Attachment A

Submission by the Department of Natural Resources, Environment, the Arts and Sport
In response to:

Ichthys Gas Field Development

Draft Environmental Impact Statement

October 2010

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General notes

Assumptions

The guidelines for preparation of an EIS state “Any and all unknown variables or assumptions made in the assessment must be clearly stated and discussed. The extent to which the limitation, if any, of available information may influence the conclusions of the environmental assessment must also be discussed and assessed in relation to risk and international best-practice.” The draft EIS draws conclusions on a range of issues. These conclusions often appear to be based on assumptions that are implicit rather than clearly expressed. The uncertainties that are associated with some of the concluding remarks in the text should have been explicitly documented throughout the draft EIS so that readers were able to ascertain the strength of conclusions drawn. For some of the key issues, this identification of uncertainties and assumptions could help to inform further studies or research that might need to be undertaken to reduce uncertainty. The Supplement, henceforth called the EIS (the draft EIS together with the Supplement form the EIS), should provide a comprehensive list of the assumptions made against the conclusions they inform.

Risk assessment

In general the risk assessment is qualitative given that INPEX has not accumulated sufficient information to conduct a more robust risk assessment. In the main part, INPEX has relied on unsubstantiated assumptions to inform risk. Robust baseline surveys may be required as indicated throughout this submission.

It is difficult to determine the extent to which information requirements outlined in Section 6 of the draft EIS guidelines relating to Risk Assessment were addressed. Chapter 6 of the draft EIS contains very little detail and only briefly and very generally acknowledges the inherent levels of uncertainty. It does not discuss the issue of risk associated with realising benefits. The risk assessment components of subsequent draft EIS chapters contain little to no discussion of the residual risk that would be expected to be borne by the community.

Confidential resources

Where confidential or commercially sensitive reports or information have been requested, INPEX may lodge an objection to the making of part of the report available to the public. Please refer to Section 10 of the Environmental Assessment Administrative Procedures. Previously requested references are listed in the ‘Appendices’ component of the table below.

Habitat Mapping

The proponent has not undertaken any broad scale habitat mapping to understand the location and extent of marine habitats in the region. This is in clear contrast to other marine EIS’ that have been conducted. A lack of understanding of habitat extent in the harbour means that predictions of potential impact are not substantiated. For example, the proportion of the total hard substrate or coral communities in the harbour is unknown so there can be little understanding about how these communities will be impacted or the implications that impacts to one area might have on the sustainability of that habitat type in the harbour.

There is little information provided on how the proponent constructed the habitat maps on pages 84-88. They are inadequate for the intended purpose and give the impression of comprehensive habitat mapping.

Dredging and spoil disposal

The draft EIS has not adequately addressed the impacts from dredging, dredge spoil disposal, increased suspended sediments and changes in light attenuation associated with the trophic component of the Darwin Harbour ecosystem. In general terms, the draft EIS has not provided a comprehensive review of existing information and presented these data. The draft EIS has relied very much on the proponent's own collected data sets and "models". For example, seabed surface sediment figures show only URS sample sites; however, the Department of Natural Resources, Environment, the Arts and Sport (NRETAS) provided INPEX with a much larger data set that would have enabled the mapping of seabed surface sediments. There is no mention of these additional data in the draft EIS and they have not been used to fully describe and map seabed characteristics for Darwin Harbour. Additionally, there are no suitable marine monitoring control sites proposed. Without suitable control sites, any localized or regional impact such as coral bleaching caused by a warm water event could be attributed to the project.

Scenario Planning

Sometimes models may not accurately simulate observed conditions. Planning for scenarios that could eventuate, where observed conditions during dredging operations depart significantly from conditions simulated by the sediment transport modelling, should be discussed in the EIS. Currently, NRETAS assumes there is a high degree of uncertainty associated with the modelling predictions as the draft EIS gives little insight into the conservatism or otherwise of the many assumptions used to build the model.

The EIS should address this by clearly stating the assumptions that were used to build the sediment transport model where empirical data was unavailable, with an explanation supported by evidence of the basis for each assumption. Further sensitivity analysis should be applied to some of the modelling parameters to clarify to what extent changing the input values might affect the model results. The likelihood that input values for more sensitive parameters will change once the dredging contractor is nominated, and the environmental implications of such changes, should also be discussed.

Management contingencies will need to be developed to protect significant habitats in the event that observed sediment parameters arising from dredging activities stray outside of the predicted values. The processes for developing contingencies and establishing triggers for implementing contingency action should be discussed in the EIS.

Underwater Noise

Underwater noise has not been adequately dealt with, particularly in regards to piling and blasting. Noise modelling should be conducted for Darwin Harbour. Methodologies must be based on best practice and exclusion zones must be determined using current and empirical scientific evidence as well as biological variables of species concerned. If current technology or current knowledge is inadequate then a report explicitly identifying the gaps and data needed should be produced.

Walker Shoal

Options for avoiding Walker Shoal or removing the shoal by means other than blasting have not been presented. In addition, blasting areas other than Walker Shoal have been mentioned but no further details provided. Further discussion of alternatives is required and any additional blasting proposed should be discussed within the same context.

Offsets

It is expected that INPEX will present a detailed, agreed biodiversity offsets package in the supplement and will therefore work through a consultative process with the NT and Australian Governments to establish an agreed package of offsets, in line with the Australian Government's draft offsets policy.

The Northern Territory Government will continue to discuss greenhouse gas offset opportunities with INPEX.

Executive summary

Section No.	Section name	Page No.	Relevant text draft EIS	Reviewer Comment	Link to Risk Table
2	Project Description	13	During the concept selection stage of the Project, a number of alternatives were considered for different components of the Project.	Discussion of alternatives and reason for discounting not apparent.	
6	Marine Impacts and Management	33	The risk assessment process, taking into account management controls and mitigating factors, identified 13 "medium" and 26 "low" residual risk potential environmental impacts associated with the offshore development area. These risk ratings are considered to be acceptably low, mitigating risks to sensitive habitats and significant or migratory species.	This is dependant on (1) the correct application of mitigation control/management controls and (2) quality and appropriateness of baseline data collected and modelling conducted. In many instances the management controls are yet to be determined or developed and therefore risk assessment can not include mitigation factors. Further, many of the assessments are based on poor data sets and more often on assumptions.	
6	Marine Impacts and Management	34	Turbid plumes will reduce the incident light levels reaching benthic biota, which could affect sensitive species such as corals and algae.	The EIS needs to provide a separate assessment for macro algae and for phytoplankton. Both groups are affected differently by dredging and dredge spoil	

Section No.	Section name	Page No.	Relevant text draft EIS	Reviewer Comment	Link to Risk Table
				disposal and play different roles within the Darwin Harbour ecosystem. Conceptual Models of the harbour environment would be useful for predicting the effects of the project on these biota.	
6	Marine Impacts and Management	34	Turbid plumes can also release nutrients stored in marine sediments, providing a food source for fish and subsequently attracting predators such as marine mammals and reptiles	The use of the word “nutrients” needs to be clarified (dissolved or particulate matter/infauna). No baseline has been conducted to determine infauna composition or nutrient content of sediments; no discussion of the implications to phytoplankton (with the possibility of algal blooms) and bacteria. There is no mention of the possibility of releasing contaminants into the water column and its impacts. Conceptual models would clarify these interactions.	
9	Socio-economic Impacts and Management	63	Non-Aboriginal cultural heritage	In the threat and control tables, underwater heritage issues have been addressed under the socio-economic impacts (pg 63). This is relevant but it also means that it has been excluded from other parts of the risk tables which highlight key potential threats such as sea bed disturbance, sand removal, trenching and rock dumping (41, 42, and 43). Page 63 has an entry for maritime heritage that does not consider the issue of unlocated sites and objects and with that the issues of dredging, rock dumping etc. If INPEX have undertaken sufficient remote surveying and diver verification work throughout the harbour then it should be listed as a separate aspect in the matrix and covered under management controls/mitigative measures. Another separate aspect should be the spoil dump and what remote sensing should be conducted there.	

Chapter 3 Existing natural, social and economic environment

Section No.	Section name	Page No.	Relevant text draft EIS	Reviewer Comment	Link to Risk Table
3.2.1	Oceanography and hydrodynamics	34	Oceanography and hydrodynamics	The draft EIS mentions that the "*Broad-scale oceanography in the north-west Australian offshore area is complex ….*", however the draft EIS does not describe the oceanographic characteristics in sufficient detail. For example, factors such as seasonal changes in surface current direction (including maps); sub-surface currents; upwelling characteristics; combined effect of sea-surface currents, and seasonal meteorological conditions in water transport; Leeuwin and Holloway currents; and the importance of currents to productivity of the region need to be considered and discussed in the EIS. The EIS could provide conceptual models of processes in the marine environment and the geomorphological features within the development area and Darwin Harbour to better understand the linkages between key processes that drive the marine ecosystem. Key references: Baker 2008 and Brewer et al 2007	
3.2.2	Biogeographical setting	36	Biogeographical setting	This section would benefit from a more detailed review of the existing literature, including recent publications by CSIRO and GA. Maps showing existing knowledge (such as geomorphic features, sediment facies) would be useful.	
3.2.3	Seabed and bathymetry: Ichthys field	39	Soft substrates are typical of deep continental shelf seabeds and this habitat is very widely distributed in the deeper parts of the Browse Basin (see Appendix 4).	This statement can only be supporting if the supporting data is referenced and presented or summarised within the EIS. Currently, the data provided in the draft EIS is based on a relatively small number of sampling sites can	

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				not be considered representative for determining differences within the region (see also comments for Appendix 4).	
3.2.3	Seabed and bathymetry	39-40		There is reference to the Fugro remote sensing surveys, which although they appear substantial, were primarily conducted to locate engineering obstacles like Walker Shoal, not small but significant historic sites. Further detail should be provided about the Fugro surveys in terms of calibration and a formal statement claiming the surveys were adequate to locate previously undiscovered sites. The sub-bottom profiling survey would also be of particular interest. There is concern that previously undiscovered sites may be affected. The size of the proposed dredgers indicates that it may be difficult for a dredger to tell if they had dug up and destroyed a site like the wreck of the Rachel Cohen for example. The Heritage Management Plan also needs to include strategies to deal with any underwater archaeological sites discovered during the dredging process. There may be a need for more substantial remote surveys which could better capture any potential underwater heritage sites, prior to any dredging activities.	
3.2.3	Seabed and bathymetry: Pipeline route	40	Pipeline route	Many statements are made about the general characteristics of bathymetry, substrates and seabed communities. However, this section needs to provide the data that underpins these statements. The following maps may assist the reader in assessing the statements made in this section: (1) results from acoustic methodologies; (2) a bathymetric profile of the pipe line route.	

Section No.	Section name	Page No.	Relevant text draft EIS	Reviewer Comment	Link to Risk Table
3.2.3	Seabed and bathymetry: Pipeline route	40	Rock subcrop occurred in some areas and exposed outcrop was very rare.	This statement needs to be substantiated with data. Hard substrates are biodiversity hotspots. The draft EIS states that these substrates are rare in this region. The pipeline route should minimise detrimental impacts on these substrates these may play an important role in maintaining biodiversity in the region (island principle). The ratio between non-mobile and mobile substrates should be determined	
3.2.3	Seabed and bathymetry: Pipeline route	40	Pockmarks	The term pockmarks needs to be explained and described; a discussion on their relevance should also be provided.	
3.2.5	Seabed and bathymetry: Pipeline route	43	The source of these nutrients has not been determined—they may be transported from distant deeper sources via upwelling currents (this is known to occur elsewhere on Australia's north-west continental shelf)	This is the first time upwelling is mentioned and used as an explanation of a result. This is a key oceanographic characteristic for the North-West region and needs to be reviewed and discussed in the relevant introductory section (3.2.1).	
3.2.5		43	Phytoplankton	Phytoplankton characteristics have not been reviewed in the introduction section of this chapter. CSIRO and GA publications may assist in providing a context on the subject.	
3.2.6	Marine sediments: Ichthys field and offshore areas	43	Sampling of marine sediments in the offshore development area was conducted by RPS Environmental in September 2005 and May 2007 at 10 sites.	Given the variability of sediment types (see later section), the size of exploration area and the pipeline length, the sampling intensity (10 sites) seems inadequate. There needs to be a clear justification for the selection and the number of sites used. Further, the EIS needs to review and include existing data into its assessment. For example, offshore sediments maps, geomorphological maps should be added to the EIS.	
3.2.6	Marine sediments: Ichthys field and offshore areas	43	Background data on marine sediments in the region are scanty because of the remoteness of the location and the fact that there has been minimal exploration and development	The EIS needs to list the internal and external source data sets accessed. This would ascertain whether there are any key data sets missing. For example, the draft EIS does not	

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			activity there by the oil & gas industry.	mention the GA MARS data base which holds marine sediment data. They have considerable number of data points within the NW Shelf and Gulf of Bonaparte regions.	
3.2.7	Marine benthic habitats and communities	44	The benthic communities at the Ichthys Field were characterised by RPS Environmental in 2007 using sidescan sonar and bathymetric surveys, ROV surveys and sampling of infauna	The sampling program and methods used are insufficient to establish meaningful characterisation of community composition of offshore substrates. No benthic trawls were conducted to describe community composition. A single grab is an inappropriate method.	
3.2.7	Marine benthic habitats and communities	45	Browse island / Echuca shoal	The EIS needs to provide a discussion about how their community structure findings compare with other shoals within the oceanic shoal marine bioregion.	
3.2.7	Marine benthic habitats and communities	45	Species richness and abundance decreased with increasing distance from land and with increasing water depth. … appeared to be related to sediment particle size, the sites with high sand fractions having a suite of species different from those found at sites dominated by clay or silt sediments, regardless of the distances between the sites and differences in water depth.	Methods used can not establish meaningful species richness and abundance estimates. In describing benthic communities, the EIS needs to determine the assemblages that correspond with the different sediment types encountered.	
3.2.7	Marine benthic habitats and communities	46	Macrophytes such as seagrasses and macroalgae of the genus Sargassum do not appear to occur in intertidal or shallow subtidal areas at Browse Island (see Appendix 4).	These statements are based on data provided by unpublished reports (eg RPS 2007a, RPS 2008b). These data / reports need to be provided with the EIS so it can be independently reviewed for accuracy and appropriateness.	
3.2.7	Marine benthic habitats and communities	46	Pipeline route survey	In general, this study is considered to be inadequate in describing the marine benthic habitats. See comments for Appendix 4.	
3.2.7	Marine benthic habitats and communities	47	Notable hard substrate	It is unclear what the minimum size of substrate type is to qualify as “notable”. Further, why was the calcarenite outcrop not described if it was the only “notable” hard substrate type within a 97 km stretch of pipeline?	

