ntepa Northern Territory Environment Protection Authority

GUIDELINES FOR THE ENVIRONMENTAL ASSESSMENT OF MARINE DREDGING IN THE NORTHERN TERRITORY

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1 Foreword

Dredging involves the excavation, lifting and transport and placement of underwater or intertidal sediments and soils for the construction and maintenance of ports and waterways.

Capital dredging projects involve the excavation of sediments to create ports, harbours and navigable waterways, whereas maintenance dredging ensures sufficient water depth is maintained for safe navigation by the periodic removal of sediment. Capital and maintenance dredging activities are necessary as they involve social, economic and environmental benefits to the whole community.

Dredging and the placement of dredged material have many implications for the environment. The Northern Territory Environment Protection Authority (NT EPA) has developed these guidelines to ensure proponents take all reasonable and practicable measures to protect the environment from marine dredging.

2 Introduction and Background

2.1 Purpose

The purpose of this guideline is to provide information for those planning to dredge in the marine and estuarine waters of the Northern Territory (NT).

This guideline provides advice to proponents, consultants and the public about specific procedures, methodologies, frameworks and minimum requirements the NT EPA expects to be addressed by proponents of proposals which are subject to Environmental Impact Assessment (EIA). By imparting clarity and consistency to the mechanics of EIA, this guideline serves to deliver more effective and timely approvals.

There are a range of legislative and administrative requirements that relate to the assessment, licensing and approval of dredging proposals. These need to be identified and completed before any dredging project commences operational activity. The NT EPA administers the EIA process for proposals under the NT *Environmental Assessment Act* (EA Act). The EA Act applies if a proposal is likely to have a significant impact on the environment.

An EIA is based on predictions of environmental impacts and the degree to which these impacts have been minimised and will be managed during project implementation. Prediction and associated environmental management programs form the basis of NT EPA judgements about environmental acceptability of proposals and their impacts. Outcomes of the EIA process inform approval decisions and set the regulatory scene for the construction and operation of approved projects.

Dredging activities include navigational dredging (maintenance and capital works), dredging for development (infrastructure, reclamation and aquaculture) and waterway management (e.g. channels to convey floods). This guideline provides generic guidance that applies Territory-wide and as such does not differentiate between types of dredging proposals, regional environmental differences, provide specific technical/scientific guidance on impact prediction methods for developing, or define pressure-response thresholds for predicting environmental impacts, all of which need to be considered by the proponent in developing a proposal.

Proponents should be aware of obligations under all relevant NT and Commonwealth statutes, including those administered by the relevant Port Corporation when dredging is proposed within the bounds of a NT gazetted port. Dredging within port waters requires the permission of the port manager to ensure that the proposed dredging design, safety and operational issues are satisfactory.

The submission, assessment and approval process in the NT could take up to 6-8 months. Early consultation with the NT EPA is beneficial so that the environmental assessment and regulatory process is timely and effective. Appendix 1 summarises the permits or approvals that may be necessary for dredging operations in NT coastal waters and Appendix 2 outlines Policies and Guidelines applicable for dredging operations.

2.2 Limitations of this Guideline

This Guideline:

- is confined to generic matters relating to marine and estuarine dredging and does not address more proposal-specific issues;
- does not provide prescriptive rules for any particular assessment method;
- is not an instrument for predicting outcomes of deliberations by the NT EPA;
- is intended to provide a more certain and consistent approach to assessments;
- is intended to apply to proposals prior to the proponent submitting the proposal Notice of Intent to NT EPA for environmental assessment; and
- does not relate to the mining of extractive mineral proposals.

The Northern Territory Environment Protection Authority (NT EPA) has prepared this document in good faith, exercising all due care and attention, but no representation or warranty, express or implied, is made as to the relevance, completeness or fitness for purpose of this document in respect of any particular user's circumstances. Users of this document should satisfy themselves concerning its application to their situation and, where necessary, seek expert advice.

2.3 What is dredging?

Dredging is the excavation, transport and relocation of solid matter from the seabed of any marine, coastal or estuarine waters. Excavated material is termed dredge spoil which requires disposal to land, dedicated spoil grounds (offshore), or by side-casting at a distance removed from the dredging activity. The removal and disposal of sediments inevitably has some environmental impact. Best practice environmental management involves minimising impacts at and near the dredging and disposal sites and has economic, social and environmental benefits for the proponent.

Dredging proposals generally fall into one or more of the following three categories:

- capital works for new marine infrastructure;
- capital works for the expansion of existing marine infrastructure; and
- maintenance of existing infrastructure.

Dredging excavation can be performed on submerged sediments, through the water column, from land in intertidal areas accessed at low tide or behind bunds or caissons constructed to manage tidal water to maintain a 'non-inundated' dredge site. In the NT, dredging has been carried out to establish navigation channels and turning basins, to maintain or increase navigable water depths in shipping channels, ports and harbours, to construct trenches for the placement of sub-sea pipelines and to remove soft sediments from the foundation footprint of bund walls, causeways and rail easements.

Dredge spoil can be disposed in a number of different ways. Spoil can be loaded into a hopper (part of the dredge itself or on a separate vessel) and transported to a disposal site where the contents of the hopper are emptied directly in the open ocean (i.e. *sea dumping).* Spoil may be moved via a pipeline that allows the dredge material to be pumped to a location where it may be used for engineering purposes (e.g. *land reclamation*). Dredged material is sometimes pumped directly from the dredge site to a disposal location at sea or on land.

A number of different types of dredges can be used for dredging proposals. These include hydraulic dredges such as cutter suction dredges, trailing suction hopper dredges and mechanical dredges including bucket or grab dredges. Physical, environmental and economic factors will determine the selection of equipment.

The NT EPA is of the view that unconfined ocean disposal of dredge spoil in NT waters should only be considered after the environmental, social and economic costs and benefits of alternatives for reuse and confined disposal have been fully explored.

2.4 Potential environmental impacts of dredging

All dredging causes environmental impacts at the dredge and disposal sites and potentially further afield. Some examples of the types of potential environmental impacts associated with dredging proposals include:

Impacts to benthic habitats

- Increased turbidity and reduced light (especially for corals and seagrass);
- direct loss of benthic (bottom-dwelling) communities and habitats by removal or burial; and
- indirect impacts on benthic communities and habitats from the effects of sediments introduced to the water column by dredging and spoil disposal.

Other types of impacts

- changes in wave diffraction and energy dissipation;
- changes to shorelines, bathymetry and habitats through modified ecological and physical processes;
- adverse effects of contaminant release and dispersion (including impacts associated with reclamation or onshore disposal of acid sulfate soils) on marine water quality;
- introduction of invasive pest species translocated in dredging (or ancillary) equipment that can have compounding ecological and economic consequences;
- impacts to fish populations, habitats, commercial and recreational fisheries;
- changes to coastal processes and hydrodynamics that may lead to degradation of community facilities such as groynes and boat ramps; and
- impacts on the behaviour and survival of aquatic life, including protected species.

The NT EPA expects proponents to give an appropriate level of attention to each of the significant environmental issues associated with their particular dredging proposals.

Dredging introduces sediment to the water column to varying degrees from three principal processes:

- from the interaction of the dredging equipment with the seabed;
- from overflow associated with loading of dredged material onto hopper barges or decant of sediment laden water associated with land reclamation; and
- during dredge spoil disposal to the marine environment.

Physical interaction of dredging equipment with the seabed causes sediment to be liberated into the surrounding water column at the dredge site. When all of the dredged material is not captured by the dredging equipment (e.g. fugitive loss from a cutter suction dredge cutter head, or TSHD draghead, spillage from grab/bucket dredges), a proportion is liberated to the surrounding environment as suspended sediment. Turbulence from propellers and movement of hulls can disturb and lift sediments into the water column where under-keel clearance is limited.

Hydraulic dredges produce slurries that consist of sediment-laden water with some coherent dredged solids. Sediment-laden water may overflow from the barges used to transport spoil to dump sites or reclamation areas. This can introduce significant loads of suspended sediment to the immediate environment. Sediment-laden overflow is the second principal source of sediment introduced to the water column by dredging and is commonly referred to as ‘spill’. The amount of ‘spill’ allowed at the dredge site should be informed by a cost benefit assessment of improved solids inventory in the barge per vessel journey versus the increased impact of the ‘spill’ at the location.

