rocky reefs, in particular, are less resilient to disturbance than soft sediments habitats. As reefs are slow growing, they are susceptible to chronic contact damage reducing biodiversity. Survey data has been used to align the cable to avoid rocky reefs as far as practicable, thus reducing the risk of this impact.

Where the cable is laid directly on the seabed it is expected to remain stationary under its own weight once it is in place; no further substantial sideways movement is anticipated. As such, ongoing habitat disturbance from the cable moving post laying is not predicted. During the laying activity soft sediments directly under the cable are expected to experience little disturbance, however any (localised) increase in suspended sediment may cause temporary reduced feeding capability of any deep sea sponges or other filter feeders adjacent the laying footprint (UNEP, 2007).

While short-term impacts localised to the portion of the cable being laid are likely from increased suspended sediment and turbidity; sands are predicted to settle quickly. Mobile fauna within the area of disturbance have potential to be temporarily displaced from the area; however, any benthic species in the direct path of cable laying will be directly affected by such activities. This may include small, slow moving fishes like Syngnathids (in shallow areas less than 20 m WD). Impacts may occur from collision with equipment laying the cable, burial under the cable or from localised sediment suspension affecting filter-feeding species (UNEP, 2007; Söker *et al*., 2000). This is may lead to temporary loss of biodiversity where it overlaps with the direct cable footprint.

Significant research from dredging and marine construction disciplines demonstrates that disturbed habitats quickly recolonise from adjacent habitat such that within a few months to years disturbed areas support the same biodiversity as prior to impact (e.g. Ottaway *et al*., 1989; Smith and Rule, 2001; Wilber *et al*., 2007).

Given these findings, recolonisation of areas disturbed by cable laying from adjacent habitats is expected to occur relatively quickly. Never the less, longer term, localised changes in the benthic environment may occur given the cable structure encourages the growth of biofouling species through introduction of hard substrate (OSPAR Commission, 2009).

Studies by Kogan *et al*. (2003, 2006) showed no statistical difference in the abundance and distribution of 17 animal groups living on the seabed within 1 m and 100 m of a surface-laid coaxial scientific cable. Likewise, 138 sediment cores with an infauna of mainly polychaete worms, nematodes and amphipods showed that the infauna was statistically indistinguishable whether near or distant from the cable.

As the cable will occur across areas of open, sandy seabed, the introduction of hard substrate will cause a localised alteration from what is the natural, extant, benthic communities (OSPAR Commission, 2009). However, given previous research findings, this is not predicted to cause a significant impact to any sensitive environmental receptors.

D.3.3 Management Controls

To reduce or eliminate the impact of seabed disturbance, a number of management controls can be implemented when possible:

- The cable laying route in deep waters will be positioned to avoid underwater features such as rocky reefs, other cables (as far as practicable) or debris
- Ecologically sensitive areas identified from review of benthic survey data as well as desktop assessments will be avoided if possible.

D.3.4 Environmental Outcome

The activities associated with the cable laying will disturb the seabed and benthic habitats within an area of up to 56.36 km^2 with the actual distance footprint expected to be a significantly smaller portion of this area.

The cable laying activities will occur in/over benthic habitats that are widely represented at a regional scale. Once the cable has been installed, further disturbance or damage to soft sediment habitats and benthic communities is not anticipated. Localised, short-term disturbances to sediments and/or epibenthos living on the cable are expected to occur if any future maintenance is required. This would be an unplanned activity and is addressed in Section 3.15.

The environmental risks will be limited to the immediate surrounds of the cable, and are expected to be short term in nature, with low risk on existing species; as such risks associated with planned seabed disturbance are considered to be acceptable and as low as reasonably practical.

D.4 Artificial Light Emissions

D.4.1 Environmental Hazard Description

Artificial light emissions may occur during the use of vessel safety lighting.

D.4.2 Impact Analysis

Artificial light from vessels may attract and disorientate fauna such as birds, marine turtles, fish, and other pelagic species in the locality, particularly during peak breeding periods and when the vessel is positioned within visual distance of breeding locations.

Seabirds

Birds may be attracted either directly or indirectly by the light source. Studies conducted between 1992 and 2002 in the North Sea confirmed that artificial light was the reason that birds were attracted to and accumulated around illuminated offshore infrastructure (Marquenie *et al*., 2008). Structures in deep water environments tend to attract marine life at all tropic levels, creating food sources and shelter for seabirds (Surman *et al*., 2002), and providing enhanced capability for night foraging. Birds may also use light as a cue for migration.

Marine Reptiles

Turtles use light for navigation. The attraction of turtles to artificial lighting occurs as the light source has a highly directed light field in comparison to the disparate light of natural navigational light sources (e.g. moonlight) (Witherington and Martin, 1996; Witherington, 1997). The level of artificial light necessary to initiate a response in marine turtles is unknown; however, the magnitude of impact has been shown to vary between species and in relation to light wavelength and intensity. Green turtle eyes have been shown to be most sensitive to short wavelengths of light in the blue-green to orange region of the visible spectrum (400 to 640 nanometres) (Granda and O'Shea, 1972). Dedicated environmental monitoring from drilling rigs revealed that very few, if any; turtle hatchlings approached lit drill rigs at night. Those that did approach did not remain around the drill rig for very long (usually less than 30 minutes) (Apache, 2007). Therefore, artificial lighting from vessels is not likely to impact on hatchlings even though they may transit through the cable route during installation activities.

Artificial lighting is known to disrupt the normal behaviour of nesting female turtles, as well as hatchlings attempting to orient towards the ocean (Salmon, 2006). Given that most of the proposed works will occur in deep water away from lands, the lack of nesting beaches in proximity to the project area, the potential for vessel artificial lighting to disrupt turtle behaviour is considered minimal.

There is currently insufficient evidence to indicate that artificial lighting affects sea snake behaviour. In addition, they are unlikely to be encountered in large numbers within the majority of the cable route due to most sea snakes displaying a habitat preference of shallow coastal waters.

Fish and Other Pelagic Species

The response of fish to light emissions varies according to species and habitat. According to Meekan *et al*. (2001), light trap experiments have shown that some fish and zooplankton species are attracted to light sources, with traps drawing catches from up to 90 m away (Milicich *et al*., 1992). A study of larval fish populations by Lindquist *et al.* (2005) around an oil and gas platform in the Gulf of Mexico found that an enhanced abundance of clupeids (herring and sardines) and engraulids (anchovies), both of which are highly photopositive, was caused by platforms' light fields. The concentration of organisms attracted to light causes an increase in food source for predatory species; marine predators are known to aggregate at the edges of artificial light halos. Shaw *et al.*, (2002), in a similar light trap study, noted that juvenile tunas (Scombridae) and jacks (Carangidae), which are highly predatory, might have been preying upon concentrations of zooplankton attracted to the light field from platforms. This could lead to increased predation rates compared to unlit areas.

As any artificial light spill will come from the cable installation vessel, it will traverse through the environment at installation speed. The potential impacts from artificial lighting on fish and other pelagic species are, therefore, considered temporary and mobile across the cable route. Chance of encounter with susceptible species during installation activities is considered minimal with temporary period of exposure. Hence, lighting is not considered likely to have long term influence on behaviour of species encountered during the cable installation activities.

Other Marine Fauna

Currently there is no evidence to imply that artificial light sources negatively impact on the migratory, feeding or breeding behaviours of cetaceans. According to Simmonds *et al*., (2004), cetaceans predominantly utilise acoustic senses to assess their environment rather than visual stimuli and light sources. However, these species may be indirectly impacted by artificial lighting should their food sources be attracted to light. Migrating species may also be impacted by artificial lighting through changes to their migration patterns.

Such impacts are temporary and not considered likely to have long term influence on behaviour of species encountered during the cable installation activities.

D.4.3 Management Controls

To reduce or eliminate the impact of artificial lighting, the following management controls can be implemented when possible:

- Light spill from the nearshore vessel operations will be minimised where possible using directional lighting. Light shields could be considered to avoid spill if sensitive receptors are determined during activities to be negatively affected
- Lighting on vessel decks will be managed to to reduce direct light spill onto marine waters, unless such actions do not comply with navigation and vessel safety standards (AMSA Marine Orders Part 30: Prevention of Collisions; AMSA Marine Orders Part 21: Safety of Navigation and Emergency Procedures).

D.4.4 Environmental Outcome

Minimum lighting is required for safety purposes on board the vessels, and for navigational purposes. Vessel presence is required to undertake the activities and therefore environmental consequences due to lighting are possible.

It is necessary for all vessels in Australian waters to comply with the navigation safety requirements prescribed within the Navigation Act 2012 and the subordinate Marine Orders with regards to workplace safety equipment (e.g. lighting) and navigation. While light spill will be reduced wherever possible, the elimination of deck lighting on vessels would result in:

- Increased probability for vessel collisions and accidents
- Presenting new safety risks to crew members
- Non-compliance with marine codes and regulations.

The use of directional lighting whilst adhering to navigation safety measures to reduce the risk and impact of artificial lighting to faunal species have been identified. However, negligible spill of artificial lighting cannot be avoided.

Turtles and shorebirds are identified as being the most sensitive to artificial light sources. Given that both these species do not nest within the project area or adjacent habitats, and that most of the project will occur in deep water away from nesting areas, it is unlikely the artificial light will interfere with their breeding success and population longevity. Indirect impacts on these and other marine species could include changes in migration patterns; nonetheless, such impacts are temporary and mobile across the cable route and are not considered to pose a significant risk.

D.5 Artificial Noise Emissions

D.5.1 Environmental Hazard Description

The activities associated with the placement of the cable will generate standard shipping noise associated with vessel movements between port environments. This should not cause an unacceptable noise affecting the nearest residents given the POPs are approximately 1 km and 2 km offshore in Perth and Sydney respectively. In Bass Strait vessels will not transit within 7 km of islands and as such no residents are expected to be affected by noise during offshore laying activities.

Disturbance to marine fauna (including avifauna) from above ground and underwater noise may occur in response to noise generated by vessel movement and cable laying activities. Cable laying activities with noise generating activities will involve the use of vessels that generate underwater noise from general operations.

D.5.2 Impact Analysis

The proposed cable laying activities may generate above ground and underwater noise related to deployment of the cable, engine and general vessel operations. Vessels transit oceans on a regular basis and the proposed activity is expected to generate noise which is no different to (or which may be less than) that generated by standard shipping operations. The latter have not been observed to affect protected species from noise disturbances.

Never-the-less, vessels are expected to use sounders and other navigational equipment to support vessel positioning and cable laying operations. These have potential to generate underwater noise that could influence sensitive fauna that use acoustic means of navigation or communication.