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3.2.7	Marine benthic habitats and communities	47	Epibenthic species in the communities surveyed are common throughout north-west Australian offshore waters and are not considered to be of particular significance in the context of the Project.	This comment cannot be substantiated with any confidence. The survey conducted is not considered to be adequate, systematic, or representative of the pipeline route to enable reliable establishment of differences between sites along the pipeline. As mentioned previously, no data have been provided to allow robust comparison of results with other areas within the region.	
3.28		49	Table 3-1	Crocodiles (CITES II) should be included here for completeness.	
3.2.8	Protected Species	52	Dugongs	1st paragraph. – ensure that peer-reviewed, source references are used where possible. 3rd paragraph – cite Bayliss 1986, and also Elliott 1981. 5th paragraph - 1st sentence replace reference with better reference – e.g. Bayliss 1986.	
		53	Turtles	There is little mentioned of foraging turtles. The likelihood that each species forages in the harbour should be provided – references that could be used include Whiting 2002	
		53	Turtles	Citation needed for Fog Bay feeding turtles - Whiting 2000 thesis (CDU)	
3.3	Nearshore			There is a need for development of a suite of relevant ecotoxicological tests for water and sediment for use in the event of a spill or wastewater discharges.	
3.3	Nearshore	56		Development of a basic conceptual model is an integral part of the assessment process. A conceptual diagram for ecological and human health risk assessment should be developed to illustrate primary and secondary pollutant / stressor sources, release and transport mechanisms, exposure media and ecological and human receptors.	
3.3.2	Nearshore environment:	56	Oceanography and hydrodynamics	This section needs to discuss the strength of currents; the duration of strong currents and	

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	Oceanography and hydrodynamics			net exchange for areas within Darwin Harbour. Also, the meaning of "tidal excursions range" is not clear.	
3.3.4	Water Quality	60		It is expected that monitoring requirements will be included as Licence conditions (under the *Water Act*) therefore monitoring plans will need to be developed for submission with the licence application.	
3.3.4	Water Quality: Turbidity and light attenuation	63	However, the mean change in turbidity was relatively minor: from 4 to 12 NTU over the range of conditions analysed.	This statement 'relatively minor' is misleading. The NTU measurement is a surrogate for suspended solids and the relationship between NTU and suspended solids is not linear. The relationship has not been established and varies depending on the nature of the particles in suspension but a 3-fold increase in the NTU value, for example, may represent a 30-fold increase in suspended solids. If turbidity is to be used for monitoring and the description of environmental conditions, the relationship between suspended solids and turbidity measurements must be demonstrated.	
3.3.4	Nutrients and Phytoplankton	64		If limited data is available on the nutrients in sediments in Darwin Harbour, detailed baseline studies need to be undertaken. Ongoing monitoring should continue during periods of waste discharge activities for both construction and operation phases.	
3.3.4	Nutrients and phytoplankton	64		No sampling of phytoplankton through chlorophyll a measurements was undertaken in Darwin Harbour and its tributaries for this project. Again, monitoring of these parameters needs to be conducted prior to and during the construction phase. Monitoring should then be continued for any water discharge activities during the operational phase.	
3.3.4	Nutrients and phytoplankton	64	Algal blooms, which are symptomatic of nutrient-rich water, have not been recorded in	Given the recently reported algal blooms in the harbour, some discussion on whether INPEX	

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			Darwin Harbour (WMB 2005)	might contribute to cumulative pressure would be useful.	
3.3.5	Marine sediments	64	Fig 3-15 and associated text	This subchapter fails to incorporate existing data (from other studies) to value add to the review and description of marine sediments in the harbour. The existing data plus additional collected data need to be shown in a figure and need to be discussed within the text.	
3.3.5	Marine sediments	69	Table 3-6	A number of statements are incorrect in the table: coral is not a geological unit, it is a community description; there are no carbonate deposits by corals in Darwin Harbour (unlike the Great Barrier Reef, for example); Coral "reefs" in Darwin Harbour are all coral communities on conglomerate sandstones.	
3.3.6	Marine communities	70	Darwin Harbour has a complex assemblage of marine habitats (Figure 3-16) and there are large differences in the extent, diversity and significance of the biological communities inhabiting them.	The mapping of Darwin Harbour sea floor is inadequate for the purpose of the EIS. The following issues contribute to this: • The mapping does not describe habitat in the harbour. Instead, it is a mixture of substrate data with the occasional community type added. • Neither the map nor any data provided describes the extent of biological communities. • The EIS needs separate maps for substrate type and benthic fauna/flora community types. • The data provided here is not suitable to be used for risk assessments and the development of management plans. The figure showing mangrove communities is a good example of a habitat map (Figure 3-37, page 104).	

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				This chapter is more a review of existing data and contains limited new data. The draft EIS has not described seabed communities within the footprint of impacts (should include areas that can be identified through modelling as possible impact areas and not focus alone on Darwin Harbour (ie South of the line between East Point and Mandorah). Nor has it used appropriate methods to allow assessment of community structure and differences between sites/areas. Broad community types can be described through underwater video / diver transects using higher taxonomic level species descriptors. For monitoring purposes, species specific information is required to allow development of robust monitoring programs that can deliver impact assessments and management actions. The draft EIS does not present a comprehensive description of the species assemblages found in the impact areas and reference areas. The data is descriptive, and does not allow a robust assessment of biodiversity importance / uniqueness nor does it allow a comparison between sites within impacted and non-impacted areas. It is essential to have site-specific species information. The level of species identification should be described to at least family if not genus level. The review of the marine community has only provided species level information for coral communities and skimmed over describing site-specific species level community structures at non-coral communities on hard or soft	

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				substrates. It has resorted to phylum level identification, which is inadequate.	
3.3.6	Marine communities	72	Known localities of coral-dominated communities are Channel Island, Weed Reef, north-east Wickham Point and South Shell Island	East Point Aquatic Life Reserve, Dudley Bommies and the Pinnacle are also localities of well known coral-dominated communities within Darwin Harbour.	
3.3.6	Marine communities	73	Walker shoal	The epibenthic community on Walker shoal would be lost due to blasting. The draft EIS has not dedicated a section to describing in detail (to species community level) the fauna and flora present; discussed its importance / relevance within the Darwin Harbour ecosystem; and likely implications of loss of biodiversity for Darwin Harbour.	
3.3.6	Marine communities	73	Seagrass	This section does not discuss the importance of these seagrass meadows for Dugong and that they are the only known seagrass meadows within the Darwin Harbour – Shoal Bay region. Seagrass meadows occur at Casuarina Beach and Fannie Bay.	
3.3.6	Marine communities	73	Seagrass	The reference Whiting 2004 is probably incorrect. If so, replace with Whiting, S. D. (2002). Rocky reefs provide foraging habitat for dugongs in the Darwin region of northern Australia (Whiting 2002).	
3.3.6	Soft sediment communities	74	It is estimated that there are probably 40-60 species of crabs associated with mangroves in Darwin Harbour.	The equivalent information is also available for polychaetes, viz. It is estimated that there are about 70 species of polychaetes in the mangrove sediments in Darwin Harbour (Metcalfe & Glasby 2008). [Metcalfe, K. N. and C. J. Glasby (2008). Diversity of Polychaeta (Annelida) and other worm taxa in mangrove habitats of Darwin Harbour, northern Australia. Journal of Sea Research 59(1-2): 70-82.]	
3.3.6	Marine	75	Significant habitats	This section does not provide a full assessment	

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	communities			of significant habitats as defined in the Executive Summary (p 34). Seagrass meadows/habitats at Casuarina Beach and Fannie Bay need to be included in this section.	
3.3.6	Marine communities	77	Bayu-Undan gas pipeline	The EIS needs to provide an assessment of the degree to which the community structure associated with the pipeline compares to similar naturally occurring habitats. The draft EIS uses the rock armour and pipe line as a positive outcome by creating additional hard substrate for epibenthic communities to establish. However, it does not discuss to what extent this will happen, how long it will take for an assemblage to develop into comparable habitats that have developed under natural conditions.	
3.3.6	Marine communities	78	Dredge spoil disposal ground	This section is inadequate. The underlying data set that supports this section is poor in terms of spatial representation, taxonomy, comprehensiveness, and methodology used. See comments associated with Appendix 8.	
3.3.8	Protected species	80	Table 3.8 Lists Blue Whale, Humpback Whale, Green Turtle, Hawksbill Turtle, Flatback Turtle, Pacific Ridley Turtle as having no listing under NT legislation	All these species are listed as Data Deficient under the *Territory Parks and Wildlife Conservation Act*. Additionally, the whale shark is also data deficient under NT legislation and the flatback turtle is data deficient on IUCN	
3.3.8	Protected Species	81	Cetaceans	Remove Whiting 2003 from 2nd paragraph as it doesn't relate to this group.	
3.3.8	Protected species	81	Para 1: humpback whales are known to migrate to northern Australian waters – but the species rarely ventures as far north and east as NT waters	Although data are lacking on the location and range of Humpback whales, anecdotal reports of sightings from Coastwatch Flights and the public suggest there are more regular sightings of the species in NT waters. An NTG project has recently identified the NW coast of the NT as becoming increasingly used by	7-41

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				humpback whales, on the southward migration at least. This information suggests that humpback whales might be more common in NT Waters than previously thought, but there is a lack of quantitative data to support this.	
3.3.8	Protected species - cetaceans	81	Para 5: Aerial surveys conducted by Freeland and Bayliss in 1984-85 identified large numbers of “Irrawaddy” dolphins in the waters of the Gulf of Carpentaria	The interpretation of information presented on population size and density of snubfin dolphins is not accurate and does not include more recent data. The paper that is referenced, Freeland and Bayliss (1989) conducted aerial surveys in the Gulf of Carpentaria, and estimated around 1,000 individuals. This estimate has been questioned due to the difficulty in distinguishing different species from aerial surveys in turbid waters (H. Marsh pers. comm. Cited in IUCN red List). Surveys undertaken between 1987 and 1995 in Queensland coastal waters revealed much lower population densities (Parra et al. 2002). Also, photo-identification studies conducted from 1999 - 2002 indicate a population of fewer than 100 individuals in Cleveland Bay, north-east Queensland (Parra et al. 2006a). A preliminary survey of the north-eastern Kimberley coast conducted by Thiele in May 2006 recorded 15 groups of animals, totalling 88 individuals (IUCN, 2010). The majority of identified snubfin populations are thought to be small (Jacob 2009).	7-31
3.3.8	Protected Species	82	Cetaceans para 2	Remove Mustoe 2008 and use a better reference such as Parra et al. 2004. The former reference is an unpublished report; peer-reviewed references should be used preferentially where possible.	
3.3.8	Protected species - cetaceans	82	Para 6: Preliminary observations since 2008 have identified relatively high numbers of snubfin dolphins at Cobourg Peninsula and in	This information needs to be presented correctly and contextually in the EIS. . Observations at Cobourg and Kakadu are	

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			the South and East Alligator Rivers (Kakadu National Park)	based on repeated transects where a proportion of all sightings will include the same individuals sighted numerous times due to the residency and site fidelity pattern displayed by these species. Sighting data suggests the populations would be less than 100 snubfin dolphins at Cobourg and less than 80 for the Alligator Rivers region. These numbers are not considered to be high. Overall, despite its wide distribution, populations of snubfin dolphins appear to be rare in most areas, and those that are known are thought to be localised and discrete (Parra and Arnold 2008). It is inappropriate to use the data presented in Palmer 2010 to compare snubfin dolphin numbers in Cobourg to Darwin or Kakadu.	
3.3.8	Protected species - cetaceans	82	Para 7: Indo-Pacific humpback dolphins are widespread and common throughout Australian tropical waters from Shark Bay etc	Information on population size and density of Indo-Pacific humpback dolphins must be updated in the EIS. Data on the status of humpback dolphin populations in Australia are scarce however existing data suggests they are not a common species. Corkeron et al. (1997) have suggested that they are in decline. The only statistically defensible estimates for Australian waters are of 34-54 (CVs=13-27%) in Cleveland Bay, Queensland (Parra et al. 2006a), and 119-163 (95% CIs = 81-251) in Moreton Bay, Queensland (Corkeron et al. 1997). Coastal dolphins are under threat and in need of management intervention to reduce anthropogenic threats (Thomson et al 2000; DeMaster et al 2001, Parra et al. 2006a).	
3.3.8	Protected species - cetaceans	82	Para 10: Observations from the NT coastal dolphin research project indicate that shallow, intertidal areas in Darwin Harbour are regularly used by Australian snubfin and Indo-Pacific humpback dolphins	This statement is overly simplistic. The EIS needs to acknowledge recent studies of Orcaella and Sousa, which have shown a heterogeneity in distribution and varied use of patches within a habitat and that there will be a	7.31

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				few important key habitats (hotspot areas) (Stensland et al. 2006, Parra 2006). Such fine-scale habitat selection and spatial heterogeneity is important for the coexistence of sympatric species like Orcaella and Sousa (Parra 2006). Current and up-to-date specific sighting locations indicate that the Indo-Pacific humpback dolphins have been predominantly recorded around East Arm and at the mouth of Reichardt and Blessers Creeks (also Howard River and Hope Inlet, Shoal Bay) and foraging was the dominant behaviour (Fortune et al 2009; Palmer 2010). Snubfin have been recorded in East Arm, Woods Inlet and in Fannie Bay.	
3.3.8	Protected species - cetaceans	82	Para 12: 34 humpback calves have been recorded throughout Darwin Harbour and Shoal Bay	This statement is incorrect. There are no data on the humpback dolphin calves throughout Darwin Harbour. Rather, there are specific sighting locations of mother/calf pairs where they have been recorded predominantly around East Arm and at the mouth of Reichardt and Blessers Creeks (also Howard River and Hope Inlet, Shoal Bay) (Palmer 2010).	7.31
3.3.8	Protected species - cetaceans	82	Para 13: From the current understanding of the ecology of these two species, it is reasonable to conclude that potential habitat for snubfin and Indo-Pacific humpback dolphins occur through-out the Darwin Harbour	This statement is overly simplistic and the draft EIS does not provide any new evidence to support this conclusion. The EIS needs to acknowledge recent studies of Orcaella and Sousa which have shown a heterogeneity in distribution and varied use of patches within a habitat and that there will be a few important key habitats (hotspot areas) (Stensland et al. 2006, Parra 2006). Such fine-scale habitat selection and spatial heterogeneity is important for the coexistence of sympatric species like Orcaella and Sousa (Parra 2006).	7.31
3.3.8	Protected species - cetaceans	82	Para 15: A similar study on site fidelity has not been undertaken for the snubfin and Indo-	This statement is not correct. Investigation of site fidelity has been a component of a multi-	7.31

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			pacific humpback dolphins of Darwin harbour	species dolphin program undertaken by the Northern Territory Government in Darwin Harbour since 2008. This research has been focusing on three species of coastal dolphins; the Australian snubfin *Orcaella heinsohni*, Indo-Pacific humpback dolphin *Sousa chinensis* and Indo-Pacific bottlenose *Tursiops aduncus*. Initial results suggest that populations of Sousa and Tursiops are resident (site fidelity), whereas Orcaella occurs in low numbers and appears transient. Recent photo-identification and mark resighting analysis indicate resident populations of fewer than 50 individuals for both Indo-Pacific humpback and the Indo-Pacific bottlenose. Analyses of movement patterns via photo-identification for all three coastal dolphin species suggest very little movement between Darwin Harbour and Shoal Bay populations. All three species have been recorded foraging in Darwin Harbour with mother/calf pairs (Fortune et al 2009; Palmer 2010).	
3.3.8	Protected species	83	Dugong	This section needs to highlight that dugong are often seen at Casuarina Beach and Fannie Bay. Feeding trails have been recorded in these areas.	
3.3.8	Protected species	83		General comment: there have been no formal studies or assessments of sea turtles in Darwin Harbour. For this reason it is difficult to assess likely impact. It is known from other studies and observations that significant foraging areas occur outside Darwin Harbour in adjacent areas. Anecdotal observations indicate that green, hawksbill, flatback and olive ridley turtles occur inside Darwin Harbour but the significance of the harbour to these species is not understood.	