Sediment is released to offshore waters during spoil disposal at sea. Adequate characterisation of the sediments to be dredged needs to be undertaken to inform decisions on dredging equipment to be used, and the likely fate of the sediment released at the dredge site and dredge spoil disposal site. Early acquisition of high quality geotechnical data for the dredge site is important to help reduce uncertainty in the impact prediction process. Geotechnical information will assist in the selection of ‘fit-for-purpose’ equipment, modelling the particle size distribution and the fate and consequence (especially transport) of sediments generated from that equipment/process/substrate combination.

3 Legislation

Proponents and assessors should carefully review projects to determine legislated requirements relevant to particular projects.

3.1 Northern Territory Legislation

3.1.1 Assessment and approval

- *Environmental Assessment Act*
- *Water Act*
- *Planning Act*

3.1.2 Cultural & heritage

- *Northern Territory Aboriginal Sacred Sites Act*
- *Heritage Act*

3.1.3 Land use

- *Planning Act*
- *Aboriginal Land Act*
- *Crown Lands Act*
- *Soil Conservation and Land Utilisation Act*

3.1.4 Industry

- *Fisheries Act*
- *Petroleum (Submerged Lands) Act*
- *Energy Pipelines Act*

3.1.5 Water quality & biodiversity conservation

- *Water Act*
- *Marine Pollution Act*
- *Biological Control Act*
- *Territory Parks and Wildlife Conservation Act*
- *Fisheries Act*

3.1.6 Air quality, noise and waste management

- *Waste Management and Pollution Control Act*
- *Public and Environmental Health Act*

3.1.7 Safety and navigational

- *Marine Act*
- *Darwin Port Corporation Act*
- *Work Health and Safety (National Uniform Legislation) Act*

3.2 Commonwealth Legislation

Some dredging proposals may need consideration under Commonwealth legislation. Those Acts include the Environment Protection (Sea Dumping) Act 1981 (Sea Dumping Act), Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and Historic Shipwrecks Act 1976 (Historic Shipwrecks Act).

The application of this legislation will often depend on the location of the dredging action, whether the dredge spoil is proposed to be disposed offshore, and the location of the offshore disposal ground. The proponent should contact the Australian Government Department of the Environment if they wish to seek advice on the application of Commonwealth legislation.

Where assessment is required by both the NT and Australian Governments, jurisdictions will work together to coordinate the assessment under a bilateral or accredited process wherever possible. However, notification or referral processes are administered independently and proponents should seek advice from the relevant agencies as early as possible.

3.2.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act is the Australian Government environmental assessment and approval legislation. The EPBC Act allows the Australian Government Environment Minister to assess and approve a proposed action that may have a significant impact on a matter protected by the EPBC Act (matters of National Environmental Significance (NES)). Matters of NES include:

- World Heritage properties;
- National Heritage places;
- Ramsar wetlands of international importance;
- Listed threatened species and ecological communities;
- Listed migratory species;
- Commonwealth marine areas;
- Great Barrier Reef Marine Park;
- nuclear actions (including uranium mines); and
- a water resource, in relation to coal seam gas development and large coal mining development.

The EPBC Act also protects:

- the environment, where actions proposed are on, or will affect Commonwealth land; and
- the environment, where Commonwealth agencies are proposing to take an action.

The EPBC Act webpage also has a search tool that helps determine whether NES matters occur in the area of a proposed activity. To generate a map and environmental report on the area refer to:

http://www.environment.gov.au/erin/ert/epbc/index.html

Activities within the Commonwealth marine and terrestrial reserves, including Uluru-Kata Tjuta and Kakadu National Parks, may be subject to specific additional requirements. Further information can be found at

http://www.environment.gov.au/parks/parks/index.html

3.2.2 Environment Protection (Sea Dumping) Act 1981

The *Sea Dumping Act* implements Australia's obligations under the London Protocol, which aims to prevent marine pollution by dumping of wastes and other matter. The *Sea Dumping Act* applies in all Australian waters, except areas determined to be within the 'limits of a State or of the Northern Territory'. The National Assessment Guidelines for Dredging (NAGD) (Commonwealth Government, 2009) sets out the framework for assessing and permitting offshore disposal of dredged material and the requirements of the *Sea Dumping Act*. The NAGD include a definition of 'waters within the limits of the State' as follows:

> 'Waters within the limits of a State are those waters that lie within the constitutional limits of the State as determined by Letters Patent issued to the Governors of each of the States at Federation. They can include features such as bays, gulfs, estuaries, rivers, creeks, inlets, ports or harbours. Generally, the limits of the States are low water along the coastline together with bay closing lines (usually of no more than 6nm in length) and also river closing lines. In some areas of the coastline locating the limits of the State may be difficult. This can occur particularly where islands lie very close to the coastline and in relation to certain bays. In such cases there are detailed legal principles that must be applied to determine the exact location of the State limits'.

A permit under the *Sea Dumping Act* may be required if dredge spoil from a project undertaken in the Northern Territory, is to be disposed of in Australian waters. It is recommended that proponents contact the Australian Government Department of the Environment for clarification on whether the *Sea Dumping Act* will apply for a particular offshore disposal ground.

The NAGD can be found at:

http://www.environment.gov.au/coasts/pollution/dumping/guidelines.html

3.2.3 Historic Shipwrecks Act 1976

This Act covers shipwrecks in Commonwealth and NT waters and prohibits the interference, damage or removal of a wreck or any artefacts without an appropriate approval. Under this Act, all wrecks that are older than 75 years old are automatically protected, inclusive of those found in Territory waters. Automatic protection occurs regardless of whether a site has been previously recorded. The Minister for the Environment can declare any historically significant wrecks that are less than 75 years old. The Commonwealth administers the Act. Delegation under the Act is vested in the Department of Lands Planning and Environment (DLPE).

The Australian National Shipwreck Database includes all registered shipwrecks and allows users to search for historic shipwrecks protected by Commonwealth or State/Territory legislation. The database is available at:

http://www.environment.gov.au/heritage/shipwrecks/database.html

Contact the Director of Heritage (DLPE) for more information on shipwreck sites in the Northern Territory and advice on application of *Historic Shipwrecks Act 1976* and obligations under the NT *Heritage Act*.

4 Environmental Impact Assessment

The *Environmental Assessment Act* and *Environmental Assessment Administrative Procedures* form the basis of the environmental assessment process and are administered by the NT EPA. The environmental assessment process is often the first formal process for notifying Government of a dredging proposal.

EIA is a predictive tool for identifying and characterising the environmental impacts and risks associated with a proposed development. EIA is ideally applied at the early planning and design stages to increase the likelihood of both ecologically sustainable development and the protection of environmental values. The EIA Process outlined in Appendix 3 provides the NT

EPA with the information needed to assist consideration of and decisions on matters that could significantly affect the environment. It enables environmental issues to be considered in a balanced way, with other aspects involved in determining the acceptability of a proposal and it ensures that unnecessary and unacceptable harm to the environment can be avoided.

For these reasons it is important that any potential environmental impacts and constraints are identified early in the planning and design of any dredging proposal. Early identification ensures that environmental assessment is integrated with engineering and economic feasibility studies in the project formulation so as to produce the best and most appropriate project design, including mitigation, monitoring and management options.

A Notice of Intent (NOI) is the mechanism for a proponent to advise the NT EPA of its dredging proposal. The NOI is the basis for the NT EPA to make a decision on whether the proposal requires further EIA (e.g. an Environmental Impact Statement).

If a project requires further EIA, it is undertaken in a systematic and transparent manner with opportunities for public review and input.

This guideline provides the information requirements that must be addressed for a dredging proposal NOI, including:

- location of the site to be dredged and identification of impacts (Identification of impacts - Section 4.1);
- justification and alternatives (Evaluating alternatives - Section 4.2);
- the quantity and physical and chemical characteristics of the spoil (Assessment of sediment quality - Section 4.3);
- the physical and biological values of the site to be dredged, and the site to receive spoil (Impacts to benthic communities and habitats - Section 4.4, Ecological impacts of sediment disturbance - Section 4.5, General approach to predicted impact on benthic habitat - Section 4.6);
- the location and physical characteristics of the site for disposal of spoil;
- the proposed dredging method inclusive of spoil loading and disposal where applicable; and
- an Environmental Management Plan (EMP) or Dredge Management Plan that demonstrates how environmental duties under Section 12 of the *Waste Management and Pollution Control Act* will be exercised (Environmental management plans - Section 4.9).