Cetaceans

Dolphin species can be classified as ‘medium frequency’ cetaceans. This is due to the species producing and using sounds ranging from tens of kHz to 100 kHz for echolocation, communication and navigation. In contrast, low frequency sounds are used by baleen whales (e.g. humpbacks, blue and minke), thereby making them the most sensitive of cetaceans to artificially generated low frequency noise. According to McCauley (1994), baleen whales are capable of generating a vibrant and range of underwater sounds of frequencies between 12 Hz to 8 kHz, though predominantly producing sounds of frequencies below 1 kHz (McCauley, 1994). Findings of studies into the hearing mechanism of baleen whales indicate that their hearing has been adapted to detect low frequency acoustics. The combined knowledge of baleen whale sound detection and generation from studies by McCauley (1994) and Richardson *et al.* (1995) suggests that the hearing of baleen whales is most sensitive to these lower sound frequencies.

The hearing mechanism of toothed whales (e.g. sperm whales, killer whales) have been estimated to detect sounds with frequencies between 150 and 160 kHz (Southall *et al.*, 2007), though the hearing range is principally within the 50 to 130 kHz frequency range. According to NRC (2003), research has revealed that toothed whales are predominantly sensitive to aural stimuli above the approximate frequency of 10 kHz. This research has indicated that for acoustics below frequencies of about 10 kHz, hearing sensitivity declines with decreasing sounds frequency, with sensitivity to noises below 1 kHz appearing to be poor.

Observed responses from cetaceans to artificially generated sound include changes in swimming direction, increases in swimming speed and marked ‘shocked’ reactions. Other noted reactions in response to anthropogenic sound include changes to the diving, surfacing and breathing behaviours and avoidance of the sound source and the immediate area, among other behavioural changes (NRC, 2003). However, the extent and intensity of these reactions are not consistent and fluctuate widely depending on a variety of factors in relation to the individual animal and scenario (NRC, 2003). Subsurface noise generated by vessel operations has the potential to disrupt the ability of marine fauna to perceive natural sounds, in a phenomenon called ‘auditory masking’. It is possible for auditory masking to interfere with communication and the social functions of marine animals, the identification of predators and prey, and the navigation and coordination capabilities of these animals.

Richardson *et al.* (1995) suggests that insufficient evidence has been obtained with regards to call masking among whales though there are indications that observed lengthening of calls by humpback whales and orcas to low-frequency noise may be in response to auditory masking (Fristrup *et al*., 2003; Foote *et al*., 2004). However, auditory masking is not likely to affect toothed whales, as they detect frequencies above the frequencies generated by the proposed activities.

Cetacean species may develop avoidance behavioural patterns and minor route changes during migrations as a result of mid-frequency noise generated during cable laying. It is expected that the occasional incidences of cetacean species within the proximity of the cable laying region would induce movement away from the source of acoustic disruption, thereby indicating minimal impact on these species. Physiological damage as a result of the anthropogenic sound, such as the loss of hearing, would only be probable if the cetaceans are exposed to strong sounds from higher energy sources. As no high energy noises are expected to be generated this is not considered likely.

Further, none of the vessel operational activities are expected to generate noise that would surpass the threshold peak impulse sound pressure required to cause direct physical damage to cetacean physiology. According to McCauley (1994) and Richardson *et al.* (1995), the sound pressure threshold for direct physical trauma to occur in cetaceans is typically viewed to be >200 dB re 1Pa. Kongsberg Maritime Ltd (2010) report non-injury limits for cetaceans (both permanent or temporary) at 183 dB. The OSPAR Commission (2009) noted that there are no strong signs to link underwater noise generated by subsea cable installation to a high risk of harming marine fauna.

Other Marine Mammals

Other marine mammals such as seals may be present within the cable route. Pinniped response to noise is not well documented, but has been known to cause short-term disturbance, with increased activity following loud noises and displacement from haulouts, but within minutes activity levels are likely to drop and displaced pinnipeds return (Demarchi et al., 1998). The impact assessment completed by Kongsberg Maritime Ltd (2010) gave consideration to potential acoustic impacts to pinnipeds from a range of construction activities. Impact thresholds were reported to range from 171-218 dB (re 1 µPa rms at 1 m) across both permanent and temporary threshold shifts. They noted a non-injury threshold was set at 180 dB by the US government.

Similar to findings for cetaceans, proposed ship movements and cable laying activities are not expected to have any influence on the acoustic sensitivities of these animals. Accordingly, the proposed action is not expected to have any impacts upon other marine mammals from acoustic disturbance.

Birds

Marine birds, such as albatross and petrels, may occur as transient visitors to the cable route while foraging. As identified in the National Recovery Plan for these species (DSWEPAC, 2011), there are ten separate breeding locations under Australian jurisdiction, the closest of which is at Albatross Island, is located over 110 km from the cable route. Shipping traffic which would generate above ground noise comparable to that which will be generated by the proposed activity circumnavigates Australian waters on a daily basis without impact on these animals. Given that coupled with the distance to sensitive nesting receptors, noise generated during cable laying operations is not expected to impact on breeding populations of these threatened species.

Various other bird species utilise islands in Bass Strait as nesting habitat; the cable route will not transit within 7 km of any of these islands. As noted above, the cable laying activities will occur in an area already subject to commercial shipping traffic. As such, no additional disturbance to nesting birds is expected as a result of noise generated during cable laying activities.

Marine Turtles

There is a lack of research investigating the impacts of noise on turtles. Bartol and Musick (2003) found that turtles have high hearing sensitivity to low frequency sound, detecting sounds frequency in the range of 100 to 700 Hz. Turtles have also been reported to develop erratic swimming behaviour and increase swimming activity in response to increased levels of artificial sounds (McCauley *et al*., 2002).

Up to five species of marine turtle have been identified as potentially occurring in within the activity area although the cable route is not considered as core habitat for any of the five turtle species and the species may visit the area as transient visitors in search for food. The impact on turtles is considered unlikely as the site is predominantly deep waters and is remote from known rookeries and turtle feeding areas with limited risk of encountering any adults during the transient cable laying activity.

Sharks and Fish

Elasmobranchs (rays, skates and sharks) utilise low frequency sound to detect prey (Myrberg *et al*., 1978). Due to their lack of swim bladders, they are not classified as hearing specialists (Baldridge, 1970). Sharks have demonstrated highest hearing sensitivity to low frequency noise ranging from 40 Hz to 800 Hz (Myberg, 2001). These low frequency sounds generally mimic noise from prey and are irregularly pulsed, broadband and transmitted with no sudden increase in intensity (Myrberg *et al.,* 1978). Beyond those frequencies, sharks may exhibit avoidance of the source of acoustic disturbance.

The ability of fish to withstand underwater noise and their sensitivity to it varies widely across species. According to Amoser and Ladich (2005), most fish are classified as hearing generalists, with relatively poor hearing, reduced sensitivity to noise and vibrations in comparison with hearing specialists, which have developed hearing specialisations. Gordon *et al.* (2003) suggest that hearing specialists are especially susceptible to intense acoustic vibrations as many hearing specialist species possess an air-filled swim bladder. A number of species of fish are considered to have no known noise sensitivities to underwater noise impacts. These include the goat fish, sweetlip, red emperor, trigger fish, snapper, rock cod, tuna and mackerel (Willis *et al.,* 2010, Nedwell *et al.,* 2016, Yelverton *et al.* 1975, and references within). The hearing capability, habits, distance to the noise source and timing of noise occurrence in the fish lifecycle are also factors that contribute to fish sensitivity and resilience to underwater noise (McCauley and Salgado-Kent, 2008). For instance, larval fish are considered more susceptible to impacts than adults of the same species due to their smaller body size. Kongsberg Maritime Ltd (2010) indicated peak threshold levels ranged from 183 dB for fish less than 2 grams up to 206 dB (re 1 µPa rms at 1 m) for fish over 2 grams in size. As none of the proposed activities are expected to produce sound energy levels less than these thresholds, the proposed action is not expected to cause permanent or temporary impacts on sensitive fish species.

As such, impacts on sharks and fish from noise sources generated during cable installation activities are expected to be constrained to a short-term period and may result in behavioural responses which reflect avoidance of the affected regions. Such actions would be temporary in nature and localised. At a population level, the behavioural responses are not expected to be significant.

D.5.3 Management Controls

The following controls can be implemented for the purposes of decreasing or mitigating the impact of noise on marine fauna when feasible:

- Activities that generate underwater noise (installation activities) could be timed to reduce overlap with migratory movements and therefore reduce potential threat to migratory mammals
- Vessel machinery can be maintained in accordance with the manufactures specifications to reduce noise emissions
- The interaction of all vessels with cetaceans, pinnipeds and whale sharks will be compliant with Part 8 of the Environment Protection and Biodiversity Conservation (EPBC) Regulations (2000). The Australian Guidelines for Whale and Dolphin Watching (Commonwealth of Australia, 2017) for sea-faring activities will be implemented across the entire project. This includes the implementation of the following guidelines:
  - Caution zone (300 m either side of whales and 150 m either side of dolphins) – vessels must operate at no wake speed in this zone.
  - Caution zone must not be entered when calf (whale or dolphin) is present
  - No approach zone (100 m either side of whales and 50 m either side of dolphins) – vessels should not enter this zone and should not wait in front of the direction of travel or an animal or pod, or follow directly behind
  - If there is a need to stop, reduce speed gradually.
  - Do not encourage bow riding.
  - If animals are bow riding, do not change course or speed suddenly.

D.5.4 Environmental Outcome

Above ground and underwater noise generated by cable ploughing, water jetting and cable laying within the project area may result in localised influences on fauna.

The vessels are required in the field for the survey and cable laying activities, therefore, vessel elimination is not considered to be a practicable alternative on this basis.

Noise emissions generated by the vessels would be similar to that of other marine vessels which cross through the region (e.g. commercial shipping vessels) and would be unbroken rather than pulsed noise emissions. Noise levels are not expected to surpass the acoustic noise limits identified for marine fauna protection. Due to the short-term nature of the activity and rapid movement of activity to new regions, exposure of sensitive marine receptors to noise would not occur over extended periods of time. The observed avoidance behaviour of marine fauna, as a result of their mobility, also reduces the probability of inflicting any impact to marine fauna as a result of anthropogenic noise sources.

Due to the transitory nature of the marine fauna found in the wider area, marine fauna sensitive to artificial noise, such as cetaceans, pinnipeds and turtles will not remain in the region. Behavioural impacts (e.g. avoidance patterns and swimming movements away from the area) are the most probable form of impact to marine fauna as a result of anthropogenic noise generated by this activity, particularly for sensitive species such as cetaceans. Vessel noise is anticipated to only induce temporary and localised behavioural impact if encountered, with afflicted marine species expected to adopt normal behavioural patterns within a short time frame in the open waters surrounding the cable route.