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3.3.8	Protected species	83	Turtles Limited flatback nesting	Mention should be made within the EIS of the educational importance and thus significance of nesting turtles on Casuarina Beach, which is the only capital city beach in Australia where this occurs.	
3.3.8	Protected species - cetaceans	83	Parra 16: Van Parjis et al (2000) investigated the vocalization of snubfin dolphins.	Additionally, Van Parjis and Corkeron (2001) also investigated the vocalizations of Indo-Pacific humpback dolphin. The variety of sounds produced by Indo-Pacific humpback dolphins is similar to those of related Delphinines, such as Tursiops sp. and Stenella sp. Rates of vocalization were greatest during foraging and socializing, and few vocalizations were emitted during either travelling or milling. They recorded 17 different types of frequency modulated narrow band calls (whistles) produced by Indo-Pacific humpback dolphins ranging in frequency from 1 kHz to 22 kHz.	
3.3.8	Protected species - cetaceans	83	Para 17: The Indo-Pacific bottlenose occurs around Australian coast and frequents a large number of bays and inshore waters in considerable numbers	The EIS needs to be updated with more comprehensive and current information. Tursiops taxonomy is complex and currently the genus is divided into two species, truncatus and aduncus, which predominantly occupy different geographical ranges, although sympatric populations have been identified (Rice 1998, Wang et al. 2000a, b, Chilvers and Corkeron 2003). The taxonomic status of many populations of *T. aduncus* is unknown (Ross & Cockcroft 1990, Möller & Beheregaray 2001). There is limited information available about the status of Indo-Pacific bottlenose dolphin coastal populations and only one study in Australia has published abundance estimates (and site fidelity ranging patterns) for Indo-Pacific bottlenose dolphins inhabiting estuaries in Australia (Fury and Harrison 2008). Fury and Harrison (2008) estimated population abundance through mark-recapture analyses of	7.31

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				71 dolphins and 34 dolphins for the Richmond and Clarence Rivers respectively in northern NSW. Indo-Pacific bottlenose dolphins breed and forage in Darwin Harbour (Palmer 2010). Initial abundance estimates are less than 50 resident bottlenose dolphins in Darwin Harbour.	
3.3.8	Protected species - cetaceans	83	Para 17: The ecology of the (bottlenose) population in the NT waters has not been studied in detail	This statement in the draft EIS should be qualified by adding the following, "…however, initial studies undertaken by the NTG indicate that small numbers of bottlenose dolphins are resident and breed and forage in Darwin Harbour (Palmer 2010)." The current statement doesn't consider Northern Territory Government data and should make mention of the multi-species dolphin research program that has been conducted in Darwin Harbour since 2008. Initial results suggest that populations of Tursiops are resident. Based on photo-identification and mark resighting analysis, resident population size for the Indo-Pacific bottlenose is small < 50 animals. Analysis of movement patterns via photo-identification for coastal dolphin species has identified very little movement between Darwin Harbour and Shoal Bay.	7.31
3.3.8	Protected species - dugongs	83	Para 21: Dugongs could occur anywhere in the Harbour	This statement is not substantiated. The EIS needs to cite the most current information and should include recent Northern Territory Government data. Dugongs are regularly recorded foraging in Fannie Bay (Palmer 2010).	7.31
3.3.8		84	Maps	It is difficult to differentiate some of the proposed habitats in the maps. Clarification should be provided in the EIS of the areas that were surveyed to produce the habitat map or	

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				the methods used to derive the maps in the absence of habitat surveys.	
3.3.8	Protected species	85	Ray-finned fish Sharks and other cartilaginous fish	More discussion is required on protected species such as seahorses, which do occur in Darwin Harbour and are associated with fringing reefs and mangroves. All seahorse species are listed as “Marine fauna” under the EPBC Act. Generally, more attention needs to be given to sea turtles, sharks, rays and sawfish in the EIS.	
3.4.8	Vegetation communities	103	Draft EIS identifies monsoon vines forest and mangrove communities have conservation significance	To clarify, under the NT Land Clearing Guidelines, both monsoon vines forest and mangrove communities are classified as “significant vegetation”.	8.6
3.4.9	Flora species of conservation significance	107	Draft EIS states only one species listed under TPWCA occurred in the project area	There is a large number of plant species listed as Near Threatened or Data Deficient under the TPWCA. However the draft EIS or Appendix 16 has not listed the occurrence of these species. Many of these species have restricted range and the proposed development may impact these species.	8.6
3.4.12	Protected species	110		Table 3.14 does not list any migratory bird species protected under the EPBC Act. A large number of migratory bird species use Darwin Harbour and Shoal Bay area.	7.31

Chapter 4 Project description

Section No.	Section name	Page No.	Relevant text draft EIS	Reviewer Comment	Link to Risk Table
Chapter 4			Project description	Section 4.2 of the guidelines for preparation of the EIS requested an explanation of the objectives, benefits and justification for the project. The overall objectives for the project are not clear in the draft EIS and should be clearly stated in the context of social and economic aspects and ecologically sustainable development in the Darwin region.	
4.1.3	Design alternatives	161		The EIS Guidelines (p12 section 5 alternatives) state: "Alternative proposals must be discussed, including detailed reasons for the selection and rejection of particular options…" Further discussion of and reasons for discounting of alternatives should be addressed in the EIS for: • Long jetty vs short jetty; • Not removing Walker shoal; • Non-blasting methods to remove Walker shoal; • Alternative dredge spoil locations; • Construction of causeway to Middle Arm Point; • Alternative shipping channels; and • Onshore reuse of dredge spoil. Statements should be backed up with documented evidence.	
4.4.1		178		The construction of the causeway to Blaydin Point, potential impacts and mitigation measures needs to be discussed. The causeway has the potential to impact tidal flows and ecological functioning of the tidal flats.	

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				Shorebirds in the area may be affected (see Ray Chatto, Technical Report, 73/2003, The Distribution and Status of Shorebirds around the Coast and Coastal Wetlands of the Northern Territory, Parks and Wildlife Commission of the Northern Territory). Mapping of shorebird habitat is required.	
4.4.3	Dredging and dredge spoil disposal	182	Final dredging operations are unknown until dredge operator has been identified and contracted	The Final Dredge and dredge spoil management plan needs to be resubmitted and reviewed with all updated information before dredging commences	
4.4.4	Dredging method	183	Final selection of equipment and sequence of operation will only be finalized after a dredging company has been selected.	This creates significant uncertainty regarding predictions from sediment modelling and therefore ability to assess risk to benthic habitats and marine species. Finalised dredging methodologies and the duration of dredging is required to assess associated impacts. If the final dredging operation is altered from that proposed in the EIS such that the environmental significance of the project could be changed, a notification of alteration to the project must be referred under clause 14A of the Environmental Assessment Administrative Procedures.	
4.4.4	Dredge program	185	Using the TSHD in no flow mode	Figures need to be provided to illustrate the increase in the number of trips to the spoil ground based on this modification. This increases shipping traffic and extends the duration of total dredging.	

Chapter 5 Emissions, Discharges and Wastes

Section No.	Section name	Page No.	Relevant text draft EIS	Reviewer Comment	Link to Risk Table
5.4	Light	214		More information regarding measures to avoid, mitigate and manage impacts of lighting on marine megafauna and migratory birds is required for both onshore and offshore components of the proposal. Lighting has the potential to attract marine megafauna and migratory birds. For example, the light glow of Darwin Harbour is known to impact on the orientation of adult turtles at Bare Sand Island (50 km west of Darwin). Lighting design and luminaries should be best practice and should not add significantly to light pollution.	

Chapter 7 Marine impacts and management

Section No.	Section name	Page No.	Relevant text draft EIS	Reviewer Comment	Link to Risk Table
7	Marine Impacts			Add a summary table of all Medium risks (inshore and offshore separate) including a column with proposed mitigation and whether it is included within a separate management plan.	
7.2.2	Drilling muds	249	Risk assessment drill muds	This chapter contains inadequate description of risks associated with the impacts of drilling muds. There is no mention of literature from Europe where their findings have led to the objective of zero discharge of SBMs to environment by the end 2000. The EIS needs to provide a genuine discussion on the use of WBMs and SBMs. Further it needs to provide an estimate how much will be discharged into the marine environment and model to what degree these contaminants will be biodegraded (if at all) or accumulated over time. It also needs to (1) place this into the context of environmental effects and risk; (2) provide indicators of exposure and effect; and (3) discuss if and how monitoring will take place.	
7.2.2	Drilling muds	249	SBMs are relatively non-toxic and readily biodegradable, and are considered to be an environmentally effective solution compared with traditional mud systems based on diesel and mineral oil. Using the toxicity ratings outlined by Cobby and Craddock (1999), most formulations range from “almost non-toxic” to “non-toxic”.	This statement is inaccurate and infers that the discharge of SBMs into the environment has limited impact. However, the Department of Trade and Industry (UK) and OSPAR working group (2000) respectively state that: “Since the biodegradation of most synthetic drilling fluids was found to be unacceptably low…” or “ recently developed synthetic drilling fluids are likely to persist when discharged into the marine environment at high concentration on drill cuttings where anaerobic conditions develop” . References published prior to 2000 are typically based on inadequate testing	

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				methods, with the EU revising their assessment, resulting in the acceptance of zero discharge of SBMs.	
7.2.2	Drilling muds	253	The concentration of SBMs on drill cuttings discharged to sea will be restricted to 10% by dry weight or less in accordance with Western Australian Government guidelines (DoIR 2006). An internal target of 5% or less of SBM on drill cuttings released to sea will be set.	See comment above.	
7.2.4	Accidental hydrocarbon spills			Modelling for worse-case scenarios need to be conducted for spills, pipeline blowouts and facility blowouts within Darwin Harbour. This should include discussion of potential impacts and management measures.	
7.3.1	Alteration of habitat (nearshore)	305	An area of hard substrate to be removed at Walker Shoal by drilling and blasting for the shipping channel, represents only a small portion of the hard substrate occurring elsewhere in the Harbour.	The draft EIS has not been able to support this statement with data (either published in peer reviewed publications or newly collected data) as there is no evidence of the extent of this habitat in the harbour. Given this level of uncertainty in the data, the risk assessment is limited.	
7.3.1	Alteration of habitat (nearshore)	305	Disturbed areas are likely to be recolonised rapidly (days to weeks) by motile animals, while animals with larval phases will only re-establish after the first reproductive event following the period of disturbance. In some habitats, there may need to be a succession of recolonisation events (over perhaps several years) before the community returns to its pre-disturbance composition	The assumption that disturbed areas will be recolonised rapidly is not supported by the existing literature. Many motile fauna need non-motile seabed fauna as a refuge. The full recovery of motile fauna can only occur when non-motile fauna has been established. For example, the rock armour that has been placed on the Conoco Phillips pipe line which, after 10+ years, still has not reached similar assemblage compositions as that of other hard substrate environments in the harbour. Further, dredging activities, both for this project and others, would be continual increasing suspended sediment loads and sediment deposition in the Darwin Harbour region. These	

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				factors have well known negative effects on recruitment of epibenthic communities. Therefore, the recovery of these substrates is very long-term and monitoring should be put into place to assess its recovery. The EIS should also discuss the impact from the scouring effect of propellor currents, which may delay the return of assemblages to their pre-disturbance composition.	
7.3.1	Alteration of habitat (nearshore)	305	The area of these habitats within the disturbance footprint for the nearshore development area is minor in comparison with the areas of similar habitat occurring elsewhere in the Harbour	The draft EIS has not been able to support this statement with data (either published in peer reviewed publications or newly collected data). Currently there is no documented evidence of the extent of this habitat in the harbour.	
7.3.1	Alteration of habitat (nearshore)	305	Overall, the new hard substrates provided by nearshore infrastructure are likely to increase biodiversity and productivity in those areas of the Harbour	The draft EIS views the consequences of replacing soft substrate with hard substrates as a positive, however, this is an assumption. There are implications to the trophic systems of the Darwin Harbour ecosystem. These have not been considered in the draft EIS. If this is used as a mitigating factor, then a discussion of how this change may impact on the Darwin Harbour ecosystem and to what degree changes may occur should be provided, supported by documented evidence where appropriate.	
7.3.1	Nearshore marine impacts and management	305	Paragraph 2: An area of hard substrate to be removed at Walker Shoal by drilling and blasting represents only a small portion of the hard substrate occurring elsewhere in the Harbour.	As there is no habitat map for Darwin Harbour (as a whole) this statement needs to be supported by the appropriate data. There is also very little information provided on Walker Shoal to inform its significance in Darwin Harbour.	7.31
7.3.1	Alteration of habitat (nearshore)	306	Habitat modification - Residual risk	The residual risk should be considered at least to be medium to high, as these habitats might be at risk of being altered (with unknown recovery rates) or lost with no recovery. Very little is known about these habitats to make	

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				informed decisions and therefore a precautionary approach should be taken.	
7.3.1	Summary of impact assessment	307	Potential impacts column (Table 7.29)	The potential impacts table does not adequately identify the risks associated with all the activities listed in Table 7-29. The blasting activities result in the physical loss of habitat which will potentially affect the coastal dolphins prey availability and indirectly the loss of food supply (Jefferson et al. 2009). Dredging and trenching potentially influences coastal dolphins prey and affect the dolphins indirectly by loss of food supply due to disturbance of the seafloor and increased sedimentation (Jefferson et al. 2009). Furthermore, both Indo-Pacific humpback and snubfin dolphins are likely to exist as meta-populations (small and partially or completely isolated populations). This makes them susceptible to extinction if rates of dispersal between populations are adversely affected (Hanski, 1998, Tilman et al., 1994). Without knowledge of the meta-population structure and degree of dispersal and hence an understanding of how to manage the meta-populations, the conservation and long-term survival of these species in Australian waters could be at risk. The importance of Darwin Harbour to the three species of coastal dolphins within a regional context is currently unknown.	7.29
7.3.2	Dredging			Wolanski *et al* (2006) identified that flocculation is a key sedimentation process in the harbour where freshwater and saline water mix. No modelling of suspended sediments for dredging activities appears to have been undertaken. The EIS needs to clearly show at the various dredging and dredge spoil disposal phases	

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				what the equilibrium state will be for suspended sediments in combination with light attenuation aspects. The combined effect of light attenuation, sediment load and currents will be key drivers for the health of flora and recruitment parameters for benthic fauna. The EIS also needs to explain the extent to which the model will be verified with evidence-based data and how this will be incorporated into management actions.	
7.3.2	Dredging	308	This was considered appropriate for the nearshore development area, as the key environmental receptors of interest (e.g. mangroves and key coral sites) in East Arm and Darwin Harbour are outside the immediate dredging footprint	A key habitat has been omitted from the discussion: subtidal deposition areas (i.e. soft substrate areas in low tidal energy environments). Subtidal soft substrates are important feeding grounds for many species of fish (eg Blaber, 2000). Subtidal flats also play an important role in the trophic ecosystem (eg McKinnon 2006). The EIS needs to provide an assessment of all areas (including seagrass meadows) that are likely to be impacted by sediment deposition (short or long-term perspectives) and not solely devote its assessment to corals.	
7.3.2	Dredging	310		Figures 7-18a to 7-20b Legends are not clear. Are suspended solids concentrations absolute values or above background levels?	
7.3.2	Dredging	319	Sediment accumulation on the subtidal seabed in Darwin Harbour occurs mainly within the dredging foot print.	This statement is incomplete and disregards the potential for sediments to be deposited in low energy environments. For example, NTG hydrodynamic model shows eddies in the vicinity of East Arm Wharf; Power and water information has shown a bathymetric depression just north of East Point between the intertidal areas and sand waves just in front of East Point. Any subtidal areas with a large proportion of fine sediments should be regarded as deposition areas and should be monitored because these are the areas where	

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				sediments will accumulate in the long-term.	
7.3.2	Impacts on marine habitats	321	Any invertebrate fauna communities displaced by sedimentation from dredging activity will be able to recolonise the areas.	There is no discussion of what is a tolerable threshold for burial of infauna (as done with mangroves). Infauna play an important role within the trophic ecosystem structure of Darwin Harbour. Assuming the impact as minor without supporting data is inappropriate. Any assumptions should be explicitly stated. If the information is not available, then monitoring should be designed to establish the sedimentation thresholds and identify if there are any impacts from additional sedimentation. This should not only focus on mangroves, but also on other benthic communities where sediment deposition is expected (e.g. seagrass meadows at Fannie Bay and Casuarina Beach and subtidal soft bottom substrate communities).	
7.3.2	Impacts on marine habitats - mangroves	321	An increase in fine sediment deposition in the seaward mangrove zone may facilitate an increase in deposit feeding polychaetes, which consume detritus in marine sediments.	This is a possibility, but the seaward zone is dominated by herbivorous polychaetes (Metcalfe & Glasby 2008), which may well decrease in abundance/diversity as a result of increased sedimentation.	
7.3.2	Impacts on marine habitats: corals	322	The coral species that occur in East Arm also exist elsewhere in Darwin Harbour (see Appendix 8) and it is considered that there is good potential for the recovery over time of any areas affected by the dredging program as natural recruitment will gradually rejuvenate the communities; and … it is considered that any decline in coral abundance will be reversible over time as natural recruitment replenishes the community.	No evidence to support the statement is provided. This is a major weakness in the assessment of potential impact on a very important ecological community in Darwin Harbour.	
7.3.2	Dredging Impacts on	322	“Erftemeijer and Reigl (2008), for example, in	The interpretation of the tolerance limits of	0-1

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	marine habitats Hard coral communities		a review of 53 studies exploring differences in sensitivity of corals to sedimentation and turbidity from dredging, suggested that minimum light requirements of corals can be as low as <1% of surface irradiance and that their tolerance to suspended sediment concentrations can be up to 165 mg/L in marginal nearshore reefs." "Maximum tolerable sedimentation rates of >300 mg/cm2•d–1 were found and the duration that corals could survive high sedimentation rates was found to be more than 14 days for very tolerant species."	corals by Erftemeijer and Reigl (2008) is not complete. Erftemeijer and Reigl (2008) wrote about ranges rather than minimum thresholds. For example, the following passages from the original text illustrates this point: • "Minimum light requirements of corals range from <1% to as much as 60% of surface irradiance." • "Tolerance limits of corals for suspended sediment concentrations range from <10 mg l-1 in pristine reef areas to 40 or even 165 mg l-1 in marginal near shore reefs." • "Maximum allowable sedimentation rates for corals range from <10 mg cm-2 day-1 to >300 mg cm-2 day-1. The duration that corals can survive high sedimentation rates range from <24 hours for sensitive species to >14 days (complete burial) for very tolerant species." The disparity between the interpretation of the literature and what is written in the draft EIS has considerable implication for management of impacts associated with coral communities and the proposed dredging program.	
7.3.2	Dredging Impacts on marine habitats Hard coral communities	322	"Dredging in the nearshore development area will generate plumes of turbid water that will periodically impinge upon adjacent hard coral communities, such as those at South Shell Island and off the north-east coast of Wickham Point. The extent of adverse impacts upon these communities will depend upon how close the corals are to their limits of tolerance of sedimentation and to their critical light limits, but given the naturally turbid estuarine environment in Darwin Harbour, it is likely that these species are adapted to	These statements are largely unsubstantiated and do not account for a clear lack of understanding of the potential for impacts from dredging. The following points can be made in relation to this: 1. No turbidity and sedimentation rate measurements have been presented in the draft EIS to support the idea that the environment at Channel Island, at South Shell Island, off the north-east coast of Wickham Point and at Weed Reef is as	0-2