The proponent should also take into account the contaminant concentrations listed in the National Environment Protection Council's Assessment of Site Contamination Measure (NEPC, 1999), or subsequent updates to these values.

A schematic representation of the Dredging Approvals Process in the Northern Territory is outlined in Appendix 4.

The Commonwealth Government's NAGD (2009) is largely adopted for use in the NT. This ensures consistency in environmental management and sediment characterisation across NT and Australian Government jurisdictions.

The full Commonwealth guidance can be accessed at the following web address:

http://www.environment.gov.au/coasts/pollution/dumping/publications/guidelines.html

Reference is made in these NT guidelines to specific Appendices and Tables (which, when referred to, will be underlined in this document) associated with the Commonwealth guidance (refer to Section 4.3). These Appendices and Tables form part of the complete Commonwealth guidance which can be accessed at the above website and are not included in this guideline.

4.1 Identification of impacts

EIA is based on predictions of the extent, severity and duration of environmental impacts, taking into account confidence around the predictions and the likely effectiveness of proposed mitigation and management strategies.

The NT EPA expects that direct and indirect impacts are identified and considered explicitly.

Direct impacts occur predominantly within and immediately adjacent to where dredges excavate the seabed and where rock armour and spoil are dumped. Direct impacts typically involve irreversible loss of benthic habitats and communities, where *irreversible* is defined as 'lacking a capacity to return or recover to a state resembling that prior to being impacted within a timeframe of five years or less' (WA EPA, 2009).

Indirect impacts arise from effects of dredge-generated sediments and generally extend over areas surrounding infrastructure footprints and dredging sites. These occur when sediment deposition rates and/or elevated turbidity exceed the natural tolerance levels of benthic organisms. Indirect effects of dredge-generated sediments may restrict or inhibit key ecological processes and cause impacts that range in severity and duration from irreversible to readily-reversible. Direct and indirect impacts, along with an assessment of the reversibility of those impacts, are to be included in predictions of impacts associated with dredging proposals.

Proponents should be aware of the potential presence of Un-exploded Ordinance (UXO) and undertake appropriate due diligence r to properly manage any project where the potential for UXO exists. Contact should be made with the Commonwealth Department of Defence to ascertain the necessary process and procedures for addressing UXO issues.

4.2 Evaluating alternatives

The proponent is required to present all alternative of spoil disposal options, and justify the preferred option with regard to the environmental, social and economic impacts of each disposal option. Consultation may be required with potentially affected stakeholders or potential users of the dredged material.

Examples of considerations for assessing disposal options for dredged material are:

- Are there opportunities for the beneficial use or the recycling of the dredge spoil?
- Are beneficial uses constrained because the sediments are contaminated or contain hazardous constituents?
- Are the beneficial uses able to meet the specific criteria for which the material is intended (i.e. construction grade quality)?
- Are the beneficial uses going to be needed at the time when the material is available and will there be sufficient storage capacity for the material?
- If hazardous constituents are destroyed, reduced or removed, do the materials have beneficial uses?
- What are the comparative risks to the environment and human health of the alternatives?
- What are the costs and benefits of the alternatives?

It is important to recognise the potential value of dredged material as a resource. Possible beneficial uses include engineered uses (land reclamation, beach nourishment, offshore berms and capping material), agriculture and product uses (aquaculture, construction material, liners) and environmental enhancement (restoration and establishment of wetlands, upland habitats, nesting islands and fisheries).

4.3 Assessment of sediment quality

The proponent is required to provide sediment characteristic data from the proposed dredge 'footprint', consistent with the methods below. Phase I characterisation is required for all proposed dredging projects where a NOI is to be submitted. Subsequent phases will be required depending on risk, as outlined below.

4.3.1 Phase I – Evaluation of existing information

Phase I involves reviewing existing information on the material proposed to be dredged (including information on adjacent land use that may contribute to contamination and results from previous sediment sampling). This may identify the likely presence of contaminants and whether existing information sufficiently characterises the sediments without further testing.

Chemical or toxicity data for the sediments of the area to be dredged will remain current for a maximum of five years, where there is no reason to believe that the contamination status has changed significantly. New data needs to be gathered after 5 years, or where contamination of the site is likely to have increased or where new pollution sources are present (such as a new industry or accidental spills). Information and data older than 5 years may be useful in demonstrating trends over time.

Proponents may seek an exemption from further testing if they are able to justify to the NT EPA that further testing is not warranted.

Exemptions from some or all of the sediment testing requirements may be granted if the proponent gives sufficient justification, to the satisfaction of the NT EPA.

Sediments that meet the following criteria may not require further chemical testing:

- Dredged material composed predominantly of gravel, sand or rock, or any other naturally occurring bottom material with particle sizes larger than fine sand, but only where this material is found in areas of high current or wave energy where the seabed consists of shifting gravel and sandbars; or
- The dredging site is sufficiently far removed from known existing and historical sources of pollution to provide reasonable assurance that the material has not been contaminated and the material is substantially the same as the substrate at the disposal site.

4.3.2 Phase II – Sampling and analysis of sediments

Phase II involves identifying and investigating the list of contaminants that could be present at elevated levels in the sediments of the dredge area. This list will vary depending on historical and geographical factors. It is expected that sediments in inner harbour and berth areas, marinas or near outfalls and stormwater discharges, will accumulate contaminants.

A Sampling and Analysis Plan (SAP) should be prepared and submitted to the NT EPA prior to sampling to ensure that adequate data are collected for the assessment process. The SAP outlines the dredging proposal (volumes and areas) then sets out the study objectives and the proposed sampling, analysis and quality assurance/quality control procedures.

The draft SAP will need to be reviewed by the NT EPA and approved prior to sampling. Changes to the draft plan may be required. Sufficient time should be set aside for the SAP review process. Detailed guidance on SAP requirements can be accessed in the full Commonwealth documentation at Appendix B of that document.

Guidance on sampling and analysis methods is provided in Appendix D, and on quality assurance and quality control in Appendix F of the Commonwealth guidance.

Phase II assessment procedures include comparison to the Screening Levels at Appendix A, and to ambient baseline levels for sediments of comparable grainsize in the vicinity of the

disposal site. Where these levels are exceeded, elutriate and bioavailability testing under Phase III is required.

4.3.3 Phase III – Elutriate and bioavailability testing

Sediment contaminants will generally be present in a variety of forms. Only the bioavailable fraction will potentially impact organisms. Availability may vary with changes in sediment chemistry across an area, with depth, over time due to disturbance of the sediment (either naturally or from human activity), or from seasonal changes in the sediments or its overlying water column.

Elutriate testing – Elutriate testing assesses potential impacts to water quality. Test results are normally compared to the relevant National Water Quality Management Strategy (NWQMS - 2000) marine water quality trigger values for 95 per cent protection, or subsequent updates to these values, except where the water body has been declared to have a higher (or lower) level of protection, in which case the relevant NWQMS (2000) trigger values are to be used.

If all contaminants are below the relevant guideline values after initial dilution (i.e. after four hours – see Appendix A), effects on organisms in the water column would not be expected during disposal. Contaminants present at levels above their relevant guideline values, loading and disposal may cause adverse effects on water quality. Loading and disposal controls need to be evaluated to determine if impacts can be mitigated. The assessment proceeds to bioavailability testing if the impacts can be mitigated. If not, the dredged material is unacceptable for open water disposal.

Bioavailability testing – Bioavailability testing assesses potential impacts on sediment quality. There are a variety of methods available to investigate contaminant bioavailability. The dredged material is chemically acceptable for ocean disposal if tests indicate that the bioavailability of the relevant contaminants is below the specified criteria. If the bioavailability is above the criteria, the sediment is potentially toxic and the assessment proceeds to Phase IV.