D.6 Planned Discharges

D.6.1 Environmental Hazard Description

The possible discharges to the surrounding marine environment are sewage and food waste, brine, cooling water, deck drainage and cable discharges.

D.6.2 Impact Analysis

It is envisaged that non-hazardous planned vessel discharges will be minimal and continuous. This will also be dependent on the total number of people on board the vessel and rainfall. The reduction in water quality in associated waters is one consequence of non-hazardous substances discharge. Such effects are short-lived, lasting hours, and are typically localised and restricted to surface water layers (< 5 m). Short-term changes to existing environmental conditions are not anticipated for waters 100 m away from the source of discharge as a result of the rapid dispersion and dilution of the discharge with increasing distance from the discharge origin.

The cable laying vessel will not be participating in any fishing activities. As such, direct impacts associated with bycatch, dependence on fishery discards, and competition for resources (DSEWPC, 2011) to marine species such as albatross, giant petrels and other seabirds, are not expected to occur. Rather, the potential for impact is limited to indirect impacts associated with potential changes in water quality.

The following provides a description of possible planned discharges associated with the cable laying activities. It is noted that any planned discharge is to be undertaken in accordance with state and international obligations.

Water Turbidity and Oleaginous Discharge

Increases in water turbidity will be a possible consequence of food waste and sewage discharge into surrounding waters. The discharge of oily water from deck drainage and vessels (e.g. hydrocarbons and other contaminants) could lead to increases in turbidity and induce toxic effects in marine organisms within the surrounding area.

Water Temperature

Water used for cooling will be discharged at temperatures above surrounding seawater. The cooling water discharge will transmit heat to the surrounding waters while also mixing with the larger body of water into which it is released.

Temperature dispersion modelling has indicated that receiving waters rapidly decrease the temperature of incoming cooling water, with discharge waters less than 100 m horizontally away from the discharge point measured at less than less than 1°C above ambient water temperature levels (Woodside, 2008). This corresponding distance for discharge waters to reach this level in the vertical axis is within 10 m.

While vessel design does vary, all vessels maintain the same discharge design, where cooling water is emitted into the surrounding waters above the water line. This discharge mechanism allows for the cooling and oxygenation of the heated discharge water before it is released into the immediate marine environment. It is anticipated that the impact of cooling water discharge on the water quality of the surrounding environment will be minimal, given the relatively low quantities of discharge, differences in temperature and expanse of the ocean's water around the vessel.

Brine Wastewater

Brine discharge, particularly that with marginally higher salinity, with typically 10% higher salt content than that of seawater, is an output of the seawater desalination process. Due to the higher density of desalination brine relative to seawater, the brine discharge will sink and diffuse into the ocean currents. Average salt concentration of seawater is 35,000 ppm. Brine discharge volume is proportional to the fresh / potable water demands of the vessel and people on board.

Temporary fluctuations of 20 to 30 % in salinity can be tolerated by majority of marine species, with most pelagic species, in the short-term, anticipated to tolerate exposure to the marginal increases in salinity resulting from desalination brine (Walker and McComb, 1990). It is expected that the impact of brine discharge on the surrounding water quality of the activity zone will be minimal, given that the discharge volume and increase in salt concentration is low in comparison to the volume of water in the open sea in the area.

Nutrient Enrichment

Eutrophication can be a consequence of food waste and sewage discharge. Eutrophication can lead to changes to plankton within the affected zone, affecting the marine species in the area, which feed on plankton. In 1985, Friligos conducted a study into the discharge of sewage into deep ocean water, which found no evident variations in the ambient inorganic nutrient concentrations and the outfall region. The findings suggest the rapid dispersion of the inorganic nutrients into the surrounding waters. Similar results, indicating dispersion and dilution of discharge within hours of release into surrounding waters, were also noted by studies reported by Parnell (2003). According to Costello and Read (1994), discharge into the sea typically dilutes to 1 in 1000 dilution levels within half an hour. These findings indicate that it is unlikely for acute toxicity to develop at ecologically significant locations nor is it likely that detectable levels would be achieved at dumping locations. On this basis no impacts to the environment from sewage management are expected. Relevant legislative requirements regarding waste release to the environment will be followed by the vessel during all operations.

Cable Discharges

The proposed cable is an optical fibre subsea cable incorporating material with low environmental discharges. The fibres are enclosed in a hermetically sealed copper tube and insulated with a layer or polyethylene to form the light weight cable. Polyethylene is an inert water-insoluble and non-toxic substance which provides protection against abrasion. The polyethylene jacket covering is also used on the outside of the cable to prevent the leakage of current from the cable, which operates to a maximum current of 1.6 amps. However, due to the very high insulating properties of the polyethylene jacket, the environmental impacts of current leakage are negligible.

The impact on temperature in the local area of the cable system have been assessed in relation to the cable's maximum powering attributes. It is anticipated that powering with heat dissipation rates of fewer than 3 watts per km of cable would develop negligible temperature increases from the cable. In comparison, more than 387 hours would be required to increase the temperature of a 1000 L (1 m) tank of water by one degree Celsius using a 3-watt energy source. Therefore, negligible environmental impact would be expected due to the combination of the cable's low heat output, the extensive volume of water around the cable and the consistent movement of water around the cable via tide and current behaviour.

During normal operations, the external surface of the cable may generate exceptionally low magnetic fields. The fields are induced by electrical power within the cable, with magnetic field intensity ranging between 30 and 38 microtesla (µT) on the surface of the cable. The greatest magnetic field intensity generated by the cable would be at the exterior cable surface but would diminish inversely with respect to the distance from the cable. It has been indicated by scientific works that there are very few species capable of detecting and distinguishing weak magnetic field signals from ambient conditions. It is therefore anticipated that cable-induced magnetic fields would not disrupt marine species.

D.6.3 Management Controls

In order to mitigate or lessen planned discharges, when possible the following management plans would be implemented:

- Food waste will be collected, stored, processed and disposed to comply with the vessel's garbage or waste management plan, which will address Australian (AMSA) and international regulations (MARPOL).
- A vessel with access to a food macerator, in accordance with Regulation 4 of the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V, will be required to have food waste ground or comminuted to <25 mm and discharged only when >12 nautical miles from the territorial baseline.
- Sewage and food waste will be collected, placed into storage, processed and removed of in accordance with the landward access site waste management plan.
- Outside of State waters liquid substances will be discharged in compliance with MARPOL, including:
  - Untreated sewage will be stored onboard and disposed of onshore at a reception facility or to a carrier licensed to receive the waste, or discharged at a distance of more than 12 nautical miles from the nearest land in accordance with Regulation 11 of MARPOL Annex IV.
  - Treated sewage will be discharged in compliance with Regulation 11 of MARPOL Annex IV.
  - Sewage system will be compliant with Regulation 9 of MARPOL Annex IV and be maintained in accordance with the vessels planned maintenance system.
  - As per MARPOL Annex IV / AMSA Marine Orders 96, any vessel licensed to carry more than 15 persons will have an International Sewage Pollution Prevention Certificate.
  - Vessels may discharge oily water after treatment to 15 ppm in an oily water filter system as required by MARPOL Annex I Regulations (for the prevention of pollution by oil). To discharge, the vessels will require a current International Oil Pollution Prevention (IOPP) certificate for oily water filtering equipment, and a current calibration certificate for the bilge alarm.

- Vessel masters will ensure that the maximum carrying capacity of the sewage system is not exceeded.
- In the event food cannot meet the requirements for disposal (e.g. equipment failure or otherwise), the stored food waste will be transferred to land for disposal.
- Scupper plugs or equivalent will be available on support vessel decks where chemicals and hydrocarbons are stored and frequently handled (i.e.' high risk' areas). Non-hazardous, biodegradable detergents will be used for deck washing.
- The vessel operator will record the quantity, time and onshore location of the oily water disposal in the vessel Oil Record Book.
- Use of non-toxic, low ampere, highly insulated, water insoluble cable material.

D.6.4 Environmental Outcome

In order to undertake the activities, vessel presence is required and no alternative is available. Therefore, food, brine, cooling water, sewage and oleaginous discharge will be produced during the course of these activities. Under the Protection of the Sea (*Prevention of Pollution from Ships) Act 1983*, a representation of MARPOL Annex IV, V and I requirements respectively, permits the disposal of these non-hazardous substances into the sea by vessels within Australian waters.

The location of the vessels in deeper ocean waters suggests the rapid dispersion and decomposition of the low amounts of food, sewage and oily waste.

Another possible course of action is to retain untreated sewage and food in storage until it can be disposed of at an onshore reception facility. This alternative would require one vessel, additional or currently available, to conduct regular trips to an accompanying vessel to transfer and return wastes to shore.

This process would involve increases in fuel consumption and port movements, as well as the need for a licensed onshore waste treatment facility. Due to these factors, the onshore disposal option would result in an increase in environmental risk which given the relatively small quantities of discharge involved would be unjustifiable in comparison to the planned discharge option which is considered environmentally acceptable and preferred due to the minimal volumes of waste involved over a brief duration. The strong currents and deep waters at the site would also enhance the dilution and dispersion of any discharge, further reducing the effects of any waste released into the surrounding waters.

The waste retention and discharge options both have minimal impact on the environment and comply with the conditions of MARPOL. Considering the operational factors mentioned previously, the onboard treatment of waste is considered more feasible and more likely to be adopted for most cases during the course of this activity. Given the international acceptance and industry-wide adoption of the MARPOL standards, it is accepted that compliance with the corresponding MARPOL requirements would translate into diminished environmental impacts from planned discharges to as low as reasonably practicable.

D.7 Atmospheric Emissions

D.7.1 Environmental Hazard Description

Greenhouse gases (GHG) (including carbon dioxide (CO_2), methane (CH) and nitrous oxide (N_2O)) and non-GHG (such as sulphur oxides (SO_X) and nitrous oxides (NO_X)) are emitted as a result of the burning of fuel to power vessel engines, generators and mobile and fixed plant and equipment, as well as on-board waste incinerators. The fuel predominantly used for these activities would be diesel.

Ozone-depleting substances (ODS) may also be in use by closed-system rechargeable refrigeration systems on-board these vessels.

D.7.2 Impact Analysis

Short-term reduction in air quality in immediate region around the discharge point will be due to the burning of hydrocarbons and waste incineration (if occurring on the vessel). This would occur throughout the offshore cable laying activity.

Humans and seabirds in the immediate region would be affected by the localised decline in air quality accompanying the emission of non-GHG and GHG. It would also be noted that the emissions would contribute to the national GHG count.