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			periods of low light levels." "The coral species that occur in East Arm also exist elsewhere in Darwin Harbour (see Appendix 8) and it is considered that there is good potential for the recovery over time of any areas affected by the dredging program as natural recruitment will gradually rejuvenate the communities."	turbid as elsewhere in Darwin Harbour. No comparison of turbidity and sedimentation rate was made for coral communities locations and other areas of Darwin Harbour. 2. Information in Figure 3-16: Marine habitats in Darwin Harbour (Chapter 3, Existing natural, social and economic environment) suggests that hard bottom habitat areas are common in Darwin Harbour. However coral communities are confined to only a few locations with relatively low water turbidity and low sedimentation rate/high hydrodynamics – "refuges" where coral can growth. Alteration of water quality resulting from dredging may severely degrade coral communities in these locations.	
7.3.2	Dredging Impacts on marine habitats Hard coral communities	322	"The predicted depths of accumulated sediment on coral sites adjacent to the dredging area are negligible (<1 mm), as tidal currents are predicted to resuspend any fine sediments that fall on these areas during periods of slack water. However, it is noted that the model does not account for the small lumps and crevices that form the outer surfaces of corals, and that some fine sediments may be trapped within these that cannot be removed by ambient currents. While some coral polyps may be able to remove this sediment by secretion of mucus, there may be small patches or parts of individual corals that suffer some reduced growth or death as a result of sedimentation."	Based on this statement, the absence of sedimentation rate measurement in the "Reactive Coral Monitoring Program" is a serious flaw.	0-3
7.3.2	Impacts on marine habitats:	323	Smit hypothesised that these worms would have to grow outwards to compensate for the continuous accretion of mobile sediments, or	This statement ignores a key contextual factors relating to the amount of accretion occurring. If this hypothesis is used as a mitigating factor,	

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	other benthic com's		that they may be opportunistic users of this habitat and have a high turnover.	then there is a clear need to collect data to establish the maximum amount of sedimentation infauna can tolerate before adverse effects are seen. This would help to establish trigger values for monitoring purposes.	
7.3.2	Dredging (marine mammals)	323	Para 2: Various studies suggest that dolphins can forage for prey successfully in turbid waters etc and they may detect their prey using echolocation (Mustoe 2006).	The development being proposed in Darwin Harbour will involve significant amounts of underwater noise and has the potential to impact on coastal dolphins normal activities. Coastal dolphins can use echolocation in turbid waters to provide information about their environment, communication and location of prey (David 2006). However, it is unclear whether this can occur in combination with the major disturbances associated with the proposed development such as piling works, blasting, dredging, and increased shipping traffic.	7.31
7.3.2	Dredging (marine mammals)	324	Para 3: These diverse marine environments with the exception of seagrass beds occur widely throughout Darwin Harbour and regionally.	Darwin Harbour is one of only two macro-tidal harbours in the NT and the stated marine environments do not occur widely throughout the region. Darwin Harbour is unique in a regional context and the lack of habitat mapping for the harbour makes this statement indefensible.	
7.3.2	Dredging (marine mammals)	324	Para 4: Dugong foraging habitats such as rock reefs etc	Information provided does not include recent Northern Territory Government dugong sighting data from Palmer (2010). Dugongs are regularly recorded foraging in Fannie Bay. Preliminary seagrass identification at Fannie Bay includes two seagrass species *Halodule uninervis* and *H. pinifolia*.	7.31
7.3.2	Dredging (acid sulfate leachate)	324	Para 2: Fish deaths caused by water acidity are the most obvious and localised impacts of acid sulfate leachate in the marine environments	Information provided does not include the indirect affects on coastal dolphins due to loss of food supply (Jefferson et al. 2009) and potentially damage to coastal dolphin skin and	7.31

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				eyes.	
7.3.2	Management plans	325	Mangroves management plan	The plan needs to be broadened and include infauna within the mangrove system and intertidal flats fronting the mangroves.	
7.3.2	East Arm	325	Coral monitoring program	Coral health needs to be defined and further consideration needs to be given to the selection of appropriate reference sites. Some examples of reference sites might be Old Man Rock in front of Casuarina beach as a non-coral community or Bynoe Harbour as a reference site for coral communities. Both are possibly very similar ecosystems to Darwin Harbour. Video may not be an effective technique to measure coral health. AIMS and GBRMPA have well established monitoring techniques for dredging activities and these should be considered in the Supplement.	
7.3.2	East Arm	326	Soft bottom monitoring	Monitoring before and after impacts is not sufficient and needs to be conducted throughout the development stage of the project and a number of years after dredging and dredge spoil disposal have been completed. Monitoring sites need to be established in all areas that are identified as possible impact areas by sediment and hydrodynamic modelling.	
7.3.2	Pipeline shore crossing	326	Reactive coral monitoring	It is unclear what a "significant coral mortality" means. A baseline study could derive this parameter, and determine how robust it will be in actually predicting a mortality event above the natural conditions (including confidence levels etc). If it cannot do that, then it should not be used as an assessment method. Coral die back due to non-natural causes is not an option for a heritage listed area, therefore	

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				triggers need to be preventative and not after the fact. Furthermore, turbidity should not be the sole parameter for monitoring coral health. If this is used, then a baseline study needs to establish linkages between turbidity and the causes of declining coral health. The following linkages are required: (1) Turbidity levels, suspended solid content (type) and sediment / suspended solid settling rates; (2) Turbidity, sedimentation rates and coral health (e.g. growth, respiration, algal content, mortality) so it can identify appropriate turbidity trigger levels associated with coral health that are linked to sedimentation rates (net (as best as possible) and gross). The initial relationship between turbidity and coral health can be established under controlled circumstances (AIMS has a dedicated lab to do this). Then this can be verified under Darwin Harbour conditions. (3) The nature of the settling suspended solids with coral health (e.g. sediment type, organic content of settling sediments). Fine sediments with high organic content have been shown to lead to higher mortality rates for certain species which is noticeable within 48 hours. (4) Sedimentation / suspended solid settling rates vs short and long term tidal cycles species vulnerability to turbidity, sedimentation rates. Also, the justification for the "representative" coral species selected needs to be provided. The lack of a baseline study limits any future work in this area due to the complex nature of	

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				the environment. Although this baseline study is only for corals, it is also important that (from a long-term perspective) that areas with a low energy environment are more at risk. Baseline studies need to be developed for these environments to establish possible impacts on infauna and to determine if monitoring is required and to what extent.	
7.3.2	Residual risk	326		There are too many uncertainties to establish a risk level. Methods and mitigating factors are not yet clearly defined. A precautionary approach should be adopted thus giving sedimentation and turbidity a high risk level, until additional data has been provided.	
7.3.2	Residual risk	327	Table 7.31 - Potential impacts column – reduction in available habitat and food resources for coastal dolphins: no significant breeding or foraging areas are known in the nearshore area.	Information provided does not include recent Northern Territory Government data from the coastal dolphin program (Fortune et al 2009; Palmer 2010). Specific sighting locations indicate that Indo-Pacific humpback dolphins have been predominantly recorded around East Arm and at the mouth of Reichardt and Blessers Creeks (also Howard River and Hope Inlet, Shoal Bay) with foraging being the dominant behaviour (Fortune et al 2009; Palmer 2010). Specific sighting locations indicate that mother/ calf pairs are recorded predominantly around East Arm and at the mouth of Reichardt and Blessers Creeks (also Howard River and Hope Inlet, Shoal Bay) (Palmer 2010).	7.31
7.3.2	Residual risk	327	Table 7.31 - Dolphins may benefit from foraging opportunities around plumes.	There is limited evidence to support this statement. With increasing underwater noise in the Darwin Harbour, dolphins' ability to echolocate will be compromised. In turbid and muddy waters coastal dolphins need to echolocate to find their food. The proposed development project produces underwater	7.31

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				noise from blasting, piling works, dredging and increased shipping traffic that may impact on the coastal dolphins' ability to communicate and locate their food using echolocation.	
7.3.2	Residual risk	327	Table 7.31 - Potential impacts column – reduction in available habitat and food resources for dugongs	Information provided does not include the dugong sighting data from Palmer (2010). Dugongs are regularly recorded foraging in Fannie Bay. Preliminary seagrass identification at Fannie Bay includes two seagrass species *Halodule uninervis* and *H. pinifolia*. Sediment modelling indicates Fannie Bay will be impacted by turbid plumes.	7.31
7.3.2	Residual risk	327	Table 7.31	There is no assessment of potential impacts to migratory bird species due to sedimentation of intertidal habitats. Sedimentation may alter availability of food resources for bird species at different times of the year. This is possible in Darwin Harbour as well as Shoal Bay from sedimentation associated with the dredge spoil.	7.31
7.3.2	Residual risk	327	Table 7.31	There is no assessment of the potential alteration of hydrodynamics and tidal energy from the removal of Walker Shoal, resulting in altered bathymetry and the resulting change of deposition sites in East Arm.	
7.3.2	Residual risk	328	Table 7.31 - Acid sulfate soils - Reduced health of intertidal marine animals	Table 7-31 (Acid sulfate soils) does not adequately identify the risks associated with acid sulfate soils and the indirect affect on fauna through the potential loss of food supply.	
7.3.3	Dredge spoil disposal	329	The main concern of NRETAS was to avoid sediment deposition on Darwin's northern beaches and adjoining seagrass zones, while the DPC wanted to be sure that sediments would not return to the Harbour to infill dredged shipping channels.	These areas have not been incorporated into proposed management programs.	
7.3.3	Dispersion of dredge spoil	331	Site 9 was shifted slightly north-east to deeper water and lengthened to align with the main tidal axis. This tenth site was finally selected	More information is required on site 10 - how far to the north-east is site 10 from site 9? Please indicate on figure 7-24. Hydrodynamic	

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			as the offshore spoil disposal ground. Fig. 7-24	modelling should be conducted on site 10, especially because the Vernons, which are predicted to have an increased sedimentation rate, are closer to the preferred site 10, than the site actually modelled (site 9).	
7.3.3	Shoreline sedimentation	334	Sediment build-up is predicted to occur mainly between Lee Point and the Howard River and in Shoal Bay.	Information presented does not adequately identify the risks of sedimentation to coastal dolphins. Sediment build-up between Lee Point, the Howard River and in Shoal Bay has the potential to impact indirectly upon the Indo-Pacific humpback and the Indo-Pacific bottlenose dolphins due to loss of prey. Northern Territory Government sighting data locations indicate that the Indo-Pacific humpback dolphins are regularly recorded at Howard River, Hope Inlet and Shoal Bay and foraging was the dominant behaviour recorded (Fortune et al 2009; Palmer 2010). Bottlenose are regularly recorded around Lee Point and between Buffalo Creek and Shoal Bay (Palmer 2010).	
7.3.3	Impacts to benthic habitats	335	A sidescan sonar survey of the spoil ground, conducted in February 2009 (EGS 2009), showed a gently sloping seafloor composed of soft sediments, with no hard substrate.	Please provide maps showing these data for assessment.	
7.3.3	Impacts to benthic habitats	336	However, sampling by Smit, Billyard and Ferns (2000) showed that the benthic communities in the vicinity of the spoil ground were also characterised by motile crustaceans (small, shrimp like amphipods and crabs) that may survive inundation by dredge material through digging their way back to the surface layer of the seabed.	The statement is based on the assumption that mobile species will be able to dig themselves out of the pile of dumped dredge spoil. There is no mention how thick these piles will be. Monitoring needs to establish: (1) a baseline of infauna present (not adequately described in relevant chapters); (2) The levels of burial that species may be able to recover from and;	

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				(3) The time required for dumped substrates to establish fauna assemblages comparable with surrounding non-impacted substrates.	
7.3.3	Impacts to benthic habitats	336	Sediment deposition	There don't appear to be any graphs in the main draft EIS showing depth (mm) of sediment deposition for all phases in the disposal ground in Shoal Bay. Only shown is Phase 6, and 0-5 mm sediment deposition is not shown.	
7.3.3	Impacts to benthic habitats	336	In the longer term, the marine sediments at the disposal area will be recolonised by benthic animal communities similar to those presently established there.	This statement assumes that the soft sediments deposited from dredging would revert to the pre-impact substrates, which suggests that they will be dispersed and incorporated in the marine environment. A key issue is whether these sediments will be mobilised from the site to adjacent areas and returned in large amounts and in the short/medium term to the estuaries in the region. This statement is an assumption that needs to be established through monitoring.	
7.3.3	Gunn Point	337	The algal communities at Gunn Point are expected to have a similar capacity to recover rapidly after a period of low light conditions.	This section does not discuss the possible impacts to the unique coralline algae platforms found at The Vernon Islands. This needs to be discussed and due to its uniqueness a monitoring program needs to be established to monitor their health.	
7.3.3	Adam Bay	337	Seagrasses and hard corals were rarely recorded	The sampling design (3 nm grid sampling effort) for Smit et al (2000) is appropriate for a large scale biodiversity survey. Additional, finer-scale surveys should take place to describe benthic communities in more detail. Dugong surveys have identified the area as important feeding grounds. The presence of dugongs is indicative of the presence of seagrass meadows. That these sites are a focal point for dugongs would appear to	

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				indicate that seagrass meadows are sufficient enough to support a significant number of dugongs. Monitoring programs need to include these sites.	
7.3.3	Lee Point	338	No sediment accumulation is predicted over these seagrass beds, although some deposition (5–10 mm) is predicted for the southern end of Casuarina Beach near the mouth of Rapid Creek	Casuarina beach and Fannie Bay are the only known areas with seagrass meadows that support local dugong populations. Given the importance of seagrass to dugongs, these seagrass meadows should be monitored throughout the duration of dredging and dredge spoil disposal, and for a number of years after these activities have stopped. This will validate the modelling results and ensure that there is a robust data set that will identify if there are any long-term impacts from dredging and dredge spoil disposal.	
7.3.3	Management of dredge spoil disposal	338	Periodically during the dredging campaign, further bathymetric surveys will be undertaken to assess the distribution of dredge spoil in the disposal area and to ascertain whether the heavier sediment fractions are migrating beyond the boundary.	The draft EIS and Appendices have not stated the minimum amount of dredge spoil thickness that can be measured from bathymetric surveys. Alternative methods may need to be used to establish / verify the footprint of the dredge spoil disposal ground. The management plan needs to discuss which methods are most appropriate and why, and the survey's resolution	
7.3.3	Management of dredge spoil disposal	338	A soft-bottom benthos monitoring program will be developed with pre- and post spoil disposal sampling of these benthic communities to identify any changes occurring as a result of the disposal program	Monitoring before and after impacts is not sufficient and needs to be conducted throughout the development stage of the project and a number of years after dredging and dredge spoil disposal have been completed. Monitoring sites need to be established in all areas that are identified as possible impact areas by sediment and hydrodynamic modelling.	
7.3.3	Residual risk	339		There remain a large number of uncertainties in establishing an appropriate risk level. The draft EIS has not provided sufficient detail of	