4.3.4 Phase IV – Toxicity and bioaccumulation testing

Toxicity testing – Acute and chronic toxicity testing is undertaken when results indicate that the sediment is potentially toxic. It employs a minimum of three sensitive test organisms, representing the main contaminant exposure routes. The proponent should justify why the selected tests are considered appropriate. If all tests are passed, the sediment is not considered toxic, and is chemically acceptable for ocean disposal. Guidelines in Appendix A set out assessment criteria for situations where some tests, or some samples, show toxicity while others do not.

Pore water testing should be done, and data compared to the relevant NWQMS marine water quality trigger values, where appropriate toxicity tests are in sensitive and or near Screening Levels for particular contaminants. In the rare situation where there is no such guideline, or where scattered toxicity has been found throughout a dredge area and is not associated with any hot spot, a Phase V weight-of-evidence assessment may be undertaken.

Significant toxicity may render the sediments unacceptable for marine disposal in areas zoned for a high level of ecological protection.

Bio-accumulation testing – Bioaccumulation testing is undertaken when the sediment contains bio-accumulating substances, such as mercury, dioxins or organo-chlorine pesticides at levels exceeding the NWQMS SQG-High values in Table 4. Bioaccumulation may be a concern even where toxicity has not been identified. Appendix A sets out assessment criteria for situations where some tests, or some samples, show bioaccumulation while others do not.

Very Small Dredging Programs – The NT EPA can exempt very small dredging programs (less than 15 000 cubic metres) from toxicity testing in certain circumstances. Screening, elutriate and bioavailability testing may still be required and any exemption from toxicity testing would not apply where sediments contain bio-available contaminants exceeding the SQG-High values in Table 4. Bioaccumulation testing would be required if the sediments contained bio-accumulating substances at levels greater than those set out in Table 4.

4.3.5 Phase V – Weight-of-evidence assessment

In rare circumstances it may be possible to go beyond the assessment of toxicity (or bioaccumulation) using a weight-of-evidence assessment to make a more definitive evaluation of the potential effects of contaminated sediment after disposal. This would occur in the rare situation when appropriate toxicity tests are insensitive to the Screening Levels for particular contaminants, and there is no relevant NWQMS marine water quality trigger value with which to compare pore water data. It would also occur where the results of toxicity or bioaccumulation testing are equivocal.

A weight-of-evidence assessment takes into account the outcomes of each available line of evidence. Lines of evidence may include:

- sediment chemistry (including elutriate testing, pore water chemistry and dilute acid extract of metals);
- toxicity (endpoint relative to control);
- bioaccumulation; and
- ecology (e.g. benthic community structure).

Each line of evidence is tabulated, ranked and weighted according to its reliability as an assessment tool and its ecological significance. These are then combined to arrive at an overall assessment of whether the material is acceptable or unacceptable for marine disposal.

The proponent will need to investigate management options such as treatment, control measures and confined disposal where sediments are found to be unacceptable for unconfined marine disposal. Alternatively, material may be accepted at an onshore disposal site.

4.4 Impacts to benthic communities and habitats

An assessment of the potential impacts of the spoil on the receiving environment should be undertaken once it has been determined that sediment is non-hazardous for marine disposal from the perspective of contaminant or chemical characterisation.

This part of the NT guidance is adapted with minor amendments to accommodate a local context from the guidance issued by the Western Australian Environment Protection Agency (WAEPA) (2011). The WA guidance in full can be accessed at:

http://www.epa.wa.gov.au/Policies_guidelines/EAGs/Pages/default.aspx

The primary issue addressed in this section(s) is the assessment of direct and indirect impacts of sediment disturbance on benthic communities and habitats. The intent of this section is to:

- outline a minimum standard and consistent format for information supplied by proponents;
- guide proponents in the provision of information required for effective assessment of the extent, severity and persistence of predicted impacts associated with marine dredging on benthic communities;
- provide a basis to inform judgements about the potential effects of those impacts on ecological integrity;
- tighten linkages between predictions made during EIA and monitoring and management activities undertaken during project implementation; and
- provide a logical and consistent basis for setting conditions of approval/licensing.

Direct losses of benthic habitats and communities are, for the most part, largely coincident with infrastructure footprints where dredges excavate the seabed and where rock armour and/or spoil is dumped. At a minimum, direct losses will occur within the footprints of dredged access channels, turning basins, berth pockets and reclamation areas, and some spoil grounds. Direct losses may also extend to areas immediately surrounding infrastructure where acute or ongoing sediment-related impacts are expected to occur. Numerical modelling should be used to help understand the extent of the direct losses. Direct losses will be considered irreversible unless a scientifically-sound case can be made for recovery within a timeframe of five years or less.

The extent of indirect impacts on benthic biota is contingent on the intensity, duration and frequency of the sediment-related pressure imposed. The characteristics of sediment released to the water column may be altered by the physical and geochemical processes of dispersal, deposition and resuspension. In very general terms:

- coarse grains (gravels – coarse sands ~>2 mm) are deposited close by the dredge site and become part of the overall bed load and sometimes contribute to the direct impacts;
- medium grains (sands, 2 mm to ~64 µm) tend to settle but are more readily resuspended and re-deposited by the action of waves and currents; and
- fines (silts and clays, ~<64 µm) tend to remain in suspension for long periods (hours to weeks) and can be distributed by currents over long distances and, in some situations, lost from the local sediment system. Fine particles may interact with one another while in suspension, sometimes changing the characteristics of the suspension through processes such as aggregation and flocculation and that may alter settling rates.

Capability to confidently predict the behaviour and fate of the medium and fine size classes is important for the successful implementation of the assessment framework set out in this section.

4.5 Ecological impacts of sediment disturbance

Impacts caused by sediments released to the water column can be divided into two broad categories:

- sediment in the water column (turbidity) - can reduce the quantity and quality of light available at the seabed for photosynthesis, clog the feeding apparatus of filter-feeders and deposit feeders and inhibit key ecological processes in the water column (e.g. fertilization of pelagic gametes, survivorship and competency of propagules); and

- sediment deposited on the benthos (sediment deposition) – can smother biota, cause abrasion of exposed tissues, alter sediment bed load or produce other effects similar to those described in the first dot point above.

The extent, severity and persistence of the impacts to benthic communities depend on the intensity, duration and frequency of the sediment and the tolerances/susceptibilities of the biota.

4.6 General approach to predicting impact on benthic habitats

This assessment framework is designed to impart clarity and consistency to the way in which impacts on benthic biota are predicted and presented for assessment. It establishes an approach for generating and presenting predictions of *the likely range* of environmental impacts, which in turn, provide the basis for recommended approval conditions and environmental monitoring and management strategies. Proponents are encouraged to consider and apply the guidance provided in the following sections:

- Describing benthic habitats (Section 5.5.1);

- Background environmental data (Section 5.5.2);

- Describing impacts (Section 5.6);
- Generating and representing predictions (Sections 5.3 and 5.4); and
- Integrating predictions with monitoring and management (Section 5.7.4 and 5.7.5).

4.6.1 Describing benthic habitats

An adequately detailed benthic habitat map is a critical piece of information for assessing the potential impacts associated with dredging. The benthic habitat map (or series of maps) supplied by proponents must be at a sufficiently fine scale to provide confidence in the habitat boundaries. This reduces uncertainty in predicting areas of impact. Mapping should be undertaken to define the types and uniformity (or heterogeneity) of biological communities present. The main benthic habitat types are often defined on the basis of the abundance of dominant and sub-dominant functional groups.

Knowledge developed through survey work allows selection of local biota to use as surrogates or indicators for impact prediction and monitoring.

Technical reports describing how benthic habitat surveys and mapping were conducted and how maps were produced must be supplied as part of the assessment documentation. Reports should clearly state any assumptions, consider their implications, and describe methods used in the field and laboratory to interpret data and prepare spatial products. Spatial data associated with the benthic habitat map and infrastructure outlines should be supplied in a suitable GIS compatible format. Early advice should be sought from the NT EPA regarding the preferred data format of spatial data and associated metadata statements.

4.6.2 Background environmental data

Acquisition and analysis of background data are integral to any environmental impact assessment. For example, long-term background data sets for a suite of dredging-relevant environmental variables (e.g. light climate, total suspended sediment concentration, sediment deposition rate, correlations between these factors) can be used to develop knowledge about natural tolerances and susceptibilities of local benthic organisms. Independent baseline data sets are critically important for calibration and validation of numerical models.