The combustion of fuels from activities is not expected to affect the air quality of coastal communities, as the majority of the cable laying activities will occur in distant locations offshore. In addition, the gaseous emissions are of relatively low quantities and it is expected that under normal conditions these emissions would undergo rapid dissipation into the surrounding environment.

The likelihood of accidental emission of significant quantities of ODS is deemed to be rare due the maintenance of ODS-containing refrigeration systems on vessels. Despite this, there is potential for the unintentional discharge and brief emission of ODS to contribute to the depletion of the ozone layer. Maintenance of refrigeration systems containing ODS is on a routine, but infrequent basis, and with controls implemented, the likelihood of an accidental ODS release of material volume is considered rare.

D.7.3 Management Controls

A variety of possible management controls can be implemented in order to mitigate or eliminate the occurrence of gaseous discharge:

- All equipment will be properly maintained in good working order.
- Catalytic converters and exhaust filters will be correctly fitted where appropriate and available to minimise diesel exhaust emissions.
- Idling time of diesel engines should be limited and engines should not be overloaded.
- Fuel oil will meet regulated sulphur content levels in order to control SO_X and particulate matter emissions.
- Engines will be operated in a manner so that regulated NO_X emission levels are achieved.
- Compliance with MARPOL Annex VI (as implemented in Commonwealth waters by the Commonwealth Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (PSPPS Act); and Marine Orders - Part 97: Marine pollution prevention - air pollution). In particular:
- Optimisation of fuel use to increase efficiency and minimise emissions

- Use of low sulphur fuel when it is available to minimise emissions from combustible sources
- Implementation of a planned servicing / maintenance system to manage emissions
- Vessel engines will hold a valid and current International Air Pollution Prevention Certificate (IAPPC).
- ODS will not be deliberately discharged during the maintenance, service, repair or disposal of systems or equipment, and through good maintenance, fugitive emissions will be minimised.

D.7.4 Environmental Outcome

As the proposed cable laying activities require the presence of vessels, there is no potential for the elimination of gaseous emissions from vessels. Vessel gaseous emissions resulting from the combustion of hydrocarbons and waste incineration is permitted on Australian waters under the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*. This Act meets the requirements and obligations outlined in the MARPOL Annex VI. In addition, since the activity is predominantly situated in open ocean waters, air emissions will experience rapid dissipation into the surrounding environment and will not extend to onshore communities.

Other feasible and reliable fuel types for vessels have not been found. However, in order to reduce emissions, low sulphur-oxide marine-grade diesel would be used to fuel the vessels, as opposed to heavy fuel oil. For the purposes of controlling sulphur oxide and particulate matter emissions into the atmosphere, the applicable fuel will satisfy standardised sulphur content quantities. Under the MARPOL Annex VI requirements, ODS use in closed-system refrigeration systems is considered acceptable. Inadequate workplace conditions (e.g. the lack of air conditioning) and unacceptable food hygiene standards would result from the lack of such systems on vessels. As such, the removal of ODS closed-system refrigeration systems is not considered feasible. Assuming that the risk of unintentional release of ODS has been mitigated by the consistent maintenance of such systems by qualified staff it can be considered that all feasible measures have been considered and implemented, and that the anticipated environmental impacts of gaseous emissions are acceptable. Given the international acceptance and industry-wide adoption of the MARPOL standards, it is accepted that compliance with the corresponding MARPOL requirements would translate into diminished environmental impacts from planned discharges to as low as reasonably possible.

D.8 Interference with Other Users

D.8.1 Environmental Hazard Description

A number of different environmental hazards may arise from unrelated shipping traffic crossing the path of a cable-laying vessel. These may include vessel damage, which is addressed under Section 3. Given a cable laying vessels passage is a planned alignment which may cross fishing grounds or navigational waters, this activity may result in the temporary reduction of accessibility to fishing grounds, or require other vessel operators to re-route vessel movements to avoid crossing paths with cable laying vessels.

Once cables are laid on the seabed, there is also a risk that fishing equipment could interact with the cable causing entanglement.

D.8.2 Impact Analysis

The potential impact of the interim occupation of an area by a cable laying vessel is the temporary loss of access to fishing grounds. There is potential that fishing processes would be disrupted, that fishing apparatus may be damaged upon catching onto a cable or subsea instruments or that vessels may be required to change navigational course to avoid collision risk.

The visible vessel presence at the site during the cable laying phase may prove a reasonable and recognisable obstacle to regional shipping traffic. Vessels involved in the laying of cable have limited manoeuvrability, meaning that all other maritime traffic may need to evade these vessels and their associated instruments.

D.8.3 Management Controls

The following management controls have been considered and may be implemented if feasible in order to mitigate or remove interference issues between activity-related vessels and other users of the sea:

- Cable laying related activities will be undertaken in accordance with all marine navigation and vessel safety requirements under the International Convention of the Safety of Life at Sea (SOLAS) 1974 and Navigation Act 2012. For the vessels, this requires equipment and procedures to comply with AMSA Marine Order - Part 30: Prevention of Collisions, and Marine Order - Part 21: Safety of Navigation and Emergency Procedures.
- Stakeholder consultation (local councils, fishing bodies, etc.).
- Notification to the following Australian Government agencies will be made prior to moving the cable laying vessel on location:
  - The Australian Hydrographic Office of proposed activity, location (i.e. vessel location) and commencement date to enable a Notice to Mariners' to be issued
  - The Australian Maritime Safety Authority (AMSA) Rescue Coordination Centre (RCC) of proposed activities, location (i.e. vessel location) and commencement date to enable an AusCoast warning to be issued
- Vessels will also be equipped with all navigational and safety requirements for operation in Australian waters. These may include an automatic identification system (AIS) and an automatic radar plotting aid (ARPA) system capable of identifying, tracking and projecting the closest approach for any vessel (time and location) within radar range (up to approximately 70 km).
- Visual observations will be conducted by trained watch keepers on all vessels 24 hours per day to support management of collision risk or entanglement/interference with other users.
- Where possible, the cable can be buried to a maximum depth of 1 m below soft substrate using plough or water jet burial to avoid interference with over users.
- In shallow water depths (0 to 10 m in Perth, 0 to 30 m in Sydney) the cable will be passed through a sub-surface conduit to limit any risk of entanglement or interference with inshore waterway users.
- In coastal waters the cable will be laid within Protection Zones that restrict activities that have potential to interfere with the cable; thereby also limiting potential for interference with other users.

D.8.4 Environmental Outcome

As cable laying activities cannot be undertaken without vessel presence, the vessels may not be removed to eliminate the associated issues. However, there is potential for disruption to commercial shipping operations, as indicated by a review of commercial shipping data, with commercial fishing operations likely to be affected via need to adjust course to avoid collision/overlap risk. As such, stakeholder consultation and marine user notifications, which are industry standard processes, will be implemented for the activity in order to inform and mitigate the impacts on commercial vessels. Notifications will also be undertaken to inform all maritime users of action (including location and duration) to support management of collision risk. Inshore, cable will be passed through a sub-surface conduit to avoid interference with other users.

Apart from engagement and consultation with other vessels, use of the sub-surface conduit and installation within the designated protection zones, no other management controls have been identified to mitigate the possibility of disruption to commercial vessel operations. Because of this, the impacts of shipping disruption have been deemed reasonable and controlled to keep the effects of vessel operation to existing shipping traffic as low as reasonably possible.

D. Unplanned Activities

D.9 Pest Introduction and Proliferation

D.9.1 Environmental Hazard Description

Vessels carrying invasive marine pests (IMP) may unintentionally but successfully introduce these species to the region where the activity is occurring. IMPs may be carried within the external biological fouling on the vessel hull, within seawater pipes (e.g. cooling water) and associated infrastructure or on submersible marine instruments and equipment. Ballast water exchange may also allow for the transportation and proliferation of IMPs within the area of activity.

Before vessels can proceed to the site location, quarantine obligations will have to be fulfilled by all vessels. Ballast water exchange record requirements will need to be complied with. Vessels will also be required to maintain possession of Australian Quarantine and Inspection Service (AQIS) Clearance documentation in order to verify compliance with Mandatory Ballast Water Requirements, or verify biofouling management measures outlined by the AQIS.

D.9.2 Impact Analysis

According to DAFF (2009), IMPs are identified as marine plants, animals and algae which have been introduced into a location that is not within their natural dispersal range but which provides conditions that support their survivorship. IMPs at risk of introduction to the cable area predominantly originate from Southeast Asian countries.

Ecosystem health, biodiversity, fisheries, aquaculture, human health and waterway industries including tourism are at potential risk from the impacts of IMPs (DAFF, 2009; Wells, 2009). The extent of the detrimental effects introduced marine pests may have includes depletion of viable fishing areas and aquaculture stock, out-competing native flora and fauna, over-predation of native flora and fauna, reduction of coastal aesthetics and increased maintenance costs, human illness through released toxins, reduction in vessel performance, damage to vessel engines and propellers and damage to industrial infrastructure.

The introduction of new species is not a rare occurrence. However, the physical, chemical and biological circumstances of the environment into which the species has been introduced are important determining factors as to whether the species will successful establish and become an invasive pest.

Flora and fauna species atypical to the region can be attracted to newly created hard substrate habitats; such as those that would be provided by the presence of the submarine cables and their accompanying protective structures (OSPAR Commission, 2009). It is anticipated that this would not be likely due to the depth of the cable, with the new habitat provided by the cable and accompanying infrastructure expected to accommodate native species, which had previously limited access to available hard substrate habitats.

D.9.3 Management Controls

The following controls and processes may be employed when possible in order to mitigate or eliminate the risk of introducing pests:

- International vessels arriving in Australia from a foreign port or location should adhere to Australian quarantine requirements.
- The management of ballast water prior to entry to Australian waters must follow AQIS guidelines and compliance requirements in relation to marine pest introduction risk

management for any internationally sourced vessel Details of AQIS requirements can be found in The Australian Ballast Water Management Requirements (version 7) available at *http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/avm/vessels/ballast/australian-ballast-water-management-requirements.pdf*
Australia is phasing out ballast water exchange in line with the agreed schedule set out in the Ballast Water Convention in favour of a method that is compliant with the Regulation D-2 discharge standard. In order to achieve this, vessels will be required to install an IMO approved Ballast Water Management System (BWMS), or use one of the other approved methods of management. Where ballast water exchange is to be implemented, it must be conducted to the equivalent of a 95 per cent (or greater) volumetric exchange, using one of the acceptable methods of ballast water exchange identified in the Australian Ballast Water Management Requirements (DAWR, 2017). Ballast water exchanges must be conducted as far from the nearest land as possible, and in all cases within an acceptable area as defined in the ABWMR (DAWR, 2017).