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				community structure of epibenthic communities in impacted and reference areas; it has not provided detailed methodologies and the resolution for which it can measure an impact. A precautionary approach should be adopted thus giving dredging and dredge spoil disposal a high risk level, until additional data has been provided.	
7.3.5	Accidental hydrocarbon spills	347	Potential environmental impacts of spills	Information presented does not identify the risks to coastal dolphins in the event of a hydrocarbon spill.	7-37
7.3.7	Underwater noise and blast emissions	356	Pile driving	Noise modelling for the pile driving is required. Pile driving noise modelling will be different from the blasting noise modelling.	
7.3.7	Underwater noise and blast emissions	356	Para 2: Underwater noise propagation modelling is not considered appropriate for the nearshore development area etc	Given the potential risks to coastal dolphins from underwater noise, the absence of any underwater noise propagation modelling is a major gap in the draft EIS. The scale and extent of underwater noise in a nearshore environment and semi-enclosed harbour in Australia is significant. The omission of underwater noise modelling does not allow for an assessment of impacts and adequacy of mitigation measures.	7-41
7.3.7	Underwater noise and blast emissions	356	Project activities in the nearshore development area can be assessed through available literature and experience and an understanding of the key receptors in the nearshore environment	Given the potential risks to coastal dolphins from underwater noise, the absence of any underwater noise propagation modelling is a major gap in the draft EIS. The scale and extent of underwater noise in a nearshore environment and semi-enclosed harbour in Australia is significant. The omission of underwater noise modelling does not allow assessment of impacts and adequacy of mitigation measures. Further, the lack of studies and literature for Darwin Harbour suggests that there may not be	7-41

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				an adequate understanding of the key receptors in the nearshore environment.	
7.3.7	Underwater noise and blast emissions	357	For blasting generally, the risks of mortality is confined to an area in close proximity to the point of detonation, with a surrounding wider area where injury is possible etc	The risks to coastal dolphins from underwater blasting proposed over a substantial timeframe cannot be assessed with any certainty. Using the precautionary principle, the risk is presumed to be higher than stated. The draft EIS zones of impacts are based on a reference published in 1973 and the original paper was not cited directly, instead cited indirectly in Ecos (1996). A copy of the original article was sourced. The impact zones are derived from extrapolation of tests conducted on sheep, dogs, monkeys and ducks. There are obvious problems with the uncritical use of such a study. Tests were run to determine the far-field underwater blast effects on mammals and birds. The tests were conducted in a specially constructed test pond facility, 220 by 150 feet at the surface and 30 feet deep over the 30- by 100- foot centre portion. Explosive charges weighing up to 8 pounds were detonated at ten-foot depths. Sheep, dogs, and monkeys were suspended in the water, mostly with their long axis perpendicular to the surface at 1-, 2-, and 10-foot depths. The duck was selected as a model to represent birds on the surface and birds that dive beneath the surface. Ducks were tested on the water surface and at 2- foot depths. The nature of the immersion-blast injuries was described and related to the impulse measured in the underwater blast wave. Impulse levels which were safe and which produce injuries in mammals and birds were presented. Underwater-blast criteria were presented which corresponded to safe and damaging impulse	7-41

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				levels for birds and mammals along with curves relating the impulse criteria as a function of range and charge weight (Yelverton et al 1973). The proponents need to clearly identify the direct, indirect, on-site, off-site and cumulative impacts associated with underwater blasting (Jefferson et al 2009). Also, it is equally important to consider that sub-trauma levels of sound can have profound effects on individual fitness. These effects can take the form of masking of important signals, including echolocation signals, intra-species communication, and predator-prey cues; of disrupting important behaviours through startle and repellence; or of acting as attractive nuisances; all of which may alter or result in abandonment of important habitats (Ketten 2008).	
7.3.7	Underwater noise and blast emissions	357	This indicates that marine mammals more than 1259 m from the source, and 10 kg fish more than 660 m away, would not receive blast related injuries.	Evidence supporting blast impact zones needs to be robust to ensure the safety of megafauna.	7-41
7.3.7	Underwater noise and blast emissions	357	Using multiple small charges set on micro delays would reduce the overall peak pressure levels, so the zones of impact presented in the table 7.39 are conservative	Currently there is no evidence provided in the draft EIS that micro-delays reduce underwater blast impacts. Micro-delays are understood to be an important part of the blasting action and should not be considered an impact mitigation measure. The risks to coastal dolphins from underwater blasting proposed over a substantial timeframe cannot be assessed with any certainty. Zones of impacts are based on a reference (Yelverton et al 1973) unseen and cited in Ecos (1996). Impact zones are derived from extrapolation of tests conducted on sheep, dogs, monkeys and ducks. There are obvious problems with the uncritical use of such a study. Using the	7-41

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				precautionary principle, the risk is presumed to be higher than stated. Impact identification should include direct, indirect, on-site, off-site and cumulative (Jefferson et al 2009). Also , it is equally important to consider that sub-trauma levels of sound can have profound effects on individual fitness. These effects can take the form of masking of important signals, including echolocation signals, intra-species communication, and predator-prey cues; of disrupting important behaviours through startle and repellence, or of acting as attractive nuisances, all of which may alter or result in abandonment of important habitats (Ketten 2008).	
7.3.7	Underwater noise and blast emissions (Drill and blasting)	357	Table 7-39 Zones of impacts	Evidence supporting blast impact zones needs to be robust to ensure the safety of marine megafauna.	7-41
7.3.7	Underwater noise and blast emissions (Cetaceans)	359	Para 2: Confined blasting has the potential to disturb, injure or even kill dolphins. Management controls such as protection zones will therefore be implemented.	The risks to coastal dolphins from underwater blasting proposed over a substantial timeframe cannot be assessed with any certainty. Two species of coastal dolphins are recorded in and near the blast zones. These species are cryptic and difficult to see and when combined with the muddy, turbid water and low surfacing profile can make these species extremely difficult to sight. Therefore it is not considered that the current proposed protection zones can guarantee that dolphins are not present when blasting occurs. There is a high probability that losing a small number of individuals presents a high risk to the population. Based on dugong life history (Kwan 2002), which is similar to that of coastal	7-41

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				dolphins, any losses greater than 1 or 2% of breeding females can lead to a population decline. Photo-identification data from the harbour suggest that there are less than 50 resident humpback and bottlenose dolphins in the harbour. This suggests that a maximum loss of 2 female dolphins could cause a decline. Therefore, in the absence of any empirical data to suggest otherwise, any dolphin mortalities could threaten the Darwin Harbour population with potential consequences for the sustainability of the regional population.	
7.3.7	Underwater noise and blast emissions (Cetaceans)	359	While some of the higher-frequency components of the pile driving noise will be audible to these dolphins the modulation and tonal characteristics of this noise would be different from dolphin vocalizations and would be highly unlikely to interrupt communication.	This statement is not supported by the available evidence and the information provided for assessment is insufficient. The Indo-Pacific humpback dolphin has a similar range to many of the related Delphinines including Tursiops sp. and Stenella sp. Seventeen different types of frequency modulated narrow band calls (whistles) produced by Indo-Pacific humpback dolphins ranging in frequency from 1 kHz to 22 kHz have been recorded (Van Parjis and Corkeron 2001). Increasing noise impacts on coastal dolphins' ability to access critical resources and habitats (Jefferson et al. 2009). A comparison of tonal characteristics and modulation between the coastal dolphins and pile driving noise should be provided in the EIS to support this conclusion.	7-41
7.3.7	Table 7-41 Use of explosives (Localised injuries)	361	Fauna protection zones, with blasting activities suspended if marine megafauna are observed inside these zones.	Two species of coastal dolphins are recorded in and around the proposed blast zone. The dolphins are cryptic, have a low surface profile and the water is muddy and turbid making it all the more difficult to sight these dolphins. The current proposal provides no certainty that dolphins would not be present in these fauna protection zones.	7-41

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				The proponents have not discussed the medium or long-term impacts of such a sustained blasting program on coastal dolphins.	
7.3.7	Table 7-41 Pile driving (Avoidance of the area by marine megafauna, including threatened species)	361	No significant breeding, foraging or aggregation areas for threatened species are known to exist in the nearshore development area. An observation zone will be put in place to ensure that large animals are clear of the area prior to the commencement of pile driving	However, there are significant breeding, foraging and aggregation areas for megafauna in the nearshore development area. Specific sighting locations indicate that Indo-Pacific humpback dolphins have been predominantly recorded around East Arm (Elizabeth River) and at the mouth of Reichardt and Blessers Creeks and foraging was the dominant behaviour (Fortune et al 2009; Palmer 2010). The Indo-Pacific bottlenose are recorded around at the mouth of Reichardt and Blessers Creeks and foraging was the dominant behaviour (Palmer 2010). Specific sighting locations indicate that mother/ calf pairs of Indo-Pacific humpback dolphins are recorded predominantly around East Arm (Elizabeth River) and at the mouth of Reichardt and Blessers Creeks (Palmer 2010). Three species of coastal dolphins have been recorded in and around the pile-driving area. Two species are cryptic, have a low surface profile and when combined with muddy and turbid waters sighting these dolphins is particularly difficult.	7-41
7.3.7	Table 7-41 Dredging (Avoidance)	361	No significant breeding, foraging or aggregation areas for threatened species are known to exist in the nearshore development area.	Northern Territory Government data shows that the area may be significant for marine megafauna. Specific sighting locations indicate that Indo-Pacific humpback dolphins have been predominantly recorded around East Arm (Elizabeth River) and at the mouth of Reichardt and Blessers Creeks and foraging was the dominant behaviour (Fortune et al 2009; Palmer 2010). The Indo-Pacific bottlenose are	7-41

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				recorded around at the mouth of Reichardt and Blessers Creeks and foraging was the dominant behaviour (Palmer 2010). Specific sighting locations indicate that mother/ calf pairs of Indo-Pacific humpback dolphins are recorded predominantly around East Arm (Elizabeth River) and at the mouth of Reichardt and Blessers Creeks (Palmer 2010).	
			The greater part of Darwin Harbour will remain unaffected by changes in underwater noise levels	This statement is speculative. Underwater noise modelling needs to be undertaken to improve assessment of the impact of the proposed development.	
7.3.7	Table 7-41 Use of explosives (Localised injuries)	361	Confined blasting methods with micro-delays between blasts will be used to reduce peak pressures and the radius of the impact zones	Currently there is no evidence presented in the draft EIS that micro-delays reduce underwater blast impacts. Micro-delays are understood to be an important part of the blasting action and should not be considered an impact mitigation measure. Evidence supporting blast impact zones needs to be robust to ensure that megafauna are protected.	7-41
7.3.7	Table 7-41 Use of explosives (Localised injuries)	361	No significant breeding, foraging or aggregation areas for threatened species are known to exist in the nearshore development area.	Northern Territory Government data shows that the area may be significant for marine megafauna. Relevant sighting data from the Northern Territory Government would help to inform this. Specific sighting locations indicate that Indo-Pacific humpback dolphins have been predominantly recorded around East Arm (Elizabeth River) and at the mouth of Reichardt and Blessers Creeks and foraging was the dominant behaviour (Fortune et al 2009; Palmer 2010). The Indo-Pacific bottlenose are recorded around at the mouth of Reichardt and Blessers Creeks and foraging was the dominant behaviour (Palmer 2010). Specific sighting locations indicate that mother/ calf pairs of Indo-Pacific humpback dolphins are	7-41

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				recorded predominantly around East Arm (Elizabeth River) and at the mouth of Reichardt and Blessers Creeks (Palmer 2010).	
7.3.7	Table 7-41 Use of explosives (Localised injuries)	361	Confined blasting methods with micro-delays between blasts will be used to reduce peak pressures and the radius of the impact zones	Currently there is no evidence provided in the draft EIS that micro-delays reduce underwater blast impacts. Micro-delays are understood to be an important part of the blasting action and should not be considered an impact mitigation measure. Evidence supporting blast impact zones must be robust to ensure megafauna are protected.	7-41
7.3.7	Table 7-41 General shipping and vessel movement (Displacement)	362	No significant breeding, foraging or aggregation areas for threatened species are known to exist in the nearshore development area.	Northern Territory Government data shows that the area may be significant for marine megafauna. Relevant sighting data from the Northern Territory Government would help to inform this. Specific sighting locations indicate that Indo-Pacific humpback dolphins have been predominantly recorded around East Arm (Elizabeth River) and at the mouth of Reichardt and Blessers Creeks and foraging was the dominant behaviour (Fortune et al 2009; Palmer 2010). The Indo-Pacific bottlenose are recorded around at the mouth of Reichardt and Blessers Creeks and foraging was the dominant behaviour (Palmer 2010). Specific sighting locations indicate that mother/ calf pairs of Indo-Pacific humpback dolphins are recorded predominantly around East Arm (Elizabeth River) and at the mouth of Reichardt and Blessers Creeks (Palmer 2010).	7-41
7.4.1	Conclusions (Nearshore)	367	While coastal dolphins, dugongs, marine turtles and sawfish are known to occur in Darwin harbour, no significant breeding areas or feeding grounds have been identified for these species in the nearshore development area	Northern Territory Government data shows that the area may be significant for coastal dolphins. Relevant sighting data from the Northern Territory Government would help to inform this. Specific sighting locations indicate that Indo-Pacific humpback dolphins have been	

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				predominantly recorded around East Arm (Elizabeth River) and at the mouth of Reichardt and Blessers Creeks and foraging was the dominant behaviour (Fortune et al 2009; Palmer 2010). The Indo-Pacific bottlenose are recorded around at the mouth of Reichardt and Blessers Creeks and foraging was the dominant behaviour (Palmer 2010). Specific sighting locations indicate that mother/ calf pairs of Indo-Pacific humpback dolphins are recorded predominantly around East Arm (Elizabeth River) and at the mouth of Reichardt and Blessers Creeks (Palmer 2010).	

Chapter 8 Terrestrial impacts and management

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8.3.1	Vegetation clearing	387	The area of MVF on Blaydin Point represents about 4% of MVF in the Darwin Harbour and 1% of Darwin region.	Based on spatial data of rainforest vegetation in the NT (i.e. same data as used in the draft EIS), the Blaydin Point MVF is significant: within 5 km radius the patch represents 20% of MVF and is ranked the second largest patch; within 10 km radius represents 11% of dry MVF and is ranked the second largest dry MVF patch; within 20 km radius represents 4% of dry MVF and is ranked the tenth largest patch; within 50 km radius represents 1% of dry MVF and is ranked the 27th largest patch.	8.6
8.3.2	Alteration of habitat	391		The potential alteration to mangroves from the proposed dredging should also be mentioned in this section. Additionally, there is the potential for alteration of Mangroves vegetation due to changes in the amount of freshwater during the wet season discharging from adjacent land (e.g. storm water management). A decrease in freshwater has the potential to increase soil salinity and potentially reduce the number of mangroves species (Ball 1998).	

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8.3	Table 8-6	391		"Potential Impacts" (Table 8-6); the discovery/disturbance of unrecorded prescribed archaeological (Aboriginal heritage) sites that are protected under the Heritage Conservation Act. Included under "Management controls / mitigating factors" should be education of all construction workers as to what a site (e.g. a midden) may look like and / an archaeologist and/or Larrakia representative to be present when clearing activities taking place. There is a moderate chance that vegetation clearing will reveal more sites, given the relatively dense vegetation cover in this area and the history of sites being revealed by clearing works previously.	
8.4.3	Air Emissions Operations phase	399		Comments relevant to air emissions for the onshore phase are detailed in the Appendices section of this submission (Appendix 19).	

Chapter 9 Greenhouse Gas Management

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9	Greenhouse gas management	416		The NT Government recognises that climate change is a serious environmental threat with significant social and economic impacts. The proposed INPEX Ichthys Gas Field Development Project will result in greenhouse gas emissions of a very high order. It is estimated by the proponent that the project will result in net greenhouse gas emissions of approximately 7 Mt of CO2 per annum over its 40 year life. Of this, 5.2 Mt of CO2 per annum will be emitted in the Territory (the remaining emissions will count against Commonwealth territory). These estimated emissions represent approximately 31.87% of the total annual greenhouse emissions from the Northern Territory[1] in 2008. Although the price of emission permits under an Australian emissions trading scheme will be set by the market, the estimated annual emissions from this proposal could be valued at approximately $119,600,000[2], based on the projected price for the Australian Government's proposed Carbon Pollution Reduction Scheme (Australian Government, 2008). This represents an indication of the potential economic cost of	

[1] Australian Government Dept of Climate Change (2008) State and Territory Greenhouse Gas Inventories 2010.

[2] Under an Australian emissions trading system the price of carbon pollution permits will be set in the market.
Ultimately, the price for permits will depend on a number of factors, including the national emission trajectory, scheme coverage and international linking, and the costs of emission reduction opportunities. However, modelling by Treasury for the Australian Government suggests that, in the context of efficient market-based global action to stabilise greenhouse gas concentrations, the initial emission price could be in the order of A$23/t CO_2-e.

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				the proposal from a greenhouse emissions perspective. The proposal has very significant implications for the emission of greenhouse gases.	
9.11		429		The Northern Territory Government will continue to discuss greenhouse gas offsets opportunities with INPEX.	