Proponents are strongly encouraged to seek specialist professional advice regarding the types of baseline data that should be collected to inform and maximise the confidence in predictions of the extent, severity and duration of dredge-related environmental impacts. Relevant background environmental data should be used to inform, validate and enhance confidence in predictions of environmental impacts.

4.7 Generating prediction models

Predicting direct impacts of dredging is relatively straightforward as these impacts are generally inherently linked to the dredge area and/or disposal sites and immediately surrounding areas.

Numerical modelling is most commonly used to inform predictions of the extent, intensity and persistence of dredge-generated sediment plumes, and the extent, severity and duration of resultant indirect impacts in benthic habitats. Inputs can range in severity and duration from irreversible to readily reversible. Modelling techniques are particularly valuable predictive tools for proposals where suitable empirical data from previous dredging campaigns are either not available or unsuitable for informing accurate predictions of environmental impacts.

The approach commonly applied to predict indirect impacts from dredge-generated sediments involves implementing three key types of predictive modelling in a logical sequence:

- hydrodynamic modelling;
- sediment transport modelling; and
- ecological response modelling.

Proponents are strongly encouraged to seek early advice from suitably qualified specialists and the NT EPA regarding the application of this guidance, including the use of predictive numerical simulation models, in the context of their proposal.

Clearly presented information on the calibration and validation of numerical models, assumptions and sources of uncertainty and their associated implications for predictions will assist the NT EPA in forming judgements about reasonableness and the confidence it can place in predictions of environmental impacts.

The level of agreement between model outputs and data measured in the field will vary from application to application and depend on many factors. It is inappropriate to set a requirement that specifies the level of agreement between model outputs and observations to be achieved. Instead, it is expected that proponents set out the process and outcomes of calibration and validation exercises and relevant assumptions on a project-to-project basis.

High quality, peer reviewed information is more likely to provide reliable predictions than when proponent documentation provided, is ambiguous, includes unsubstantiated conclusions or is not relevant.

4.8 Peer review

It is not mandated that proponents commission peer reviews of all studies underpinning an assessment. Peer review by a suitably qualified expert (or experts) can, in some situations, assist in achieving timely assessments. If proponents choose to commission a peer review or are requested to do so by the NT EPA, it is beneficial to seek agreement on the terms of reference and scope before commencing the review.

It is expected that the peer reviewer's reports, including their 'close out' comments, based on the document that is ultimately submitted for assessment, are received by the NT EPA. Proponents should expect that the peer review, including the terms of reference and the peer reviewer's reports will be made public as part of the EIA process.

4.9 Environmental management plans

The fundamental purpose of an Environmental Management Plan (EMP) is to provide the proponent with a way to ensure that the environmental protection outcomes established for a project are not compromised. It must establish a framework for monitoring in a way that informs adaptive management of dredging to mitigate the impact on the environment. The EMP needs to focus on the key threats posed by the project and the pathways by which those threats could cause the environmental protection outcomes to be compromised.

The primary threats to the surrounding marine environment from dredge-generated sediment are shading caused by sediments suspended in the water column and smothering of benthic habitats and organisms caused by the deposition of these sediments. These pressures, if unchecked, could cause flow-on effects to critical habitats such as coral habitats and seagrass meadows.

The EMP should be geared towards achieving management targets that indicate a level of impact that is lower than the limits established as environmental protection outcomes. It is to be designed to provide early warning of potential impacts to trigger pre-emptive management before the environmental protection outcomes are compromised. The proposed monitoring set out in the EMP needs to be designed to demonstrate with a high degree of confidence that the environmental protection outcomes have been met.

An EMP should be clear, unambiguous and contain the following key elements:

- clearly stated objectives;
- an adaptive monitoring/management feedback loop to achieve those objectives;
- management triggers along pressure-response pathways;

- a monitoring regime that includes site locations and methods to provide data that allow assessment against the management triggers;
- clearly set out data evaluation procedures to identify where and when management triggers have been reached;
- contingency management strategies to be employed if triggers are reached; and
- a reporting process.

It is expected that proponents provide the EMP as part of the documentation submitted for assessment. These plans should contain information sufficient to allow the monitoring methods, data interpretation and the efficacy of proposed management to be assessed. It should be noted that:

- some impacts are better assessed by targeted research than by routine monitoring; and
- monitoring programs should be integrated with regional monitoring programs where possible.

4.9.1 A risk-based environmental monitoring and management framework

The framework around which to design environmental monitoring programs should be risk-based using understanding of dose-response pathways for key biota in the benthic communities to be monitored. Essentially this means that monitoring would be designed around the application of indicators that signify progressively greater risk of unacceptable impact. For example, monitoring may take the following general risk-based form and apply suitable techniques to measure the responses in primary, secondary and tertiary indicators. Further explanation and guidance is provided below:

1. **Primary indicators** signify a very early warning of potential threat and low level of risk to the biota of interest. A primary indicator could be a water quality measure linked to potential impacts from dredging such as turbidity, the light attenuation coefficient or sediment deposition rate. Exceeding a criterion linked to a primary indicator would trigger tier 1 management, which could include ***investigating the cause of the exceedance*** and ***increasing monitoring*** to include a secondary indicator.

2. **Secondary indicators** signify a moderate risk to the biota of interest and might include measures of biotic stress such as change in the colour of coral tissues or a reduction in the shoot density of seagrass. Exceeding a criterion linked to a secondary indicator would trigger tier 2 adaptive management, which could include implementation of measures to ***reduce dredge-related impacts*** and monitoring of a tertiary indicator.

3. **Tertiary indicators** signify a high and unacceptable level of risk to the biota of interest. A tertiary indicator would be a measure or measures that are immediate pre-cursors to an unacceptable impact. Exceeding criteria linked to a tertiary indicator would trigger strong management action to ***alleviate impacts***.

Clear definition of project impacts (in terms of extent, severity and duration) and areas to be protected allows for unambiguous audit of project performance against approval conditions, which in turn reduces uncertainty around compliance or enforcement issues.

Strong links between predictions and approvals highlight the importance of robust model calibration and validation, and high-quality science - all targeted towards reducing predictive uncertainty. It is recognised by the NT EPA that development of knowledge of cause-response relationships in particular cannot occur immediately, but this is an important goal that should be strived for collectively over time as opportunities are presented and resources are available. An EMP should reflect contemporary best practice and ideally be risk-based, using readily measurable indicators to trigger management responses to prevent unacceptable impacts.

4.9.2 Critical windows of environmental sensitivity

Proponents should consider *critical windows of environmental sensitivity*. Critical windows of environmental sensitivity include times of year or particular sites where key species or ecological communities or critical processes may be particularly vulnerable to pressures from dredging. The identification of critical windows of sensitivity is particularly important for matters protected under the EPBC Act.

There are numerous examples of known critical windows of marine environmental sensitivity and it is likely that with further local and regional scientific research others will be identified. Some examples which might be considered include spawning and larval settlement periods for corals, habitat for spawning aggregations and juveniles of fish (e.g. barramundi) and invertebrates (e.g. mud crabs), critical habitat for breeding of marine wildlife (e.g. turtles), the timing and routes for migration of specially-protected migratory species (e.g. JAMBA/CAMBA listed migratory birds, whales) and habitat that supports primary food resources for marine mammals (e.g. seagrass areas grazed by dugong).