- All ballast water exchange details are to be recorded in a ballast water report and submitted in accordance with the requirements outlined in the ABWMR (DAWR, 2017).
- Where required, a biofouling vessel risk assessment (VRASS) will be carried out within sufficient time prior to mobilisation to site to enable any required cleaning operations to be undertaken prior to the cable laying activities.
- Where required, the vessels will be in possession of a current International Anti-fouling System Certificate to verify that it complies with the International Convention on the Control of Harmful Anti-fouling Systems on Ships.
- If an IMP is identified or suspected, then the contractor is obliged to immediately (within 24 hours) notify the applicable government agency (Department of Primary Industries and Regional Development in the State of WA; or Department of Agriculture, Fisheries and Forestry in Commonwealth waters).
- Changes to Australia's biosecurity system came into effect on 16 June 2016 with commencement of the *Biosecurity Act 2015*. New biosecurity requirements may come into force during the life of the project. If this occurs, these management controls should be reviewed to confirm adequacy.

D.9.4 Environmental Outcome

Organisms from the natural environment naturally collect on vessels and submersible equipment as biofouling. Vessels also require ballast water for safe operational purposes. As such, these occurrences and risks are difficult or impractical to eliminate.

To mitigate the possibility of introducing IMPs, the planned activities will be conducted with equipment and vessels, which would ideally have been operational and active within state waters, or Commonwealth waters since their last dry-dock inspection or cleaning session. Where possible, equipment should not be obtained from higher risk areas in Southeast Asia susceptible to IMPs.

Shallow water environments are the predominant preferred habitat for the successful introduction of most known marine pests. As the location of the activities would be mostly in deep water, it is not likely that an IMP would be able to adapt and develop a successful translocation to the deep waters of the immediate activity zone.

Successful marine pest establishment is known to be more prevalent in regions of disturbance and new hard substrate, which provide more opportunities for effective translocation by these species. However, considering the zone of disturbance will be predominantly located in deep water, the cable has a limited surface area (approximately 30 mm in diameter), and the cable will be buried for some of its length (particularly in shallow water areas), the chance of a successful translocation for IMPs is considered unlikely.

In addition, Commonwealth government quarantine requirements and practices consistent with the National Biofouling Management Guidance for Petroleum Production and Exploration Industry (AQIS, 2011) will be observed and adhered to by internationally sourced vessels as is the industry standard. Because of these factors, the risk of the successful introduction of an IMP is considered as low as reasonably practicable.

D.10 Accidental Release of Solid Wastes

D.10.1 Environmental Hazard Description

A variety of hazardous and non-hazardous solid waste may be released unintentionally into the environment from overfull and/or uncovered bins or if blown off the deck of a vessel. Accidental spillage during transfers of waste from vessel to vessel, and incorrectly disposed items may also cause the unintentional release of solid waste into the surrounding environment.

Non-hazardous solid waste includes plastics, packaging and paper materials and products while examples of hazardous solid wastes include oily and contaminated wastes, aerosol products, fluorescent tubes, batteries and medical waste.

D.10.2 Impact Analysis

There is capacity for non-hazardous solid waste such as plastic bags to detrimentally affect the environment and cause entanglement or be ingested by fauna. The entanglement and ingestion of non-hazardous solid waste is a risk particularly prevalent for seabirds and marine turtles. The ingestion of solid wastes like plastic bags can consequently result in internal tissue damage, prevention of normal feeding behaviours and potentially death of the affected fauna.

The pollution of the immediate environment with the release of hazardous solid waste has the likely consequence of negatively affecting the health of flora and fauna within the area. Particular fish, cetaceans, seabirds and reptiles are susceptible to chemical impacts, including disease or physical injury after ingesting or absorbing the waste.

D.10.3 Management Controls

The following management controls have been considered and may be implemented if feasible in order to mitigate or remove the risk of accidental solid waste release:

- Appropriate waste containment facilities will be included on site and managed to avoid overflow or accidental release to the environment.
- No waste materials will be disposed of overboard, all non-biodegradable and hazardous wastes will be collected, stored, processed and disposed of in accordance with the vessel's Garbage Management Plan as required under Regulation 9 of MARPOL Annex V.
- Hazardous wastes will be separated, labelled and retained in storage onboard within secondary containment (e.g. bin located in a bund).
- All recyclable and general wastes to be collected in labelled, covered bins (and compacted where possible) for appropriate disposal at regulated waste facility.
- Solid non-biodegradable and hazardous wastes will be collected and disposed of onshore at a suitable waste facility or to a carrier licensed to receive the waste if required by legislation.

D.10.4 Environmental Outcome

Small amounts of solid non-biodegradable and hazardous wastes will be generated during the cable laying activities. Storage of these wastes on board in fully enclosed containers is considered good (and common) practice within this industry. During the activities, immediate removal of these wastes from the activity area to appropriate regulated waste facilities would not have significant environmental benefit. This would require additional fuel usage (increased emissions) or increases in the transfer of wastes between site and vessels (increased risk of vessel collisions and/or loss of wastes to the environment during transfer procedure). This is, therefore, not considered a practicable solution. As such, a periodic removal or incineration if permitted under MARPOL regulations of stored solid wastes will be conducted.

During the activities, given the adoption of the industry standard management controls listed above, it is considered that all practicable measures have been implemented and the likelihood of solid wastes being discharged to the environment has been reduced to as low as reasonably practicable.

The unplanned release of non-hazardous and hazardous solid wastes through inadequate containment and practices is unlikely to have any significant environmental effects, as impacts would be temporary and localised. The management controls are considered effective in reducing the potential environmental impact to the marine environment. As such, the risk associated with unplanned releases of non-hazardous and hazardous solid wastes is considered as low as reasonably practicable.

D.11 Dropped Objects

D.11.1 Environmental Hazard Description

Damage to benthic habitats can occur due to an object being dropped overboard (e.g. equipment falling from vessel deck). Any marine organisms associated with the affected benthic habitat within the dropped object's footprint may also be harmed.

D.11.2 Impact Analysis

Disruption of Habitats

Based on a 5636 km cable length and 10 m cable route footprint either side of the cable, a dropped object from cable activities would be in a disruption zone of 56.36 km^2 area.

Disturbance of marine biota within the affected habitat would occur although the habitat itself would not be permanently destroyed. Due to the gradual infill process of such seabed disturbances, the affects on the seabed caused by a dropped object may persist for a length of time even if the object was retrieved.

Physical damage of any sessile or slow moving fauna (e.g. Syngnathids) and epibenthos (e.g. algae, sponges) may occur within the area of disturbance caused by the dropped object.

Direct impacts from dropped objects to the seabed can include smothering/disturbance or damage of habitat and epibenthos. Objects that are not retrieved (where that action would cause significant disturbance or safety risk) would be expected to be colonised by epifauna relatively quickly (primary fouling will occur within weeks to months). Eventually dropped objects will degrade, but that may take years. Immediate localised and short term impacts would be related to increased suspended sediment and turbidity; however sands are predicted to settle quickly and the impacts to water quality will be so localised and short term they are not predicted to have any effect on filter feeders.

Where objects are dropped to and remain on the seabed, damage to habitat will be long term until the object degrades. By providing a hard substrate on previously soft sediment, this will also result in a localised change in biodiversity with fouling communities settling on the object. As such, it will take an extensive period of time (decades) for the localised environment to return to a state similar to prior to impact.

The current alignment of the cable avoids sensitive marine habitats such as hard coral or seagrass, where possible, but will bisect rocky reef with macroalgae.

Additional Environmental Implications

Injury to fauna (e.g. entanglement or ingestion) and deterioration of the habitat or water quality in the immediate area are also potential indirect consequences of dropped objects.

As noted under Section 2.6 above, pollution and contamination caused by the discharge of hazardous solid waste into the marine environment can have direct and indirect effects on the marine biota. Physiological injury from ingestion or absorption and other chemical impacts may affect individual organisms.

D.11.3 Management Controls

A number of management controls can be implemented when possible to reduce or eliminate the impact of dropped objects on the environment:

- All equipment and gear on the vessels should be securely fastened during mobilisation/demobilisation.
- If required, anchoring should be planned for sandy seabed environs and should not occur in sensitive habitats except in the event of emergency.
- Lifting is to be carried out by competent personnel using equipment that is suitable, certified and maintained.
- Waste management controls are to remain effective to reduce risk of release of wastes that could be ingested or cause entanglement.
- During the activities, detailed records of equipment lost overboard or dropped will be maintained and reviews will be undertaken to reflect on methods to mitigate repetition of the incident.

D.11.4 Environmental Outcome

Procedures have been implemented for each specific lifting/handling requirement and would be performed should any equipment lifting be needed. The equipment used for lifting operations is to be maintained as specified in the planned maintenance system.

The chance of a dropped object affecting the environment is deemed to be reduced to levels as low as reasonably possible with the adoption of these industry accepted controls and procedures.

D.12 Marine Fauna Collisions/Entanglement

D.12.1 Environmental Hazard Description

There is potential for collision to occur between marine fauna and vessels associated with the proposed activities. This risk is particularly pronounced with regards to possible collision between large slowly moving cetaceans like whales and a vessel (or deployed equipment).

The consequences of such collisions between marine fauna and vessels/equipment for the marine organisms range from changes to fauna behavioural patterns to injury or death of the organism as a result of a direct collision or of being entangled in the cable.

D.12.2 Impact Analysis

Due to their inquisitive nature, cetaceans e.g. dolphins are frequently attracted to vessels and offshore facilities.

Continental shelves are sites where high shipping traffic coincides with natural cetacean habitats. At these locations, collisions between vessels and cetaceans are considered more likely (WDCS, 2006). A number of instances of vessel collisions resulting in the death of the involved cetacean have occurred in Australian waters though data suggests that these instances are commonly associated with fast ferries and container ships (WDCS, 2006). Some cetaceans are known to be capable of detecting and manoeuvring to avoid collision with vessels (WDCS, 2006). There is a variety of whale responses to the advance of vessels, with some whale species known to be inquisitive and approach vessels that are slow moving or stationary, while other whale species dive or stay motionless in the presence of vessels. However, whales typically do not approach vessels and are more likely to adapt evasive behaviours to avoid nearby ships, including the employment of longer dives.

Due to the considerable quantities of time whale sharks spend in near-surface water feeding, whale sharks are particularly vulnerable to collisions with vessels despite their tougher skin (Norman, 1999; DEH, 2005). It has been reported that some whale sharks display signs of physical trauma most likely caused by boat contact (DEH, 2005).

The risk of potential vessel strike is considered to be low for all marine species, including cetaceans, whale sharks, marine turtles, sirenians, fish and seabirds. This risk accounts for the avoidance behaviour marine fauna species adopt to evade vessels until the vessel disruption has elapsed.