Chapter 10 Socio-economic Impacts and Management

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10	Management of Aboriginal Cultural Heritage	457 - 458		In order to avoid inadvertent disturbance of prescribed archaeological sites and thus breaching of the *Heritage Conservation Act*, an adequate distance would be 50m, not 10m from the external boundary of an Aboriginal heritage site, that triggers INPEX to flag and fence off that site and provide education and coordinates to contractors prior to works commencing - 10m is an inadequate distance when large machinery is being used.	
10	Outcome of risk assessment	485	The project facilities have been designed to minimise the risk to public safety associated with accidental events such as major hydrocarbon leaks or explosions.	The draft EIS does not outline the major catastrophe risks and possible catastrophe scale for either the offshore or onshore components of the project. It is necessary to understand the extent and duration of unlikely worst-case events. Include discussion of acceptable buffers between event sites and areas of occupation.	

Chapter 11 Environmental management program

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11	Environment management plans		General comment	Although much of the detail still remains to be completed, the management plans lack clear measurable outcomes. In setting up a monitoring plan, it is essential to have site-specific, measurable, attainable and realistic objectives. The development of a physical and biological monitoring plan needs to take the following into account: (1) defining site-specific monitoring objectives; (2) identifying components of the monitoring plan; (3) predicting responses and developing testable hypotheses; (4) designing survey and sampling methods; and (5) identifying management options. Baseline study needs to work towards/answer these questions. It is recommended that all baseline studies, monitoring programs and management plans are submitted for peer review before they are put into place to ensure they have clear, measurable and auditable outcomes. Collected data also need to be submitted at regular intervals to allow peer review of management actions.	
11	Environment management program	503	Table 11-5	Soft-bottom benthos monitoring program and intertidal sedimentation programs need to specifically mention seagrass habitats and broaden monitoring areas to the impact footprint identified through hydrodynamic modelling and sediment modelling in addition to East Arm and/or dredge spoil disposal areas.	

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Chapter 11 Annexe 1	Provisional Acid Sulfate Soils Management Plan			The Draft EIS indicates that detailed Acid Sulfate Soil (ASS) documentation will be developed for the construction phase and that the URS soil study will be supplemented with detailed geotechnical studies including tests for Potential Acid Sulfate Soils (PASS). Of particular concern is the large quantity of (PASS) to be disturbed, more than 1.5million tonnes (Draft EIS; p383). Sampling by the proponent supports published NRETAS information that shows that some of this material is potentially highly acidic and disturbance will pose a significant environmental risk. A separate ASS Management Plan needs to be developed to the satisfaction of NRETAS prior to the commencement of detailed geotechnical investigations. In addition to those stated in the Draft EIS and other supporting documentation, NRETAS requires the following issues to be addressed by the ASS Management Plan: • Safe storage and transport of large quantities of lime (in excess of 15000 tonnes) for PASS neutralisation. • Table 9, URS report (2009) "*Icthys Gas Field Development Project: onshore topography, geology, geomorphology ad soils study"* shows the liming rate to achieve neutralisation ranges from 2.2 to 140 (average 30.1) kg pure $CaCO_3$ / tonne of PASS material. The neutralisation of the 10,800 tonnes (7200 m^3) of highly acidic mangrove soils requiring up to 420 kg aglime / tonne would need some 4500 tonnes of aglime. Based on the lowest rate of 6.6 kg aglime / tonne, neutralising 1.5m tonnes of lowest acidity PASS would require 9900	

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				tonnes of aglime. Using the median liming rate of 17 kg aglime / tonne this rises to 25500 tonnes of aglime. • If neutralisation of PASS is proposed the proponent needs to a) demonstrate the effectiveness of the method(s) used to mix/incorporate lime with the large quantities of PASS material to be disturbed by excavation activities; and b) include a program of ongoing monitoring into the continued effectiveness of this process. • Clear definition of an ASS "incident" which recognises that incidents can arise outside the nominated monitoring cycle – such as encountering PASS when none were expected, • Demonstrate that staff will be trained to recognise an ASS incident outside any monitoring program. • Results of the detailed geotechnical investigations need to be included and specifically addressed. • An ASS management plan needs to include management of PASS material during transportation, for example how to respond to and manage ASS issues following an accident involving a vessel or vehicle transporting PASS material either on and off site whether or not a spill results. • Offsite PASS storage or disposal areas require site specific ASS management plans that are integrated with the project ASS plan. • The ASS Management Plan must be clearly integrated with other interrelated management plans such as the o Transport Management Plan –	

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				accidents/spills involving vehicles or vessels transporting PASS material, wash down area, leakage material on route; o Waste (Hazardous) Management Plan – acidic leachate; and the o Dredging and Dredge Spoil Disposal Management Plan. • ASS monitoring to include areas outside the development footprint – for example placing large quantities of fill onto ASS soil can result in a mud wave that causes PASS material to be exposed to oxidation. • Clear timetable for the periodic review of the project ASS Management Plan, site specific ASS management plans and related management plans in consultation with NRETAS. • Include a framework for reporting all ASS incidents and the results of monitoring programs for review by NRETAS. The Northern Territory recommends the guidelines developed by the Queensland Acid Sulfate Soils Investigation Team (QASSIT). http://www.nrw.qld.gov.au/land/ass. The ASS management plan must demonstrate that disturbance of ASS will be managed to avoid environmental harm. NRETAS requires the proponent to: • Undertake sampling in accordance with the "Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS)" (QASSIT, 1998).	

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				• Laboratory analysis is to be undertaken in accordance with the "Acid Sulfate Soils Laboratory Methods Guidelines" (QASSIT, 2004), either S-POCAS (Suspension-Peroxide Oxidation Combined Acidity and Sulfate) or CRS (Chromium Reducible Sulfur). Some of these Laboratory methods are included in Australian Standard AS4969 released in June 2008. • Prepare an ASS management plan based upon the "Queensland Acid Sulfate Soil Technical Manual - Soil Management Guidelines" (QASSIT, 2002).	
Chapter 11 Annexe 4	Provisional Cetacean Management Plan	531	Monitoring	A monitoring program rather than an incident reporting program should be presented. To evaluate the impacts on coastal dolphins in Darwin Harbour a monitoring program should be based on a pre-impact, construction-phase and operational-phase population assessment.	
Chapter 11 Annexe 4	Provisional Cetacean Management Plan	531	Reporting, auditing and review	It is acknowledged that the provisional plan will contain details as it is developed further. Monthly reporting of any incident to relevant authorities is expected.	
Chapter 11 Annexe 6	Provisional Dredging and dredge spoil disposal management plan	542	1.2 Potential impacts - Surveys of habitats and biological communities in key areas ….	Surveys conducted were inadequate to assess possible impacts from dredging and dredge spoil disposal. Further, they were not comprehensive and excluded key habitats such as seagrass meadows and subtidal benthic environments.	

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Chapter 11 Annexe 6	Provisional Dredging and dredge spoil disposal management plan	540-543		1) This section aims to mitigate against dredging impacts. In item 1.2, point number 5 lists accidental entrainment of marine fauna – but provides no mitigation or observation methods. 2) In section 2, Table 2-1 states that indicators will include: marine protected species observations and incident records – however there are no methods provided for this. It is extremely difficult to detect marine fauna entrainment in dredges and it requires a dedicated approach and techniques. The proponent needs to outline the detection approach in this section.	
Chapter 11 Annexe 6		543	Table 2-1	Significant hard coral mortality needs to be defined. See comments on coral monitoring (p 325 - 326).	
Chapter 11 Annexe 6		543	Table 2-1	Needs to add seagrass as a significant habitat.	
Chapter 11 Annexe 6		543		Information for subtidal, soft-bottom monitoring needs to be provided.	
Chapter 11 Annexe 6		544		See comments above relating to coral monitoring (pages 325 – 326).	

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Chapter 11 Annexe 6	Provisional dredging and Dredge spoil disposal management plan 4.1 coral monitoring	544	"Coral monitoring at South Shell Island and at a coral community off the north east coast of Wickham Point will investigate the degree of resilience of corals in East Arm to exposure to sedimentation and elevated turbidity. Plume dispersion modelling indicates that these communities will intermittently be exposed to turbid plumes but that there will be little, if any, sediment accumulation." Section 4.1 Coral monitoring (page 12).	If the modelling indicates that "there will be little, if any sediment accumulation" – then it will be very difficult to investigate the degree of resilience of corals in East Arm to sedimentation. In meeting with the proponent, the corals in these areas were considered to be at high risk of being lost, particularly at South Shell. It should be stated in the Supplement that monitoring will be used to validate the model outputs. Also, there is no indication in the Management Plan that the increased level of sedimentation due to the dredging activities will be measured / monitored. Section 4.1.1 Water-quality baseline monitoring program describes where and how turbidity, salinity and temperature will be measured and how trigger levels will be set (pages 13-15).	0-1
Chapter 11 Annexe 6	(Provisional Dredging and Dredge Spoil Disposal Management Plan 4.1.2 - Reactive coral monitoring program	546	"The reactive coral monitoring program focuses on measurements of turbidity rather than sedimentation. The latter cannot be measured in a way that accurately represents the degree to which corals are exposed to stress—sediments settle from the water column on to corals during slack tide periods (when current flow is minimal) but are then remobilised into the water column as tidal currents increase."	The proposed reliance on water turbidity as a response variable for coral monitoring is inadequate. According to the published literature, the reaction of a coral colony to increased water turbidity, suspended sediment concentrations and sedimentation rate is a complex process. Corals experience stress from high suspended sediment concentrations (polyps) and their effects on light attenuation (algal symbionts). Enhanced sedimentation causes smothering and burial of coral polyps, shading, tissue necrosis and population explosions of bacteria in coral mucus. Fine sediments have greater effects on corals than coarse sediments. Sedimentation also reduces the recruitment, survival and settlement of coral larvae. It is well documented that sedimentation from dredging constitutes one of the biggest potential sources of reef degradation (Johannes 1975, Dahl 1985, Rogers	0-2

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				1985; Bothner, Reynolds, Casso, Storlazzi, and Field, 2008; Carr and Nipper, 2008; Elias, Storlazzi, Field and Presto, 2010). Rogers (1990) in her literature review analysed the number of coral responses to sediment application both in the field and laboratory. Lewis (1995) demonstrated in the experimental conditions that in the relationship between turbidity and suspended solids concentration can be linear when grain size is constant, but when grain size varies as a function of concentration, the turbidity response will have a non-linear form. Therefore it is crucial to construct the relationship between turbidity and suspended solids concentration for each location and for each distinct hydrological condition (Reservoir sedimentation Handbook, Morris & Fan, 1997).	
Chapter 11 Annexe 6	4.1.2 Reactive coral monitoring program	546	"The reactive coral monitoring program focuses on measurements of turbidity rather than sedimentation. The latter cannot be measured in a way that accurately represents the degree to which corals are exposed to stress—sediments settle from the water column on to corals during slack tide periods (when current flow is minimal) but are then remobilised into the water column as tidal currents increase."	The key potential mechanism of impact on coral communities – settling sediments - is disregarded in the reactive monitoring program. The reason given for that is unsupported by the published literature. The perception of processes of sediments settling/resuspending in a coral environment is far too simplistic - "*sediments settle from the water column on to corals during slack tide periods (when current flow is minimal) but are then remobilised into the water column as tidal currents increase".* The presence of coral colonies alters bottom profile and current flow. Mucus production by coral polyps is the only reaction observed at high levels of siltation (Fabricius & Wolanski 2000). Mucus trapping tends to delay clearing of detritus from the polyp surface (Johnson 1987). The implementation of turbidity and "coral health" monitoring will not provide appropriate	0-3

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				protection for the Channel Island coral community. • The terms “coral health” and “coral condition” are both ill-defined in the proposed Reactive Monitoring Program (Section ‘Assessment of coral condition’, page 548). It is impossible to understand if in fact, “mortality will be scored” or some parameters of coral health will be assessed. • Turbidity is a measurement of the decrease in transparency of water as light is scattered by suspended particulate matter (Ziegler 2002). • Relying entirely on turbidity predictions of sediment loads may have substantial limitations, including issues with equipment and physical characteristics of environment. As stated by Ankcorn (2003), “*turbidity is not an absolute value, but a relative value representing a qualitative measurement that can yield different readings based on the method used*.” • Turbidity readings may vary between locations due to water colour and suspended particle size and composition. Due to the logarithmic relationship, slight changes in total suspended solid (TSS) concentration have large effects on a turbidity reading. This is probably due to natural variability in suspended solids size, shape and composition as well as water color. (Packman et al. 1999). When particle sizes are changing, one might expect the usefulness of turbidity as a surrogate for TSS concentration to be limited. Variability in particle size can result from changes in source materials or other factors. If source materials are changing, there could be considerable variability in turbidity for a given suspended solid concentration (Lewis 2002).	

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				• Organic particles have been shown to absorb light, and therefore provide different turbidity values than mineral particles (Lewis 1996). In a number of studies of suspended sediment concentrations and sedimentation in coral environments; sedimentation rate was successfully and accurately measured with a variety of methods. (Ridd, 1992; Larcombe et al. 1995; Bale, 1998; Ridd et al., 2001; Thomas, 2002; Thomas, Ridd, Day, 2003; Draut et al. 2009; Elias et al., 2010). A good review of the number of methods available to measure sediment accumulation over a short-term period (order of days to months) is made by Thomas & Ridd (2004). Sediment accumulation was assessed during several dredging projects in Australia: • Port Hedland Harriet Point dredging referral document http://www.bhpbilliton.com/bbContentRepository/docs/mangroveManagementPlan.pdf • Hay Point, Mackay - Dredging and Spoil Disposal http://www.gbrmpa.gov.au/corp_site/management/eim/project_examples/hay_point • Gladstone Ports Corporation Port of Gladstone Western Basin (Queensland) Strategic Dredging and Disposal Project Initial Advice Statement March 2009 http://www.dip.qld.gov.au/resources/project/port-gladstone/initial-advise-statement.pdf • Shute Harbour Dredging, Environmental Assessment & Monitoring Program, Whitsunday Shire Council	

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				http://www.frc-environmental.com.au/new/dredge.html • Ecological Monitoring of Kirra Reef, Gold Coast; NSW Dept. Public Works http://www.frc-environmental.com.au/new/dredge.html Given the importance of this habitat in Darwin Harbour, it is essential to include sedimentation rate measurement in any "Coral Monitoring" program associated with this development.	
Chapter 11 Annexe 6	4.1. 2 Reactive coral monitoring program	546	"Baseline assessment of coral communities" "Coral condition will be assessed using the same general approach as that adopted for the East Arm Wharf monitoring program (GHD Pty Ltd 2002) and the Bayu–Undan to Darwin Pipeline Project".	No descriptions of how coral communities' condition will be assessed (and what the authors mean by "coral condition") is given in this section. A reference to a GHD 2002 report is provided but it is unclear if the line-intercept method will be used to assess live percent coral cover or another technique. It is important to specify the method being proposed.	0-4
Chapter 11 Annexe 6,	Turbidity measurments	547	2 turbidity probes will deployed	The EIS needs to justify why only two turbidity probes are used to describe and monitor turbidity. Turbidity is highly spatially variable and is dependent on local currents and local substrate types.	
Chapter 11 Annexe 6	Turbidity measurement	547	Aerial surveys of turbidity	Explain how the aerial survey information would be used and compared with hydrodynamic modelling results. A descriptive assessment is not considered appropriate. A two week aerial survey is considered inappropriate as it does not take into account the meteorological conditions that are variable from day to day, and season to season.	