4.9.3 Best practice

While best practice tends to be highly site and project specific, examples considered to represent best practice in the context of dredging proposals include:

- up-front design to minimise the need for dredging, considering the environmental setting and operational safety requirements;
- dredge area design that aims to minimise direct and indirect impacts on key benthic habitats (e.g. design and locate marine infrastructure to avoid or reduce impacts on reef coral, seagrass habitat or mangroves, and heritage sites);
- using site-specific geotechnical data and understanding of dredge equipment-substrate interactions to help select *fit for purpose* dredging equipment and operating modes to minimise environmental impacts;
- using knowledge of geotechnical conditions, and dredge equipment-substrate interactions to establish likely physical characteristics and generation rates of fines produced by dredging at the site;
- using validated hydrodynamic and sediment transport models to assess the dynamics and likely fate of sediment plumes;
- the use of silt curtains where they are operable and likely to be effective in controlling turbidity release and dispersion;
- contracting dredges equipped with sediment management devices where these are found to minimise sediment generation and dispersion;
- a commitment to manage dredging in ways that minimise the release of sediments into the water column as much as practicable, particularly in situations where dredging-related sediments have the potential to impact sediment-sensitive benthic communities. Methods such as limiting the overflow duration, piping dredge spoil direct to disposal sites or to transfer vessels stationed sufficient distances from sensitive receptors to eliminate or minimise risk pathways to those receptors may need to be considered; and
- the application of near real-time data collection and interpretation methods (particularly for turbidity) to support environmental management of dredging. These should be determined on a hierarchical basis, grading from small maintenance dredging campaigns in low sensitivity environments where real-time monitoring is not warranted through to major capital dredging projects where substantial commitments to monitoring and adaptive management, including the use of telemetered turbidity meters, may be required. In all cases, the degree of uncertainty in impact prediction will be considered when determining the appropriate level of near real-time data collection and interpretation required to manage project implementation.

4.10 Acid sulfate soils

Acid Sulfate Soils (ASS) are soils, sediment or rock that contains elevated levels of metal sulfides (principally pyrite – FeS_2). Exposure of metal sulfides to oxygen – for example by drainage and excavation of these materials – can generate sulfuric acid in relatively short timeframes. This may result in acidification of soil, sediment, rock, surface water and groundwater. Runoff and leachate from exposed and oxidised acid sulfate soils can adversely impact aquatic communities, aquaculture facilities and engineering works. Acidic leachate can release aluminium, iron and other metals from soil and sediment, potentially impacting on the beneficial uses of the environment. Proponents have a duty of care not to cause adverse impact to the environment due to disturbance or transport of acid sulfate soil.

Any potential ASS issues would need to be addressed in an EMP and where required in an Acid Sulfate Soil Management Plan.

4.11 Sedimentation in mangrove areas

Mangrove communities are an important natural resource and are valued for their ecological function, community amenity and economical foundation for industry. Mangroves provide important nurseries and feeding areas for marine and terrestrial animals; provide foreshore protection and provide a sink for suspended sediments by acting as stabilisers of sediment. Mangroves are recognised by the community as being critical for many recreational opportunities and hold cultural and economic significance for indigenous Australians (DIPE, 2002).

An excess input of sediment to mangrove communities can cause stress as a result of smothering and burial of root systems. Impacts of excessive sedimentation can range from reduced vigour to total death of the mangrove vegetation, depending upon the amount and type of sedimentation and the mangrove species involved (Ellison, 1998).

The monitoring of sedimentation in mangroves is not a well-established science. Monitoring constraints include access difficulty, high tidal variation, deep mud substrates and dense vegetation. Studies have indicated that sedimentation levels of up to 50 mm would be generally tolerable by seaward mangrove communities throughout East Arm, Darwin Harbour, as an example (Ellison, 1998, 2009).

Depending on the size and scale of the dredging proposal, an intertidal sedimentation and mangrove health monitoring program may need to be included in the EMP.

4.12 Biological contamination by exotic species

Management of exotic organisms will be required if the dredged site and spoil ground are far enough apart that exotic species occur on the dredged site but do not occur on the spoil ground. Economic constraints on transport of spoil suggest that this problem will arise very rarely, as the spoil is usually dumped close enough to the dredged site that there are many other means of transferring exotic species between these sites.

Trailing suction hopper dredges (TSHDs) can move rapidly between different areas of the world. In doing so, they may translocate exotic species between different geographic regions. Risks from this source of exotic species should be assessed separately from that of other international shipping. The amount of unwanted sediment transported by TSHDs may be much greater than contained in most ballast.

There is a risk of introducing a suite of exotic species different from those carried in other normal ballast. The seriousness of this issue should not be underestimated: the introduction of a single pest species could cause a much more serious and longer-lasting impact than dredging itself.

A risk assessment of the likelihood of introductions from TSHDs should be undertaken well before the dredge leaves its previous dredging location. This assessment should consider the

climatic similarity of the location of the previous dredging project compared to the NT. Dredges that have operated most recently in tropical waters may contain species likely to establish in the NT. Special precautions should be taken to minimise the risk of introductions from the last operation. The last few dredge loads in the previous location should be deep abiotic sediments from greater than 50 cm and preferably deeper. Surface sediments must be avoided. Hoppers should be cleaned as thoroughly as possible at the completion of the last dredging. Overseas vessels should be cleaned while outside coastal Australian waters. All vessels entering an Australian port from overseas must obtain a quarantine ship clearance from DAFF Biosecurity (formerly the Australian Quarantine and Inspection Service - AQIS). Hoppers of vessels considered a risk should be inspected before dredging commences, and, for overseas vessels, preferably before they depart for Australian waters. Exotic species found during inspection of the hopper in Australia can impose considerable costs and delays to the dredging while they are removed. It is important that the need for precautions with regard to exotic species is clearly indicated at the tender stage of the proposed dredge project.

4.13 Release of nutrients

Dredging will release nutrients contained in pore water from dredged sediments. The levels of nutrients are not significant for any but large dredging projects. Levels of nutrients released into the water column should be monitored where dredging occurs during seasons in which algal blooms are likely. Spoil may change the ability of sediments to remove nitrogen by reducing the effectiveness of de-nitrification processes.

Algae should be monitored when dredging is undertaken at a location and during a period where algal blooms are likely. This is to establish whether dredging increases the risk of algal blooms. For small dredging proposals, algae should be monitored near and sufficiently distant from the dredging that it can be determined whether the bloom was initiated near to or distant from the dredging. To reduce costs, water samples may be collected and algae preserved with fixative and only analysed if a bloom occurs during the dredging. For large dredging projects, nutrient levels (N, P and silicate), as well as algae, should be monitored where *Rhizosolenia* spp. blooms are of concern.

4.14 Confined disposal

Confined disposal is appropriate for containment of fluidised clays where it is impractical to use a dredging method that does not cause fluidisation, or for containment of contaminated spoil. Uncontaminated spoil may be disposed of in natural seabed depressions, or specially dredged pits, between underwater bunds or upon flat substrate away from main shipping routes. Disposal in bunded areas or depressions is similar, but construction of bunds is more expensive and is not practical in very deep or very shallow water. Special disposal methods and care are required to ensure that spoil remains within the confined area intended. Long term planning should be undertaken in order to create a confined disposal site where there is an ongoing need for disposal of low-level contaminated spoil.

Small quantities of highly contaminated dredge spoil should be disposed of in a suitably licensed landfill for disposal of such wastes.

4.15 Capping of contaminated material

Capping is a cost-effective method of isolating contaminated sediments from the marine environment. Capping may be used with unconfined disposal where contaminated spoil is covered by clean sediment, or with confined disposal in which the cap may cover the spoil within a depression or between bunds. The capping needs to be deeper than the depth disturbed by animal burrows (30 to 50 cm). Special care must be taken during construction of the cap to ensure that capping material does not mix with the contaminated material below. Capping of silts and clays is technically difficult. Careful planning and appropriate work methods must be selected.

4.16 Land disposal

Onshore disposal is preferable where spoil is either significantly contaminated, or when fine sediments are likely to impact sensitive marine environments such as seagrass habitats. An assessment of the costs and benefits of a range of disposal options, including land disposal may be required when chemical contaminants exceed the low screening level, and toxicity or other tests indicate that levels are of concern. Proponents will be required to assess the costs and benefits of a range of disposal options, including land disposal. When chemical contaminants exceed the maximum screening level in seagrass habitats, onshore disposal using a cutter suction dredge is usually the preferred option. Land disposal is practical when using a cutter suction dredge and a dewatering site is available. It must generally meet the following requirements:

- occur within approximately 1 km of the dredging or within 3 km if the additional expense of a booster station is justified;
- have little value in its existing state;
- be large enough for containment bunds suitable for dewatering to be constructed;
- be able to be secured so that quicksand-like properties of fines present no safety risks;
- be acceptable to remain in a degraded state for up to 12 months or more if an extended period for dewatering/drying is required;
- be sited so that it is practical for seawater to be discharged back into the sea or an estuary rather than into a freshwater stream, where impacts would be unacceptable;
- be able to be drained so that evaporative water loss from the bunded area is minimised so that excessive salt is not retained in the sediment;
- be accessible to trucks if it is planned to empty the site prior to the next dredging operation;
- be acceptable to the informed public (considerable consultation with those parties that may be affected is necessary); and
- the turbidity of water discharged from land disposal sites should not exceed 50 NTU and should routinely be less than 25 NTU. It should be controlled by increasing the length of travel of water, to maximise settlement of solids within the discharge area, and, when necessary, by use of silt screens. The turbidity (and possibly contaminant concentrations) of the discharge should be monitored.