Works will occur where fishing and commercial shipping currently traverse. The risk that the additional vessel presence in the activity location will have considerable effect on marine fauna within the area is relatively small due to the relatively low vessel speeds during the activity operations, with vessel activity typically less than 6 knots.

Construction activities may coincide with the timing of some cetacean migration periods. The timing in Australian waters has been proposed to align with whole-of-project scheduling, to avoid the major time window within which whales migrate through the area. However, it is recognised that some species, such as Southern right whales, may have migratory windows that overlap with some of the installation activities. Even if whales are present, the installation vessel and its action is not considered a direct threat as the average service speed of the cable ship is only approximately 0.5 knot during cable burial activities (WD <1000 m) and 4 knots during surface laying. Southern Right Whales cruise at 1.6 knots (NSW OEH, 2014) and are considered relatively able to navigate away from vessels undertaking laying activities. As such, the impact of this activity on (migratory) cetaceans is expected to be near negligible, as interactions with whale pods can be avoided or minimised through available operational controls.

D.12.3 Management Controls

The following controls may be adopted and executed when possible to mitigate or eliminate the risk of collision between vessels and marine fauna:

- Timing of activities can be coordinated to avoid peak frequency of marine fauna if it is known that activities cross known cetacean migratory routes.
- Operations of vessels will be commensurate with Part 8 of the EPBC Regulations (Interacting with Cetaceans and Whale Watching).
- The Australian Guidelines for Whale and Dolphin Watching (Commonwealth of Australia, 2017) for sea-faring activities will be implemented across the entire project. This includes the implementation of the following guidelines:
  - Caution zone (300 m either side of whales and 150 m either side of dolphins) – vessels must operate at no wake speed in this zone.
  - Caution zone must not be entered when calf (whale or dolphin) is present
  - No approach zone (100 m either side of whales and 50 m either side of dolphins) – vessels should not enter this zone and should not wait in front of the direction of travel or an animal or pod, or follow directly behind
  - If there is a need to stop, reduce speed gradually.
  - Do not encourage bow riding.
  - If animals are bow riding, do not change course or speed suddenly.

D.12.4 Environmental Outcome

As these activities require the presence of vessels, there is no potential for the elimination of vessels from the locality. Average vessel speeds typically do not exceed 4 knots during cable laying operations, with average vessel speeds of 0.5 knot for ploughing operations. In order to reduce the chance of vessel interaction with marine fauna, the management and legislative control measures would be implemented. Vessels will be transient in any one location and collision risk will, therefore, be of a limited duration in any one area. On this basis the potential risks associated with collision and interference with marine animals from vessel activities is considered to be as low are reasonably practical.

D.13 Hydrocarbon, Chemicals and Other Liquid Waste

D.13.1 Environmental Hazard Description

Note that release of hydrocarbons from vessel collision is addressed following this section. Vessels require a wide variety of liquids, chemicals and hydrocarbon compounds to operate and to be maintained. Vessel engines and equipment such as cranes and generators operate on diesel fuel while hydraulic and lubricating oils are required for the operation and continual maintenance of mechanical components. Fuel drums may also be retained in dedicated storage areas while some vessel engines adopt independent storage tanks. Examples of hazardous liquids include corrosion inhibitors, biocide and miscellaneous chemicals like cleaning agents and lubricating oils.

There are various scenarios that may result in the accidental release liquid wastes into the surrounding marine environment. Tank pipework failure or inadequate bunding are two examples. However, the quantity of hydrocarbons that can be accidentally discharged during operations is relatively small and restricted by the quantity available stored on the deck of the vessel.

If refuelling is required during the cable laying activity, then refuelling events have the potential to cause environmental impacts through reduction in water quality and/or contamination of marine flora and fauna. Spills during refuelling can occur through several pathways, including fuel hose breaks, coupling failure or tank overfilling.

In the event the refuelling pipe is ruptured, the fuel bunkering activity will cease by turning off the pump. Any fuel remaining in the transfer line will be discharged to the environment, inclusive of any fuel released prior to the transfer operation being stopped.

If multiple failures occur on the vessel e.g. failure of multiple barriers and unwatched by crew members, then it is possible that up to 10 m^2 spill of marine diesel could be released into the marine environment. This is expected to mix into the surrounding surface water within a relatively short period of time. Within a few hours, dispersion of the hydrocarbons into the natural environment would be anticipated.

Marine Diesel

Marine diesel used on vessels has a sulphur content of less than 3.50 % m/m. In the marine environment, diesel has the following characteristics:

- Diesel spills will extend rapidly in the direction of prevailing wind and waves.
- Evaporation is the dominant process contributing to the fate of spilled diesel from the sea surface and will account for 60–80 % reduction of the net oil balance.
- Warmer air and sea temperatures result in increases to the evaporation rate of diesel.
- Diesel residues are typically comprised of heavy compounds that may remain longer and will tend to disperse as oil droplets into the upper layers of the water column.

Lubricating Fluids and Hydraulic Oils

When spilt into the marine environment, hydraulic oils and lubricating fluids behave similarly to diesel. However, the spreading rate of a slick of lubricating oils would be slightly slower despite these oils being more viscous. In comparison, hydraulic oils have light to moderate viscosity and spills of these oils tend to disperse rapidly during high sea conditions.

Dispersion Behaviour

If a spill involved a light, refined hydrocarbon of volumes such that the hydrocarbon would spread quickly, a thin film of approximately (~1 g/m^2) would develop over the water surface. The slick would be visible during calm sea conditions, though for more adverse sea conditions, the spilt hydrocarbons would not be as visible in the environment.

D.13.2 Impact Analysis

There is a low likelihood that a leak or spill of hydrocarbons or other liquids (including environmentally hazardous chemicals and wastes) may occur at the site. Such an occurrence would result in the localised reductions in water quality and contamination of marine fauna at water depths of less than 1 m in the proximity of the source vessel. The potential impacts would be restricted to the immediate vicinity of the spill. However, contamination may also occur if the spill is in close proximity to coastal or shallow benthic environments.

Hydrocarbons

Due to the characteristics of the hydrocarbons and chemicals on-board the vessels, the small volumes that may contribute to such a spill and the nature of the marine environment along the cable laying route, unplanned hydrocarbon and chemical spills are not likely to result in major spatial or ecological impacts. As a result of the short exposure times, any effects from the toxic components of the diesel fuel to receptors would be negligible.

The effects on water quality would fade quickly, due to predominant wind and current mixing at the sea surface. Temporary changes to water quality from the rapid spill dilution and dispersion can translate into short-term effects on marine fauna if the spill occurs in ocean waters. Similarly, temporary effects on marine fauna may occur if the spill was in the vicinity of shallow coastal environments.

At the sea surface with concentrations expected of <1 g/m^2, oiling of wildlife is not predicted to occur either through fauna entering the water from above (e.g. seabirds) or fauna surfacing through the hydrocarbon layer at the sea surface (e.g. cetaceans, fish, marine reptiles).

There are a number of marine and migratory bird species that are expected to occur in the area, but impacts to these birds are not predicted.

D.13.3 Management Controls

The following controls can be adopted when feasible in order to mitigate or eliminate the potential for the spillage of hydrocarbons, environmentally hazardous chemicals and liquid-waste to the marine environment:

- Chemicals and hydrocarbons will be packaged, marked, labelled and stowed in accordance with MARPOL Annex I, II and III regulations. These include provisions for all chemicals (environmentally hazardous) and hydrocarbons to be stored in closed, secure and appropriately bunded areas.
- A Material Safety Data Sheet (MSDS) will be available for all chemicals and hydrocarbons in locations nearby to where the chemicals/wastes are stored.
- Vessel operators will have an up to date Shipboard Oil Pollution Emergency Plan (SOPEP) and Shipboard Marine Pollution Emergency Plan (SMPEP). All shipboard chemical and hydrocarbon spills will be managed in accordance with these plans by trained and competent crew. Related mitigation measures in place:
  - Spill exercises will be conducted at minimum of every three months and recorded in the vessel log.
  - Spill kit will be located near high risk spill areas.
  - Spills will be cleaned up immediately, spill kits re-stocked and clean up material contained, and not washed overboard.
  - Vessel decks will be bunded. Scupper plugs should be available to prevent liquid discharges from decks.
- Any contaminated material collected will be contained on board for appropriate onshore disposal.
- Spill clean-up equipment will be located where chemicals and hydrocarbons are stored and frequently handled (i.e. ‘high risk’ areas). The quantity of spill recovery materials will be appropriate to the quantity of stored chemicals.
- Transfer deck run off discharges to the sea via the scuppers. Scupper plugs or equivalent will be available on vessel decks where chemicals and hydrocarbons are stored and frequently handled (i.e.’ high risk’ areas). Plugs will be utilised during handling of large quantities of hydrocarbons or hazardous chemicals.
- Any equipment or machinery with the potential to leak oil will be enclosed in continuous bunding or will have drip trays in place where appropriate.

- Following rainfall events, bunded areas on open decks of the vessels will be cleared of rainwater.
- All hoses for pumping and transfers will be maintained and checked as per the PMS.
- On board oily water disposal will be managed in accordance with the Marine Pollution Regulation 2006. The vessel operator will record the quantity, time and onshore location of the oily water disposal in the vessel Oil Record Book.
- If vessels are equipped with an oily water filter system, they may discharge oily water after treatment to 15 ppm in an oily water filter system (providing they have a current calibration certificate for the bilge alarm) as required by MARPOL Annex I Regulations (for the prevention of pollution by oil). To discharge, the vessels will require a current IOPP certificate for oily water filtering equipment, and a current calibration certificate for the bilge alarm.

The following controls can be implemented when possible for the purposes of mitigating or eliminating the risk of the spillage of hydrocarbon from refuelling:

- Refuelling operations will be a manned operation. In the event the refuelling pipe is ruptured, fuel bunkering will cease.
- Spill clean-up equipment will be located where hydrocarbons are stored and frequently handled (i.e. 'high risk' areas).
- Refuelling of a vessel will not take place within 12 nautical miles of the territorial baseline (except in port). It will only occur in suitable weather conditions.
- Dry-break refuelling hose couplings and hose floats can be installed on the refuelling hose assembly.

D.13.4 Environmental Outcome

Removal of the use of chemicals or hydrocarbons on-board vessels is not an option for the operation of the vessel and associated cable laying activities. Similarly, since open deck drainage is an essential safety feature of any marine vessel, the risk of discharge from deck drainage cannot be eliminated. However, it is anticipated that any impacts to water quality resulting from a hydrocarbon or chemical spillage would be temporary and constrained to the immediate vicinity, if such an incident did occur. In such cases, spillage of hydrocarbons or environmentally hazardous chemicals may be attributed to machinery, engines and tanks leaking these liquids into the marine environment. Due to these limited impacts and the management controls implemented to reduce the risk of contaminants reaching the surrounding environment to levels as low as reasonably possible, the risks of a small hydrocarbon spill are considered to be environmentally acceptable.