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Chapter 11 Annexe 6	4.1.2 Reactive coral monitoring program	547	"Monitoring will be focused on hard corals of three genera"	The EIS needs to justify the selection of coral taxa for monitoring. All three taxa represent corals resistant to high turbidity and low light. This inevitably will reduce the sensitivity of this monitoring to detect changes in coral conditions because of altered turbidity and light. In addition, *Mycedium elephantotus* abundance at Wickham Point is low; *Herpolitha limax* and other Fungiidae corals have extremely low abundance at Wickham Point and Channel Island; corals from genus Turbinaria virtually absent at Channel island and not rare in other coral communities (Darwin Wharf Project Coral Monitoring – 2006 Post Dredge Survey). This may lead to difficulties in locating 25 colonies of each taxa necessary for monitoring and hinder monitoring program success. Based on the above, the following species should be included in any coral monitoring associated with the development: 1) Inclusion of sensitive to low light and high turbidity coral species and, 2) Inclusion of more common widespread species from Favids, Pectinids and Acroporids corals	0-5

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Chapter 11 Annexe 6	4.1.2 Reactive coral monitoring program	547	"Two weeks prior to the start of dredging works at the gas export pipeline shore crossing, one turbidity logger will be deployed at the Channel Island coral community and another at the Weed Reef reference site."	The timing and intensity of sampling is insufficient to detect changes associated with the dredging. The use of a single turbidity logger at the site will not allow assessment of high spatial variability in turbidity at the site. This design will only allow assessment of turbidity changes through time for the point where the logger is located. Therefore, it is suggested that at least three, randomly-placed loggers at each site should be deployed as part of a pilot study. Power analyses could then be conducted using the data to inform the number of loggers required for meaningful turbidity measurement. Bynoe Harbour should be considered as a reference site.	0-6
Chapter 11 Annexe 6	4.1.2 Reactive coral monitoring program	547	"Aerial surveillance of turbid plumes arising from dredging activities at the pipeline shore crossing will also be undertaken. This will occur during daylight hours on every second day over the first two weeks of dredging. Aerial surveys will be carried out at mid flood tide, when plume excursion "upstream" from the shore crossing would be at a maximum."	The use of aerial surveys for only two weeks to monitor plume impacts in Darwin Harbour is considered inadequate because of complex hydrodynamics and intensive tidal water movements. Very high patchiness is typical for turbidity plumes in the harbour. According to "Predicted suspended –sediment concentrations at East Arm coral sites during the dredging program" Table 7-30, page 127, Chapter 7 "Marine Impacts and Management" the percentage of time during which concentrations will exceed a background level during the dredging program is extremely low – ranging from 2.33% at South Shell Island to 0.01% at Weed Reef.	7-29

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Chapter 11 Annexe 6	4.1.2 Reactive coral monitoring program	548	"Each photograph will be overlain with an 8 × 8 grid and the points scored for mortality."	More information should be provided for the coral monitoring program on the following issues: 1) An explanation of the procedure "scoring for mortality". References to published techniques must be given. Explain how a score will distinguish between freshly dead and live coral colony tissue – this is a key issue. 2) The phrase "photographs scoring may not be performed at all" creates a degree of uncertainty and conflicts with earlier statements in the section "Baseline assessment of coral communities". On page 16 the draft EIS states: "If visibility permits, a photographic record will be made of the colonies and the surrounding coral communities. If turbidity levels are too high to permit photography, a semi quantitative assessment of coral condition will be recorded from diver observations." A description needs to be given for "semi-quantitative assessment of coral condition" technique.	7-29
Chapter 11 Annexe 6		549	Post dredging monitoring will occur if "significant levels of coral mortality are recorded at Channel Island relative to reference site"	Monitoring should also continue for a reasonable period post dredging. This is particularly the case given that high suspended solid concentrations are predicted in later phases of the dredging program.	
Chapter 11 Annexe 6	Provisional dredging and dredge spoil disposal management plan	550		There are very few details, apart from incident reporting, on what monitoring information would be reported and made available to the public or to NRETAS. Further details are needed.	

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Chapter 11 Annexe 6	Provisional dredging and dredge spoil disposal management plan			The current EMP does not provide enough information about the biogeochemical properties of dredged sediments. Sediment studies and water quality monitoring need to be undertaken at the proposed dump site using relevant parameters monitored in previous programs. The monitoring program for the dump site should be undertaken prior to, during and post construction to determine the impact that dredged sediments will have on the site and adjacent areas. Additionally, water quality and sediment monitoring will need to be undertaken in the harbour and spoil disposal site during dredging to assess the implications of acid sulphate soil disturbance or the release of arsenic from underlying geology.	
Chapter 11 Annexe 8	Provisional Greenhouse Gas Management Plan	563	Similar options are being assessed by INPEX although at this stage the offsets are not recognised under the Kyoto Protocol and are therefore not compliant with the Commonwealth Government's proposed Carbon Pollution Reduction Scheme.	While there are no savanna burning offset projects currently recognised under the Kyoto Protocol mechanisms, emissions from prescribed burning of savannas, and abatement from improved management, are counted towards Australia's international commitments under the Kyoto Protocol. Although national climate change policy is uncertain, the most recent expression of policy intent with the Carbon Pollution Reduction Scheme stated that CPRS permits would be provided for abatement from the burning of savannas along with a range of other land management activities, subject to the development of robust methodologies. See: http://www.climatechange.gov.au/government/initiatives/cprs/~/media/publications/cprs/CPRS-Implementation-of-Nov09-changes-pdf.ashx More recently, the Australian Government	

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				announced as part of its election platform its intent to introduce the Carbon Farming Initiative. The scheme is intended to facilitate the sale of carbon credits on domestic and international markets by legislating clear rules for the recognition of carbon credits. The Australian Government states that a range of projects could be eligible, including savanna fire management. See: http://alp.org.au/agenda/more---policies/carbon-farming-initiative/	
Chapter 11 Annexe 9	3.3 Provisional Heritage Management Plan	568		In order to avoid inadvertent disturbance of prescribed archaeological sites and thus breaching of the *Heritage Conservation Act*, an adequate distance would be 50m, not 10m from the external boundary of an Aboriginal heritage site, that triggers INPEX to flag and fence off that site and provide education and coordinates to contractors prior to works commencing - 10m is an inadequate distance when large machinery is being used.	
Chapter 11 Annexe 10	Monitoring	582		There is a need for a suite of relevant ecotoxicological tests for water and sediment to be developed for use in the event of a spill and wastewater discharges. It is expected that monitoring requirements will be included as license conditions. Development of a basic conceptual model is an integral part of the assessment process. A conceptual design for ecological and human health risk assessment should be developed. The EMP also discusses a groundwater study conducted by URS, but INPEX makes no commitment to monitor the groundwater bores during construction and operation phases. Corresponding surface water monitoring points should also be monitored. Regional	

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				Groundwater Dependant Ecosystems (GDEs) should be identified and their reliance on inputs from current groundwater regimes assessed. An assessment of GDEs is critical given URS's claims of changes in groundwater regimes pre- and post-development. Further consideration should be given to establishing baseline data now, given claims of the transmissivity of sands in the Bathurst Island Formation and highly fractured units of the Burrell Creek Formation. Groundwater and surface water monitoring of this nature will be required under the *Waste Management and Pollution Control Act* during the operational phase. More information should be provided in the supplement regarding investigation of options for artificial recharge of groundwater (or, if not a feasible option, this should be clarified).	
Chapter 11 Annexe 12	Provisional Piledriving and Blasting Management Plan	596	Confined blasting methods will be used with micro delays etc	Currently there is no evidence presented in the draft EIS that micro-delays reduce underwater blast impacts. Micro-delays are understood to be an important part of the blasting action and should not be considered an impact mitigation measure.	
Chapter 11 Annexe 12	Provisional Piledriving and Blasting Management Plan	596	3.1 - Trained marine fauna observers…	Two species of coastal dolphins are recorded near the blast zones. These species are cryptic and difficult to see and when combined with the muddy, turbid water and low surfacing profile can make these species extremely difficult to sight. The current proposal provides no certainty that dolphins would not be present in these fauna protection zones. This increases the risk to coastal dolphins, particularly over the full duration of blasting.	

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Chapter 11 Annexe 12	Provisional Piledriving and Blasting Management Plan	596	3.1 - For effective surveillance…	Two species of coastal dolphins are recorded near the blast zones. These species are cryptic and difficult to see and when combined with the muddy, turbid water and low surfacing profile can make these species extremely difficult to sight. The current proposal provides no certainty that dolphins would not be present in these fauna protection zones. This increases the risk to coastal dolphins, particularly over the full duration of blasting.	
Chapter 11 Annexe 12	Provisional Piledriving and Blasting Management Plan	596	The potential to use passive acoustic monitoring (PAM)	PAM 's effectiveness requires dolphins to be vocalizing and dolphins do not vocalize continuously (Van Parijs, S. M. & Corkeron, P. J. 2001). It is understood that the use of PAM and active acoustic monitoring (AAM) is being investigated by INPEX. NRETAS expects that the findings, as well as the methodologies for determining the effectiveness of these technologies for targeted species, will be presented in the EIS.	
Chapter 11 Annexe 12	Provisional Piledriving and Blasting Management Plan	596	3.2 - A watch will be maintained etc	Three species of coastal dolphins are recorded in and near the pile driving locations. These species are cryptic and difficult to see and when combined with the muddy, turbid water and low surfacing profile can make these species extremely difficult to sight. The current proposal provides no certainty that dolphins would not be present in these fauna protection zones. This increases the risk to coastal dolphins, particularly over the full duration of blasting.	
Chapter 11 Annexe 12	Provisional Piledriving and Blasting Management Plan	597	4 Monitoring	As for above, insufficient information has been presented in the draft EIS. More detail will need to be provided in the EIS on techniques and protocols to ensure the safety of megafauna when blasting. Alternatives to the proposed blasting program need to be explored in depth.	

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Chapter 11 Annexe 12	Provisional Piledriving and Blasting Management Plan	597	4 - Responses to large marine animals within the designated fauna protection zones	Two species of coastal dolphins are recorded near the blasting locations. These species are cryptic and difficult to see and when combined with the muddy, turbid water and low surfacing profile can make these species extremely difficult to sight. The current proposal provides no certainty that dolphins would not be present in these fauna protection zones. This increases the risk to coastal dolphins, particularly over the full duration of blasting.	
Chapter 11 Annexe 12	4 Monitoring	597 - 598		Triggers are currently too vague and would need to be developed in a lot more detail. Responses to adverse findings occur only during an annual review, which is too infrequent. Management of a serious incident such as death or injury to listed / protected species includes 1) reporting and 2) refresher training. Blasting is a controversial issue and there needs to be clear guidelines on what is acceptable and how incidents would be handled. The triggers are very vague and the description of what constitutes an incident is also vague.	
Chapter 11 Annexe 12	Provisional Piledriving and Blasting Management Plan	598	5 - Reporting auditing and review	Reporting, auditing and review need to be undertaken at least quarterly. Monthly reporting of any incident to relevant authorities is preferred. This may enable methodological changes to occur if incident levels are unacceptable.	

Appendices

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4	5	Water Quality and Marine sediments			There is no discussion and comparison with other studies and findings.
4	3.2	Marine ecology	16	Surveys show that the seabed at the Ichthys Field is generally flat with shallow sand waves; few epibenthic communities were recorded.	Evidence to support this statement is limited. Data was collected using ROV and towed video and the number of sample sites is low and unlikely to account for the patchy nature of distribution of epibenthic communities. The data presented is descriptive and does not allow statistical analysis and comparison of sites. This chapter should incorporate data from other studies and discuss its findings with other studies completed for the North-West shelf. (e.g. Brewer et al 2006 and Baker et al 2008).
4	3.2	Browse reef	20	Figure 3.3	As stated previously, this is not a habitat map. It is primarily a geomorphological (substrate) map as there is no community data presented.

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4	4.2.1	Information review	27	Various data sets are named and used for site selection	These data need to be presented. In particular, maps and interpretation from multibeam and side scan data needs to be presented as they form the basis for site selection. This chapter needs to incorporate data from other studies and discuss its findings with other studies completed for the North-West shelf. (eg Brewer et al 2006 and Baker et al (2008). The reason why so few sites were selected needs to be explained, as the existing bathymetry shows there are numerous other sites that could have been equally as important as the ones chosen for this study. Further, sites only appear to have been chosen in areas where there is change in bathymetry. This seems appropriate for understanding the nature of the seabed in regards to laying the pipeline, but is not necessarily appropriate for a systematic description of marine epibenthic biodiversity.
4	4.3.1	Results pipeline survey	30	Summary: The greater part of the proposed pipeline route encompasses featureless, unconsolidated clay–silty sands with low benthic diversity. Areas of hard substrate host benthic fauna that is common throughout the region, including soft corals, gorgonians and sponges.	To understand the importance of hard substrate vs soft substrate, the proportion between unconsolidated and consolidated substrates needs to be discussed. In general terms, hard substrates contain roughly 80% of biodiversity. Consequently, losing small areas of hard substrate may lead to substantial biodiversity loss. The methods used to semi-quantitatively assess the under water environment are unclear as is the number of sites sampled to describe the epibenthic fauna. The data presented are descriptive and are not sufficient for comparison between sites. To establish effective monitoring programs, more detailed studies will have to be undertaken.

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5	5	Exec Summary	vi	This report describes the configuration and testing of these models.	Besides validating the model against collected data, the model needs to be reviewed against existing models for Darwin Harbour, including a clear discussion of its limitations and confidence levels for modelled outputs. The report has not discussed its performance for intertidal areas, including mangrove areas or shallow subtidal areas. This is important given that mangroves are depositional areas and sedimentation modelling is dependant on the performance of the hydrodynamic models in these areas.
5	Exec Summary	Marine ecology and benthic community study	ES1	The objective of the marine benthic ecology study was to undertake inspections and assessment of marine benthic habitats in selected sites in Darwin Harbour including areas adjacent to the plant site at Blaydin Point, the pipeline shore crossing in Middle Arm, at potential dredging locations in East Arm and the dredge spoil disposal area in Shoal Bay. These data were used to characterise the epibenthic biota and burrowing (infauna) communities present in these areas to provide biological input to the environmental impact statement (EIS) document and assist in the assessment of project impacts.	This report has not provided sufficient information to allow mapping and analysis of existing biodiversity / seabed habitats. The information provided does not allow an assessment of the status and condition of seabed habitats, seagrasses and benthic biodiversity in the complex ecosystem of Darwin Harbour and surrounding marine environments. It does not provide baseline data that will allow the establishment of benchmarks and performance indicators for feedback to management, or facilitate risk assessment and detection of anthropogenic impact in seabed ecosystems (e.g. dredging/ dredge spoil disposal) among the range of other natural environmental variability. Additional surveys need to be conducted to describe benthic communities that will allow robust analysis of community structure; comparison between sites; and allow for mapping the extent of broad community types.

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5	2.2	BFHYDRO model	7	Darwin Harbour is well stratified during the dry-season	This statement conflicts with the general perception of Darwin Harbour ecosystem function. For example, Williams et al (2006) note that Darwin Harbour is well mixed (not stratified) during the Dry. This statement needs clarification.
5	2.2	BFHYDRO model	7	However, due to the magnitude of the tidal currents, the water column typically remains stratified with only relatively small changes in salinity extending as far upstream as the back of East Arm, except during occasional and short-lived rainfall events (Duggins 2006, NRETA 2007)	This statement needs clarification. Other reports and publications suggest that freshwater input into Darwin Harbour can stratify harbour waters, and persist up to several weeks after a large rain event (e.g. Williams et al 2006).
5	3.3	SWAN model	32	On the other hand, an analysis of the wave parameter magnitudes supported the conclusion that wave processes would not typically provide efficient forcing for resuspension of finer particles under non-cyclonic conditions, and thus would play a minor role in sediment transport in Darwin Harbour and in Beagle Gulf.	The draft EIS notes that the sites used for validating the model(s) are in areas with substrates dominated by relatively course sediment types. Further, the sites are all in relatively deep water, where wave action would have little impact on seabed substrate. The model requires a suitable site to verify this statement. Wave induced resuspension of fines will most likely occur in shallow environments (mangroves, mud/sand flats). Consequently the review has only partially fulfilled its aim and needs further verification in the EIS.
8	1.2.2	Nearshore Marine Ecology and Benthic Communities Study	2	“current condition of biological communities potentially at risk from the development was identified.”	Methods used in the field study don’t allow assessment of conditions of biological communities. A more comprehensive description of ambient factors and community components is required.
8	1.2.2	Scope of Works: Literature review		Scope of works	The outcomes and discussion from the literature review, and the list of external and internal data that were used to assist in characterising marine habitats, should be provided.

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8	2.1	Survey design and information review		Surveys were then planned and conducted to identify significant benthic communities (e.g. coral and macroalgae) in the impact areas and compare them to known locations of significant communities.	The purpose of the surveys was to describe seabed habitats and characterise epibenthic fauna and flora communities. The EIS needs to define 'significant communities' and clarify why they are considered significant. The methods used are descriptive and do not allow quantitative assessment of community composition within Darwin Harbour. To allow comparison between sites, a minimum of six sites (transects with replication) would be needed to allow some form of robust analysis. This survey design must enable the following: (1) A comprehensive and adequate assessment of spatial distribution of assemblages. There are currently no maps presented with the extent of assemblages found in Darwin Harbour. Site selection seems to be based on prior knowledge and areas primarily targeted with preconceived ideas of what constitutes a significant habitat. (2) An assessment between sampled sites to identify if any areas are more important (for what ever reason) than others. The survey design only allowed site inspections of the foot print of the development but failed to include an assessment of seabed communities within impact areas that have been identified by hydrodynamic modelling and sediment modelling. This section must present existing data or combine existing data with collected data to show existing knowledge. Macro algal communities appear to have been ignored.