4.17 Assessing spoil-ground stability

The fate of sediments deposited on a spoil ground should be confirmed where there is uncertainty. Methods could include detailed hydrographic surveys of historical changes to depth on and (particularly) near the spoil ground, tracer studies, placement of turbidity meters on and near the spoil ground, placement of measuring stakes within the spoil dump, and observations of revegetation and recolonisation of spoil grounds. Sequential aerial photography and/or monitoring at sites may be appropriate where environmental changes (due to changes in sediment transport processes) are anticipated and spoil may move from the ground.

4.18 Assessing biological effects of contaminated sediments on spoil grounds

The health of biological communities on large spoil grounds that receive significant quantities of contaminated sediment should be monitored. The frequency of monitoring should not be determined until the extent of impacts from historical deposits of contaminated sediments is known.

Assessment of sediment toxicity through an analysis of past impacts is likely to be a more reliable and cost-effective means of assessing sediment toxicity than (short term) laboratory tests and may reduce the need for these tests. Improved spoil ground management involving separate disposal regions for mildly contaminated and uncontaminated sediments, together with monitoring of sediment contamination and biological communities would greatly improve the sensitivity of this approach. Records should be maintained of the source and contamination status of spoil dumped in different areas of the spoil ground. The capacity to cap contaminated

sediments on the spoil ground, if they create toxic effects in the field (determined through monitoring), may reduce the need for routine laboratory sediment toxicity testing. It is usually wise to identify the source of contaminated sediments. The need for further biological assessments should be reviewed and the level of monitoring altered appropriately once the sources of contaminated sediments are identified.

4.19 Marine fauna protection measures

A range of activities associated with dredging may impact on resident and migratory marine fauna. There is the real risk of potential injury or loss of marine fauna due to interaction or collision with dredge vessels and associated equipment. Marine fauna may potentially be impacted by the underwater noise generated from dredging operations.

The proponent must be aware of all marine fauna that has the potential to be impacted by the proposed dredge operation, as well as the potential EPBC listed species which may be present. These species are listed as matters of NES under the EPBC Act and may include whales, coastal dolphins, dugongs, crocodiles, sawfish, marine turtles and migratory birds.

Protection measures for marine fauna should be incorporated into the EMP and would include monitoring and reporting on species present, measures for minimising vessel interactions/collisions with coastal dolphins, marine turtles, dugongs and other large marine fauna, and potentially shutting down dredge operations in their presence. Monitoring of marine fauna should include the measurements of any bioaccumulation of metals or any other identified parameters resulting from dredging.

4.20 Maritime heritage sites

There are a number of sites in Darwin Harbour subject to the NT *Heritage Conservation Act 2011* and *the Historic Shipwrecks* Act (refer to Section 3). The conservation of heritage sites is pro-active, meaning there are automatic protection provisions to safeguard unregistered or unidentified significant heritage sites. Works in submerged areas need to consider possible disturbance and protection of such sites.

The proponent must be aware of the Australian National Shipwreck Database of all registered shipwrecks. It allows users to search for those historic shipwrecks protected by Commonwealth or State/Territory legislation (refer to Section 3).

4.21 Control of noise and odour

4.21.1 Ambient (airborne) noise and odour

Dredging activities have the potential to create temporary environmental nuisances such as noise (machinery and boat movement) and odour (exposure of anaerobic sediments).

Potential sources of noise during dredging activities can include general vessel traffic. These activities may disturb marine fauna to varying degrees.

Noise and odour issues need to be anticipated, appropriate mitigation processes negotiated and effective consultation engaged with parties that could potentially be affected by the nuisance.

The proponent can refer to the Waste Management and Pollution Control *Noise Guidelines for Development Sites* at the following link:

https://ntepa.nt.gov.au/__data/assets/pdf_file/0005/284684/noise_guidelines_for_development_sites.pdf

Noise is mitigated by:

- selecting quiet equipment;
- minimising unnecessary boating activities associated with dredging;

- employing engineering solutions for noise attenuation;
- limiting operation times;
- ensure dredging equipment is well maintained; and
- implementation of Noise Management Plans and Noise Management Systems.

Dredging does not appear to have caused significant noise problems in urban areas because most dredging occurs well away from residential areas. Special precautions may be required to avoid excessive noise where dredging occurs near residential areas.

Management should give priority to liaising with the local residential community so that it can be aware of, and resolve noise issues. The disturbing effects of noise depend on the level of the noise and its character, such as tones, intermittency, etc. Higher-frequency tones are more disturbing than lower-frequency tones. Lower frequency tones are not easily controlled and can penetrate buildings such as houses. Noise can cause physical and psychological stress in employees and neighbours of the plant.

4.21.2 Underwater acoustic impacts

Dredging may create underwater noise in various forms and intensities above current ambient levels. Marine mammals (coastal dolphins, dugongs) and marine turtles (Green, Hawksbill, Flatback and Olive Ridley) for example, may be adversely impacted by increased noise in the underwater environment.

4.22 Public notification and engagement

The proponent should notify the public of proposed dredging operations in an appropriate manner and ensure all necessary precautions are undertaken to ensure public safety. There may be a requirement for community consultation – particularly if the dredging proposal requires formal environmental assessment. The NT EPA's formal EIA process is undertaken in a systematic and transparent manner which provides opportunities for public review and input.

5 Conclusion

Dredging is a necessary activity to establish and/or maintain port operations, marine infrastructure, harbours and waterways. Dredging and dredge spoil have significant potential to cause environmental harm to ecosystem health and to impact recreational and cultural amenity.

Dredging activities must be designed, managed and monitored to mitigate environmental impacts within approved limits, whilst maintaining project feasibility. Proponents must consider methods to mitigate potential impacts of proposed dredging activities and to design appropriate best practice data collection, modelling and monitoring programs prior to dredging operations.

6 References

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7 Further Information

These guidelines have been produced to provide relevant parties with NT specific information, to take into consideration when proposing a dredging operation. For more information, please contact:

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Appendix 1 - Approvals and Permits for Dredging Operations

Permit and Approvals	Agency Contact	Administrative Process
Sea Dumping Permit	Commonwealth (DoE)	A permit under the Sea Dumping Act may be required if dredge spoil from a project undertaken in the Northern Territory, is to be disposed of in Australian waters. Appropriate form and guidelines to apply for a permit are available on the DoE website: http://www.environment.gov.au/coasts/pollution/dumping/index.html
Approval under the EPBC Act	Commonwealth (DoE)	The EPBC Act provides for the protection and management of matters of National environmental significance. The EPBC Act webpage also has a search tool that helps determine whether NES matters occur in the area of a proposed activity. To generate a map and environmental report on the area refer to: http://www.environment.gov.au/erin/ert/epbc/index.html
Waste Discharge Licence	NT EPA	Dredging operations in NT waters may require a waste discharge licence under the NT *Water Act.* Refer to Guide to Waste Discharge Licences and the Waste Discharge Licensing Process on NT EPA website: https://ntepa.nt.gov.au/__data/assets/pdf_file/0004/284683/guidelines_waste_discharge_licences.pdf
Declared (and proposed) protected conservation areas	Parks and Wildlife Commission Parks Australia (08) 8920 1300	Kakadu National Park and associated waters are administered by the Australian Government and the developer should contact Parks Australia North for permits for operations in or potentially affecting these areas. http://www.environment.gov.au/parks/permits/index.html
Fisheries, Fisheries Habitats and Management Areas Permit	Department of Primary Industries and Fisheries (DPIF) – Fisheries Senior Licensing Officer (08) 89 99 2144 fisheries@nt.gov.au	Under the NT *Fisheries Act* dredging activities that may damage any fishery, fisheries management area, aquaculture lease or fisheries habitat may require a special permit (under section 16) from the Director of Fisheries, DPIF to proceed. Clause 15 of the Act suggests that certain activities cannot be undertaken where they have the potential to detrimentally effect aquatic life – specifically Clause 15(c) and 15(e). Fisheries management areas within the Darwin Harbour include East Point and Doctor's Gully. http://www.nt.gov.au/d/Fisheries/
Aboriginal Lands	Relevant Aboriginal Land Council: Northern Land Council (08) 8920 5100 Tiwi Land Council (Tiwi Islands) (08) 8981 4898	Over 84% of the NT coastline, including land down to the low water mark, is owned by Aboriginal people. Aboriginal lands are designated under the Commonwealth *Aboriginal Land Rights (Northern Territory) Act* 1976. It will be necessary to contact the relevant Aboriginal Land Council to obtain a permit to enter Aboriginal owned land. https://nt.gov.au/property/land/aboriginal-land-and-permits