Vessels will only operate with, process and/or retain in storage low quantities of chemicals and hydrocarbons. The vessels will also adopt safety measures consistent with the requirements of the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and MARPOL Annex I, II and III. These safety precautions and safeguards may entail, among other measures, the assignment of correct stowage and designation of appropriate storage and handling areas. The risks of discharge to the aquatic environment are mitigated by the adoption of these safety control measures, resulting in the reduction of these risks to levels as low as reasonably possible. A variety of measures have been implemented to prepare for spill response should any incident occur.

The risks and measures adopted to address any potential spill resulting from hydrocarbon refuelling are similar to those outlined for spills as a result of discharge. Refuelling may only be allowed if there is no other alternative and that it is occurs at a distance from the territorial baseline of greater than 12 nautical miles. As obligated under the requirements of MARPOL Annex III and the Protection of the Sea (Prevention of Pollution from Ships) Act 1983, vessels will execute safety measures when necessary. Dry break refuelling hoses, keeping equipment well serviced and maintaining spill cleanup and containment equipment are some of the safeguards that can be adopted. The most suitable and relevant standard to observe in this environment is the internationally accepted MARPOL standard due to the scope, extent and character of the activity and its use by the wider industry. The measure outlined in the MARPOL would be adopted in the event of a spill.

No refuelling would occur in coastal waters and would only occur, if required, in deep water areas or while at port which would reduce the effects of an accidental spill. In open water conditions it is anticipated that a low volume spill would dilute and disperse quickly into the surrounding waters. In port, containment procedures would be deployed to avoid significant spill dispersal. Since only minor physical and/or chemical impacts are expected, sensitive receptors in near-surface waters would not be greatly affected, thereby justifying that the risks and impacts of a potential spill have been reduced to levels as low as reasonably practicable.

D.14 Damaged Fuel Tank Associated with Vessel Collision

D.14.1 Environmental Hazard Description

During the activities, there is a possibility that vessels could collide. The rupture of a vessel's fuel tank is the predominant risk resulting from a potential vessel collision. The significance of the risk is attributed to the release of marine diesel into the aquatic environment from the damaged fuel tank. Collision between vessels and other obstacles is unlikely, with no additional sub-surface hazards found in the vicinity. Such obstacles would typically be infrastructure or regions of shallow seabeds; none of which overlap with the proposed cable laying route.

As a consequence of a tank rupture from vessel collision, a standard tank is expected to empty into the marine environment within hours.

D.14.2 Impact Analysis

Fauna Receptors

Marine Mammals

Geraci (1990) cited studies that suggested that marine mammals have the capacity to identify and avoid oil slicks. In contrast, other sources indicate that this is not evident (Etkin, 1997) with examples of marine mammals observed surfacing and feeding in oil affected areas (Matkin *et al.*, 2008).

Understanding of the effects of surface oil on marine mammals has not been fully developed. The impact of oil on marine wildlife is influenced by the characteristics of the oil and the extent to which it has been weathered. Through direct contact and ingestion, organisms oiled in the early stages of a spill experience higher levels of toxicity than those exposed to weathered oil. Within the activity zone, particularly at locations that coincide with migratory routes, the surface oil released from a vessel collision is likely to have severe effects on animals in the afflicted areas. No known key breeding, feeding or rest areas are located in the activity area, where any potential surface spill may to occur. Therefore, it is unlikely that numerous species would be exposed in the event of a spill.

Marine mammals may be affected by oil slicks via the following mechanisms, as outlined by Geraci (1990):

- Ingestion and accumulation
- Skin contact
- Interference with feeding
- Vapour inhalation
- Baleen fouling

Ingestion and Accumulation

Feeding behaviours that rely on surface skimming are especially susceptible to the ingestion of surface oil condensate. The following effects may occur as a consequence of oil condensate ingestion:

- Acute effects include neurological damage and liver disorders (Geraci 1990), gastrointestinal ulceration, haemorrhaging and secondary organ dysfunction due to ingestion of oil (Etkin 1997).
- Chronic poisoning via ingestion of components that have entered the food web (Neff et al., 1976).

There is no observed evidence from studies or records to indicate that a whale may consume enough hydrocarbons by feeding in/near a hydrocarbon spill to suffer the above acute impacts. Additionally, Mysticetes (baleen whales) are less exposed to chronic poisoning risk as they typically feed on biota that can accumulate and dispose of hydrocarbons from their systems in a relatively short period of time.

Exposure to hydrocarbon pollution, the ingestion of oil from the water column, via contaminated food and the potential subsequent effects is discussed in following sections.

Skin Contact

Hydrocarbon’s material characteristics mean they readily adhere to rough surfaces on fauna, e.g. fur, calluses and hair. Due to their hairless and smooth-skinned features, hydrocarbons typically do not stick to whales and dolphins, with testing conducted by Geraci *et al.* (1985) confirming that cetacean skin is a suitable barrier to oil. However, Etkin (1997) reported the development of eye and skin lesions on cetaceans as a result of prolonged exposure to oil.

Interference with Feeding

The loss of food species and loss of access to feeding areas due to the surface condensate coupled with the species selective diet can result in substantial decrease in body mass in marine mammals exposed to oil spills. The stress associated with oil spill exposure also has an effect on the body mass of marine mammals (UNEP, 2013).

Baleen feeders rely on a sieve-like mechanism called a baleen to filter nutrient-rich water for food such as plankton and small fish. The whale’s tongue then shifts the food to the oesophagus. This feeding mechanism is vulnerable to a heavy oil spill inclusive of exposure to weathered oil, as indicated by the combined evidence of studies conducted by Geraci *et al.* (1985). Oil can potentially disrupt the efficiency of the feeding mechanism for days by blocking the baleen plates. As such whales, which skim food inclusive of from surface waters, are therefore more susceptible to impacts from surface oil than other species.

Vapour Inhalation

Congested lungs, damaged airways or emphysema are possible consequences of vapour inhalation of surface oil, depending on the inhalation concentration. The inhalation of oil vapours is also known to cause irritation and harm to soft tissue e.g. the mucous eye membranes. The damage to an individual is greatest when it is trapped, panicked and exposed continuously or for prolonged periods to the oil (Geraci, 1990).

Fish

According to Kennish (1997) and Scholz *et al.*, (1992), open sea fish typically have the ability to identify and avoid surface slicks. Compared to other marine organisms, fish are unlikely to experience as much exposure to surface oil since diesel would remain on the sea surface.

However, since eggs, larvae and fish in their early juvenile stages are likely to inhabit the planktonic sea surface waters, recruitment success could be affected. The surface oil would predominantly have lethal or near-lethal impacts on the future growth and development of exposed larvae/eggs/juvenile fish (Kennish, 1997).

Despite being a highly mobile fauna, there is insufficient information to confirm the whale shark's ability to identify a spill and avoid the afflicted zone. Because the diet of the whale shark consists of plankton, baitfish and krill located near or on the surface of the water column, whale sharks are susceptible to ingesting surface condensate during feeding. The impact to whale sharks from surface condensate is considered to be low, given the low occurrence of whale sharks in the project area compared to the annual aggregation of whale sharks in the vicinity of the Ningaloo coast (DPW, 2013) indicating this species may avoid activity areas and therefore risk of exposure.

Marine Reptiles

Similar to baleen whales, surface diesel may impact marine turtles and seasnakes via a variety of direct and indirect means, including:

- Ingestion and accumulation
- Consumption of contaminated food
- Skin contact
- Vapour inhalation

Hydrocarbon spills are particularly detrimental to marine turtles since they are vulnerable to the impacts of such spills in all stages of its life cycle from eggs to adults, onshore or offshore (NOAA, 2010). This is compounded by indications that turtles show no avoidance behaviours to zones affected by oil spills. Ingestion and inhalation of surface hydrocarbons is also likely as marine turtles rise to the surface to breathe. Skins infections, impacts on internal organs and the occurrence of respiratory issues are likely effects of marine turtles exposure to surface hydrocarbons. Given the open ocean environ of the majority of the cable laying route, turtles within the activity zone would be transiting through the area afflicted by the surface spill. It is not anticipated that affected marine turtles would have any significant impact on overall turtle numbers in the ocean as evaporation and entrainment would not mean toxic constituents of hydrocarbons did not linger on the surface for longer periods of time.

The chance of a seasnake being impacted by the surface condensate from an oil spill is higher in shallower coastal waters where seasnakes typically remain, as opposed to the deep waters surrounding the activities region where encounter rates would be low.

Birds

The feeding and resting behaviours of birds on surface waters renders them exposed to surface oil condensate. The primary impact mechanisms faced by seabirds include:

- Ingestion of oil
- Impact on feeding areas
- Fouling of plumage.

Seabird fouling can occur when contact is made between the seabirds and floating hydrocarbons. According to Michel and Hayes (1992), seabirds may experience fouling during feeding and diving for prey, wading in shallower waters or during roosting on the surface of waters affected by surface condensate.

The structural integrity, performance and function of a seabird's plumage are affected by oil fouling. Fouling can consequently cause the loss of buoyancy, inability to fly and loss of waterproofing properties of plumage resulting in hyperthermia in affected seabirds.

Preening and feeding / diving actions on the surface of affected waters can lead to the ingestion of surface oils by seabirds. Changes in blood characteristics and intestinal irritation are some of the consequences of oil ingestion by bird species (Michel and Hayes, 1992). The quantity of hydrocarbons required to instigate effects in seabirds is not known. However, the extent of impacts on seabirds is dependent on the type of hydrocarbon they are exposed to, duration of exposure and the type of seabird affected.

As noted above, hydrocarbon condensate on the water surface can affect a wide number of prey species occupying the surface water environments, e.g. krill and baitfish. These disruptions to the food chain through the reduced availability of suitable prey caused by surface condensate may be detrimental to the behaviour and survival of certain bird species, which feed on surface water biota.

The predominant feeding behaviours of seabird species within the activity zone are either by skimming surface water or by dive bombing. These birds are therefore exposed to surface oil condensate while feeding and resting on the water surface.

The quantity of marine wildlife affected and the extent of surface oil's impact is reliant on a variety of factors including the weather, season and biological productivity of the afflicted region (Dunlop, 1988).