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8	2.2.1	ROV surveys		Observations were made at all sites, noting substrate and epibenthic biota communities present. Abundances and identification of epibenthic taxa were carried out by URS personnel in the field, with further identification taking place at URS offices in Perth, Western Australia (41 ROV dives)	There are a number of uncertainties associated with the methods used. The EIS needs to explain: • How abundances from underwater video techniques were determined; • How these were calibrated against more robust techniques (eg line transects); • What the limitations are of this technique; and • What the taxonomic resolution using this technique is.
8	2.2.2	Diving surveys		Six sites were visited (Channel Island, two sites at Blaydin Point, South Shell Island, Walker Shoal and Weed Reef) with four 10 m transects used at each site (five at Channel Island) with video and still records taken.	Sampling intensity is low considering the scale of the impacts. The EIS needs to explain: • Why only six sites were sampled using transects; • Whether there was any replication; and • Why only hard substrates were sampled. A comprehensive sampling regime is required to allow establishment of a comprehensive baseline and therefore an adequate assessment of seabed community types to be undertaken for the harbour.
8	2.2.3	Drop camera			See comments above for the ROV method.
8	2.2.4	Benthic grabs		Samples were collected from three sites (G18 – G20) at the proposed jetty location off the east side of Wickham Point, nine sites (G21 – G29) at the pipeline shore crossing location on the west side of Wickham Point and 26 sites (G1 – G17 & G30 – G38) around the perimeter of Blaydin Point, to cover options for the location of the proposed module offloading facility	Sample sites chosen are only from within the development footprint; impact areas identified through modelling need to be included. Grab sampling is highly variable within a site; clarity is required on whether there was any replication within sites. The taxonomic level to which infauna were described should be explained.

Appendix	Section No.	Section name	Page No.	Relevant text draft EIS	Reviewer Comment
8	2.2.5	Dredge spoil disposal area survey		Results were recorded and interpreted in the field	Explain in the EIS what the results from these techniques were and the methods for obtaining these results (eg. data manipulation, interpretation). Sampling methodology and intensity must be suitable to permit quantitative assessment of benthic fauna (and flora); risk assessment; and development of monitoring programs. The current information does not demonstrate this.
8	2.2.5	Dredge spoil disposal area survey		Twenty-one sites were surveyed utilising a remote drop camera; one site per square kilometre within and around the soil disposal area boundary	The dredge spoil disposal area is 3 by 7 km, (i.e. 21 km2). One sample per km2 was undertaken. Explain in the EIS the number of sites outside the identified dredge spoil disposal area and how these overlapped with impact areas identified through modelling of sediments and hydrodynamics. Sampling methodology and intensity must be suitable to permit quantitative assessment of benthic fauna (and flora); risk assessment; and development of monitoring programs.
8	3.1	Summary of Results		A summary of the locations and observations from each of the surveys can be found in the following tables, attached at the end of this report	Results need to be provided for the following sampling methods: (1) side scan sonar and single beam acoustic; (2) multibeam; and (3) transect data.
8	3.1	Summary of Results		Site descriptions	Given that Walker reef/shoal has been identified as a major impact area (total loss of habitat), it is a major oversight that this reef has not been included in the assessment process, and has not been fully mapped, described and assessed against similar assemblages in Darwin Harbour. The EIS needs to contain this information.

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8	3.2.4	Nearshore Marine Ecology and Benthic Communities Study		Section 3.2.4 Benthic infauna (Technical Appendix 8 'Nearshore Marine Ecology and Benthic Communities Study ' contains statement that "the most abundant taxa were generally identified to nominal species within families or sub-orders (RPS 2007a)."	The study is not considered to be a sufficient description of the existing marine benthic community in Darwin Harbour and the dredge spoil disposal grounds. The report provides a list of some animals and plants found at different bottom substrates, but needs to show that the infauna organisms, including abundant crustaceans and polychaetes have been identified to nominal species level. This should be a basic level of reporting to ensure assessment of impacts and future monitoring can occur. Also, it is difficult to understand why epibenthic animals such as sea anemones, ascidians, and soft coral and nektonic fish have been categorised as "infauna". This category includes benthic fauna living in the substrate and especially in a soft sea bottom.
8	3.2.11	Dredge Spoil Disposal Area	12		Samples of the infauna should have been taken at the dredge spoil area. The justification for not sampling is an acknowledgment in the draft EIS that some destruction of the infauna at the dredge spoil site will occur. However, monitoring of the spoil ground is required to effectively monitor other areas that may be impacted by spoil disposal.

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8	3.3	Benthic Fauna and associated table		The sampling sites for infauna are shown in Figure 5: details of the infauna collected and identified are in Data Table 6. Diversity of major taxonomic groups ranged between six and 11 at each site i.e. per 0.15 m2	Identification of specimens is inadequate and does not allow robust analysis of community assemblages. Grouping into major taxonomic units may be the first step towards identifying where comprehensive sampling should take place, but is not adequate for community structure assessment. Diversity assessment is inappropriate at this level. Identification at Phylum level may only account realistically for 20% of the existing diversity, where as if specimens were identified to genus level, then 80% of existing biodiversity would be accounted for. Species identification should at the least be at a Family level, but preferably at a genus level.
8	3.3	Benthic Infauna	12	Diversity of major taxonomic groups ranged between 6 and 11 at each site	This statement would be meaningful if a taxonomic rank (e.g. Species, genera, family) was provided in the EIS.
8	3.3	Benthic Infauna	12	The total number of individuals identified was 416 from 17 families Table 3.1	This information is not tabulated. An indication of the families identified should be provided. It would seem that the lowest level of identification in the study was order to subclass (Table 3.1), not family. Family-level identification is the minimum level recommended for assessment of environmental impact in the marine environment (references can be supplied if required). This was done in the offshore survey (Appendix 4) but not for the Darwin Harbour survey. The study represented in Appendix 8 needs to be enhanced for the EIS.
8	4	Discussion		General content of the discussion	Comparisons need to be made between draft EIS findings and other study findings (eg Smit et al 2000, P&W reports, East Arm EIS report, Museum data).

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8	4	Discussion		diversity	Comparison of diversity between this survey(s) and other surveys is not valid. The methods used in the draft EIS will always have low diversity outcomes as only phyla or major taxonomic groups are used, where as in other surveys, identification was conducted to a lower taxonomic level.
8	4	Discussion		The proposed pipeline route within the harbour was found to have a very low abundance of epibenthic biota. This contrasts with the nearby Bayu-Undan pipeline which had a dense covering of soft biota together with numerous fish in areas where the pipeline was covered by rock armour or suspended above the seabed	This comparison is confusing. It is comparing two very different substrate types (hard substrate vs soft substrate). In all circumstances, hard substrates are more diverse than soft substrates. Further, this paragraph seems to infer that rock armour is preferable above the existing substrate type. This does not necessarily hold true and depends very much on how and for what reason the assessment takes place.
8	4	Discussion		Seagrasses were not recorded in this area, and are not likely to occur in waters of 15–20 m depth due to low light levels at the seabed	It is unlikely that sea grass meadows occur at this depth, however, dredge spoil modelling has shown that sediments will be deposited in known seagrass areas. Therefore surveys should be conducted to determine seagrass areas and to provide a baseline of seagrass health.

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8	4	Discussion		In conclusion, due to the low diversity and abundance of the benthic communities, the ecological significance of the proposed areas of disturbance has been found to be limited. More diverse and abundant benthic communities are present elsewhere within the harbour, e.g. Channel Island and Weed Reef, which lie outside the area of potential direct impact. The subtidal soft bottom communities were found to be relatively uniform in their composition and to be widely distributed through the harbour	This survey cannot be conclusive for the following reasons: (1) no areas outside the development footprint were surveyed; (2) biodiversity measures are not comparable with other studies; and results between methods are not comparable; (3) no studies have been conducted to determine the extent of existing seabed communities and therefore it cannot be stated with any confidence that a particular community type is widely distributed or not; and (4) survey design has not established the nature of patchiness of seabed communities and therefore cannot determine if the composition of seabed communities is uniform or not. The EIS needs to address these issues.
8	4	Discussion Nearshore Marine Ecology and Benthic Communities Study Appendix 8		"due to the low diversity and abundance of the benthic communities, the ecological significance of the proposed areas of disturbance has been found to be limited"	This statement is not supported by the data presented: no thorough, consistent studies of benthic communities composition (such as benthic fauna and flora density and biomass assessment) was undertaken, no thorough taxonomic identification of fauna was completed, sampling design chosen for field works was inappropriate and no statistical analyses were conducted to process the data (only percentage was calculated). The benthic communities' biodiversity and abundance assessment study needs to be a quantitative study.

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13		Dredging and spoil disposal modelling		"The three components of the dredging activity have been simulated individually and also in combination in the necessary way to simulate their overall effect." (page 16) "In the model simulations the fine material is released into the specific area (defined in Fig. 3) that the dredging activity is scheduled to occur." (page 17)	It is evident from the document that dredging plume simulated modelling has been conducted only for East Arm and not for the proposed pipeline route. Table 14 gives calculations of the mass of fine material loss during dredging activity for the pipeline channel approach – 11000m^3. Three coral communities: the heritage listed Channel Island coral community and another two coral communities unique to Darwin Harbour, Weed Reef and north-east Wickham Point, lie in close proximity to the pipeline channel. These are likely to be impacted by increased water turbidity and sedimentation resulting from dredging operations. Plume dispersion and sediment modelling for the area along the pipeline trench should have been presented in the modelling report (Appendix 13). Existing results are based on simulation when fine material was released into the specific, rather small area, Figure 3, page 17 (total length ~ 6000m).
15		Review on the effects of noise on marine fauna			The proponent needs to conduct noise modelling for the variety of noise generating activities in Darwin Harbour (pile driving, dredging, blasting, shipping, construction activities)
19 Onshore Air Quality study	5	Existing Environment			Information on the meteorological environment would have been enhanced by the inclusion of a discussion on dispersion meteorology. The reasons for specifically selecting meteorological data for 2005 should be explained. Is this year representative of average or worse-case meteorological conditions?
19	6	Background			The approach taken for background air quality

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		air quality assessment			assessment was to model all existing sources of emissions for the airshed. This is considered a valid approach in the absence of extensive ambient air quality monitoring data (which could otherwise be used to characterise existing air quality). It would be appropriate, however, for INPEX to implement an ambient monitoring program to verify the modelling predictions. NO_2 emissions from soil relies on Darwin rainfall data. As the modeling domain is fairly large and tropical rainfall displays extreme spatial variability, additional rainfall station data should have been used.
19	6.4	Shipping emission sources			The emission estimates from shipping are not clearly outlined or explained: • Section 6.4.2 describes how the commercial shipping emission estimates were derived and provides emission factors for all pollutants and emissions summary for NO_2, SO_2 and VOCs (Table 6-18). • Section 8.3.2 discusses shipping emissions for SO_2 only; and • Table 8-2 provides emission estimates from existing shipping for NO_2 and SO_2. Clarification is sought on what exactly was modelled. Clarify whether shipping was included in both the area-based emissions files and also as point sources for berthing in the harbour. The emission rates for berthing (Table 8-2) seem low and further information is requested on how these were derived.
19	7.1	Model selection			Generally, the TAPM model used by INPEX is

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					considered appropriate in the context of Darwin regional conditions and for a screening level assessment of photochemical smog formation (i.e. impacts from ground level ozone (O_3)). However, the EIS should provide justification for the choice of TAPM V3 rather than the more recent version TAPM V4. Previous versions of the model over-predict winds in the lighter range and hence under-predict the resultant adverse air quality impacts. The potential impacts would be better simulated with V4.
19	7.2	Model setup			The model setup as reported appears to be mostly adequate; however, the pollution grid selected is probably too coarse to resolve local-scale impacts and building downwash was not modelled, which has implications for near-field effects. The EIS needs to discuss these setup issues. The values in the list file attached as an appendix in SKMs report do not correspond to the values cited in the main body of the report (e.g pollution grid size, background RSMOG and FPM). It is not clear if observational data from the Darwin Bureau of Meteorology (BoM) site was incorporated into the modelling. The output list file provided in the report is for a pollution run with meteorological input from previously saved *.M3D files. It is generally considered that observational data can be included in TAPM meteorological modelling to improve model performance. Clarification is sought on whether this was done in this case. The EIS should describe how the buoyancy

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					enhancement factors, presented in the output list file, were derived. The fraction of All Particulate Matter (APM) emitted as Fine Particulate Matter (FPM) of 0.5 is quite low for natural gas consumption and should be supported with some discussion or data to justify. Random checks between the sources / source parameters in the list file and the report confirm that the correct sources/parameters were modelled (subject to the earlier concerns raised about the list file). However, the EIS should explain why the point source emission characteristics in the output *.lst file for source numbers 75 and 76 in the output file do not appear to match any source listed in the tables in the body of the report. Limited model validation was performed in order to test the RSMOG value. Explain why annual 2005 values were compared against measured values for Jan/Feb 2009 and May/June 2009. A better approach would have been to model for 2009 and compare appropriate modelled months against measurements, which would also have provided validation of the model.
19	8.2	Emission Parameters - Area Based Emission File			It is acknowledged that Volatile Organic Compounds (VOCs) including air toxics are generally present in low concentrations in ambient environments, however, characteristics such as toxicity or persistence for some of these substances means they can be hazardous to human, plant or animal life and as such air quality goals for these compounds are usually very stringent. A comparison of the Ichthys proposal with other industry sources in the NT through the National

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					Pollutant Inventory (NPI) indicates INPEX will be the single largest producer. According to table 5.1, INPEX will produce 500 tonnes/annum and the only comparable NT emitters are offshore gas platforms. The biggest Darwin-based emitter is ConocoPhillips with 120 tonnes/annum. The Air-NEPM are becoming concerned about research indicating that there are no safe minimum levels reported for some of the more serious VOCs such as Benzene and PAHs. Further discussion of potential impacts from air toxics such as benzene and formaldehyde should be included in the EIS.
19	8.4	Existing Industrial Operations			The emission rates for the Channel Island Power Station differ from what was presented in the report for the Darwin LNG plant (Bechtel, 2001). The emission rates in Bechtel 2001 were taken from the EIS for the Channel Island Power Station whereas the draft EIS derived emissions using NPI emission factors and emission parameters obtained from the Northern Territory Power and Water Corporation. Explain why the emission rates in Bechtel 2001 are higher than those presented in this report (assuming the emissions are presented as NO_x and not NO_2).
19	8.5	Emission parameters – normal operation condition			It is not clear from this section how the emission estimates for normal and also upset conditions were derived, whether by using emission factors or manufacturers emission guarantees. There are insufficient data provided to allow a review of emission estimates, i.e. emission concentrations, flow rates, emission factors, fuel consumption. This information should be provided to facilitate further assessment of the modelling. The following general observations have been

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					made in the absence of the above information and require clarification in the EIS: • Confirm that stack heights for compressor turbines and power generation turbines are 65 m and 40 m respectively. These seem high. • Emissions rates in Table 8-2, 8-3 and 8-4 are provided as NO_2 however the emissions are modelled as NO_x with a NO_x/NO ratio of 0.9. Clarify whether the emission rates in Table 8-2, 8-3 and 8-4 are provided as NO_x or NO_2. It is assumed the emissions are presented as NO_x, as this is mentioned in the text, but the tables' headings have a typographical error. The emission rates provided in Bechtel 2001 for the Darwin LNG plant are provided as NO_x and these are the same as in the SKM report, but reported as NO_2 in the table heading.
19					The contribution from bushfires has not been included in the assessment of background conditions. These can be significant sources of pollutant levels in the NT. During bushfire season, background concentrations, particularly particulates, can be very much higher than the criteria, often for several days at a time. This should be discussed further in the EIS.

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					The following references cited in the draft EIS should be provided to NRETAS to facilitate the assessment: JKC Dredging Strategy report, 2009. Ichthys Onshore LNG Facilities (Feed), June 2009. Coffey Geotechnical, 2009. Laboratory Testing report, Ichthys Gas Field Development Nearshore Geotechnical Investigation, Volume 1. HR Wallingford, Ichthys LNG, Laboratory disaggregation and abrasion testing, Darwin harbour, Report EX6226, revision 2.0. Fugro Seismic Refraction report Vol1, 2009 Ichthys Gas Field Development - Darwin Harbour, January 2009.

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