Habitat Receptors

Rocky Shorelines

The oiling of rocky shorelines (such as at Rottnest Island in WA and the Coogee headland in NSW) is likely in the event that vessel collision occurs within the vicinity of shallow coastal waters. A spill in shallow waters from collision and tank rupture may subsequently lead to the suffocation of marine organisms and potentially toxic effects. High water movement and water energy may eventually remove oil from rocky shoreline substrates while lower energy water environments would result in oil persisting on substrates. In such cases, loss or toxicity of biofouling taxa inhabiting the shoreline would likely occur. Reestablishment of hard substrate surfaces by organisms is often a reasonably fast process lasting between weeks to months after the removal of oil from platform surfaces.

Rocky Reefs

An oil spill in near-shore environments as a consequence of vessel collision and rupturing of a fuel tank close to shore and or in shallow waters may result in impacts upon a wide variety of organisms inhabiting shallow water rocky reefs. There are extensive rocky reefs in the Perth region in around 10 – 30 m WD, similarly rocky reefs are a primary sensitive habitat along the cable route from the Coogee headland to 20 m WD. Such an oil spill could subsequently hinder the photosynthesis processes for some of these reef-inhabiting organisms and impart toxic effects to affected species.

Sandy Beaches

An oil spill close to shore resultant from a vessel collision in shallow waters can result in oil being trapped on sandy beaches, such as Floreat Beach in WA and Coogee Beach in NSW. It is likely that some of the oil will result in the contamination of sand deeper in the beach profile. This may be facilitated by the melting of oil into the beach profile, the suspension of sediments within the surf zone or the infiltration of oil condensate to sediments located deeper in the beach profile. It is noted that sandy beaches are vital environments to various protected shorebirds for feeding and roosting; no turtle nesting occurs at the beaches in proximity to the POPs.

Sensitive Benthic Habitats

Rocky Reef Species

Rocky reefs occur in shallow waters overlapping with the cable route. A number of sensitive species including temperate corals are known to occur and could be affected. There is a general absence of information on the long-term effects of hydrocarbons in the water column on reefs. Some impacts on coral are temporary while others may persist for longer periods of time, with variations of extent and duration dependent on the coral type, health of the reef and reproduction period of the coral (NOAA, 2001). The effect of hydrocarbon exposure resulting from vessel collision or ruptured fuel tank includes diminished feeding, fertilisation and larval settlement. Decreased growth rates and the demise of larvae and tissue may also be consequences of hydrocarbon exposure (Villanuvea *et al*. 2008). These impacts would occur not only to any corals present but toxicity affects would also affect filter feeding epifauna such as ascidians or sponges. The photosynthetic ability of marine flora could also be affected.

The extent of impact is dependent on the length of time the environment is exposed to dissolved hydrocarbons. One mitigating factor of the toxicity effects on hard corals is the dispersive nature of the waters on the WA, NSW, and southern coastlines, as a result of strong winds and tidal currents.

Macroalgal and Seagrass Beds

The occurrence of oil captured within the water column could affect light qualities and the ability for macroalgae to photosynthesise. Studies conducted by Burns *et al*. (1993) and Dean *et al.* (1998) reveal that fast recovery rates are possible despite heavy oiling. Periods ranging from weeks to months may, however, be needed for benthic habitats exposed to oil within the water column to recover to original water quality conditions.

Phytotoxic effects caused by absorption from the water column may be experienced by macroalgae. Reduced photosynthetic efficiency has been indicated by aquatic plants where hydrocarbon compounds have concentrated within the membranes of the plant (Runcie and Durako, 2004). A recovery duration ranging from weeks to months is required for habitats to return to original water quality conditions after experiencing long-term effects.

Soft Sediments

Even though soft sediment benthic environments may not be impacted by residue oil, shallower regions are susceptible to accumulation of oil, as noted above in discussion of beach environs.

Other

Key ecological features (KEFs) include:

- Commonwealth marine environment within and adjacent to the west coast inshore lagoons
- Western rock lobster
- Ancient coastline at 90-120 m depth
- Western demersal slope and associated fish communities
- Perth canyon and adjacent shelf break, and other west coast canyons
- West Tasmanian Canyons
- Canyons on the Eastern Continental Slope

Accidental diesel spill is not expected to impact on KEFs due the depth of these features below water surface and behaviour of oils to act as slicks on the water surface.

D.14.3 Management Controls

The following management controls may be adopted and executed for the purposes of mitigating or eliminating the risk of hydrocarbon spillage as a result of vessel collision:

- Visual observations will be maintained by watch keepers on all vessels.
- Regular notification to the following Australian Government agencies before and during operations:
  - The AMSA RCC of proposed activity, location and commencement date to enable a AusCoast warning to be issued.
  - The Australian Hydrographic Office of proposed activity, location and commencement date to enable a 'Notice to Mariners' to be issued.
  - In the event of a spill resulting in notification to AMSA, other sea users (e.g. fishing industry) will be informed of the incident via Marine Notices to prevent vessels entering an area where hydrocarbons have been released.
- Vessels will operate in compliance with all marine navigation and vessel safety requirements in the International Convention of the SOLAS 1974 and the Navigation Act 2012. This includes the requirement for all equipment and procedures to comply with the following AMSA Marine Orders:
  - Marine Orders - Part 30: Prevention of Collisions
  - Marine Orders - Part 21: Safety of Navigation and Emergency Procedures
  - Marine Orders - Part 27: Radio Equipment: sets out ship requirements regarding radio installations, equipment, watch keeping arrangements, sources of energy, performance standards, maintenance requirements, personnel and recordkeeping
  - Marine Orders Parts 3 and 6 – Seagoing Qualifications and Marine Radio Qualifications: ensures seafarer competency standards meet the needs of the Australian Shipping Industry
  - Vessels will be equipped with appropriate navigational systems which may include an automatic identification system (AIS) and an automatic radar plotting aid (ARPA) system capable of identifying, tracking and projecting the closest approach for any

vessel (time and location) within the operational area and radar range (up to approximately 70 km)

- Marine diesel oil compliant with MARPOL Annex VI Regulation 14.2 (i.e. sulphur content of less than 3.50% m/m) is the only engine fuel to be used by the vessels.
- Oil spill responses will be executed in accordance with the vessel's SOPEP, as required under MARPOL.

D.14.4 Environmental Outcome

In order to undertake the activities, vessel presence is required and no alternative is available. Navigation and safety instruments and equipment can be found on vessels, as prescribed by the International Convention of the SOLAS 1974 and actioned through the *Navigation Act 2012*. These are necessary for the safe navigation of the vessel to avoid potential vessel collisions.

In order to combat the possible eventuality of a spill from collision risk, measures have been implemented to respond to spills and minimise their effects. Marine user notifications and stakeholder consultation for affected parties within the activity zone are some of the other industry standard and activity-specific controls in place to reduce the risk of vessel collision, which could result in ruptured fuel tanks and oil slicks.

These standards and controls are considered to reduce the likelihood of a vessel collision. With all controls in place risk of vessel collision is considered managed to as low as reasonably possible.

D.15 Seabed Disturbance Associated with Cable Maintenance Activities

D.15.1 Environmental Hazard Description

The design life of the cable system is 25 years. Once the cable is installed, there is generally no requirement to access and maintain the cable.

If unplanned maintenance is required, cable maintenance activities necessitate that the cable be retrieved from the seabed. This has the potential to damage habitats and associated biota that lie within the footprint of retrieval activities and immediately adjacent to the footprint.

D.15.2 Impact Analysis

Cable maintenance is typically undertaken in the following manner:

- Initial cutting drive, where the repair ship pulls a grapnel with cutting blades perpendicular across the expected cable line
- Recovery of a (expected) fault free section of the cable via grapnel retrieval
- Recovery of a section of fault free cable past the faulty section via grapnel retrieval
- Fault isolation and cable repair between the two sections retrieved
- Final splice, confirmation tests and return of the repaired cable to the seabed.

Cable maintenance operations (including associated vessel movements) have the potential to occur across a large span of marine seabed, perpendicular to the portion of the cable needing repair. The area of potential disturbance associated with cable retrieval activities depends on water depth, and the number of grapnel runs required in retrieving the cable. Typically, the tow wire for the grapnel is 3 to 4 times the water depth. Therefore, grapnel run lines at the deepest points (>5746 m) could be in the order of 17 to 23 km long. Grapnel size will vary depending on the benthic substrate and conditions in the area of the cable maintenance, however typically grapnels range in width from 0.5 to 3.5 m. The maximum footprint of a single grapnel run is therefore expected to be approximately 0.08 km^2 (8 ha).

Disturbance of the benthic habitat and associated communities will be realised as a result of each grapnel run. This will include direct disturbance as the grapnel creates a furrow in the seabed, or indirect disturbance associated with increased suspended sediment and turbidity. Impacts are expected to be localised to the immediate vicinity of the grapnel run and cable, and temporary, with recovery timeframes dependant on water depth, sediment type and characteristics of the in situ benthic communities.

The majority of the cable will be placed in a deep sea environment, characterised by open expanses of soft sediments. Deep sea benthic communities are typically very sparsely distributed; biomass of such communities is generally less than 1 % of that found in shallower ecosystems (Glover and Smith, 2003). The selected offshore alignment of the cable avoids sensitive marine habitats such as seamounts and canyons, as such; impacts associated with deep water grapnel runs are expected to be limited.

Inshore, the cable is aligned within the PZ in an effort to reduce the potential for third party damage to the cable, and thus reduce the need for maintenance. Further, the current alignment of the cable avoids sensitive marine habitats such as rocky shores and canyons. Given the need for grapnel runs to be conducted perpendicular to the cable, there is potential for sensitive habitats to be impacted during cable retrieval activities. This could include localised physical damage and mortality to the epibenthos (e.g. algae, sponges etc.) and any sessile or slowly moving fauna (e.g. Syngnathids).

As described by preceding sections addressing disturbance to the seabed, localised disturbance impacts are expected to recover rapidly. As such, grapnel deployment for cable maintenance is not anticipated to result in permanent or long term impacts.

D.15.3 Management Controls

To reduce or eliminate the risk of habitat disturbance from cable maintenance activities, the following management controls will be implemented as far as practicable:

- Inshore alignment of the cable to be within the PZ as much as practically relevant for cable alignment to reduce the potential for third party damage (and thus required maintenance) to the cable.
- Cable placement activities to include detailed records of cable locations to enable relative certainty of cable position during grapnel activities.
- To minimise impact footprint selection of grapnel sizes is to be based on smallest available to achieve required outcome.

D.15.4 Environmental Outcome

Any cable maintenance will be performed by a specialist group who have established targeted procedures to manage identified risks. Localised, short-term disturbances to sediments and/or epibenthos living on unburied cable/within the disturbance footprint of the grapnel are expected to occur as a result of unplanned maintenance. Through these industry accepted controls and procedures, the likelihood of maintenance adversely impacting marine habitats in and around the cable alignment is considered to be reduced to as low as reasonably practicable.

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