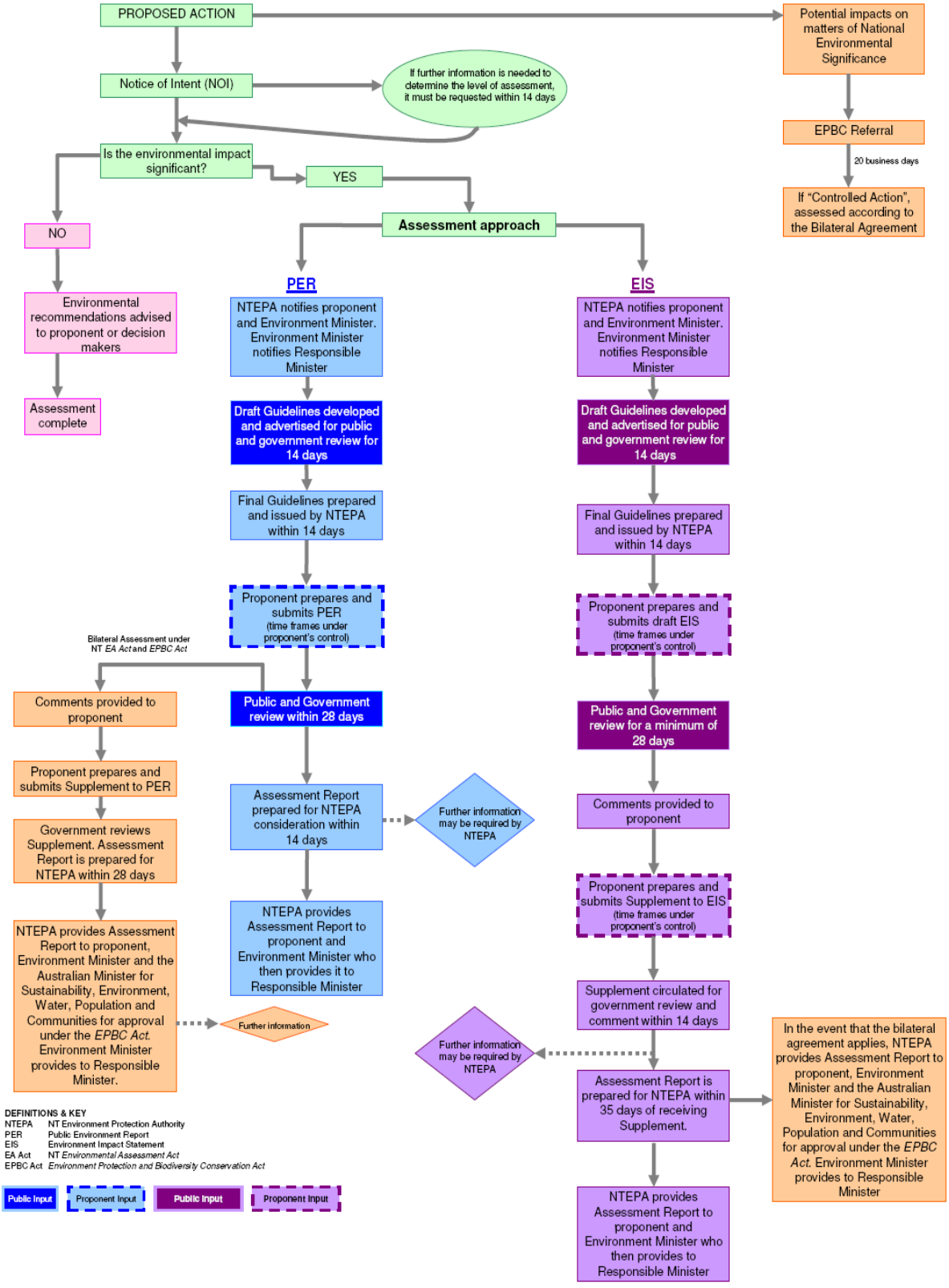
	Anindilyakwa Land Council (Groote Eylandt) (08) 8987 6710	
Aboriginal Sacred Sites and Sea Closures	Aboriginal Areas Protection Authority (08) 8981 4700 or email enquiries.aapa@nt.gov.au.	Locations of registered sites are obtained from the NT Aboriginal Areas Protection Authority. Inspection of the Register can be made in person or in writing on a standard form from the Authority website http://www.aapant.org.au/ If a person intends to carry out works enquiries should be made into obtaining an Authority Certificate. An Authority Certificate Request can be made from the form on the AAPA website: http://www.aapant.org.au/file/271/view
Sites protected under the NT *Heritage Act 2011; Historic Shipwrecks Act*	Heritage Branch (DLPE) Ph: (08) 8999 5039 heritage@nt.gov.au	Registered sites may include Aboriginal archaeological sites, shipwrecks or sites of natural conservation value. Macassan and Aboriginal sites are automatically protected. Contact Heritage Conservation Services directly to obtain information on known heritage sites in the proposed dredge area. https://nt.gov.au/property/building-and-development/heritage-properties-building-works-and-development
Areas covered by NT *Planning Act*	DLPE (Land and Planning Services) Ph: (08) 8999 6046 planning.dlpe@nt.gov.au	Dredging or dredge spoil disposal may constitute a land use requiring consent under a land use control plan The Development Consent Authority (DCA) is responsible for provisionally approving developments under the *Planning Act*. Information on whether the *Planning Act* may apply to a proposal is obtained from the DLP Lands Group. https://nt.gov.au/property/building-and-development/contact-lands-planning-and-development-assessment-services
Crown Lands requiring a miscellaneous licence	DLPE (Land and Planning Services) Ph: (08) 8999 6886 landadmin.dlp@nt.gov.au	This licence allows for the removal of non-metalliferous materials from Crown Lands under the NT *Crown Lands Act* 1992. The DLPE Land Administration Branch should be contacted with respect to this licence.
Certificate of Survey, Certificates of Competency, Determination of the Safety Manning	DLPE (Marine Safety Branch) Ph: (08) 8924 7100 marinesafety@nt.gov.au	Safety and navigational aspects of dredging operations are the responsibility of the Marine Safety Branch (MSB) of DLPE. https://nt.gov.au/marine/marine-safety

Appendix 2 - Policies and Guidelines Applicable for Dredging Operations

Policies and Guidelines	Relevance
Australia and New Zealand Environment Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) *Guidelines for Fresh and Marine Water Quality*, 2000. *National Water Quality Management Strategy*,1994. (SEWPaC). *The Framework for Marine and Estuarine Water Quality Protection – Version 1*, 2002. (SEWPaC).	Guides the setting of water quality objectives to sustain environmental values. Provides specific water quality objectives for environmental values and the context in they should be applied.
Commonwealth of Australia *National Assessment Guidelines for Dredging*. Canberra, 2009.	Guides the assessment of quality of sediments in marine waters. Sets levels of substances in sediments below which toxic effects on organisms are not expected, and levels at which bioaccumulation tests are required and bioaccumulation may be of concern even where toxicity has not been identified. The dredging guidelines set out the framework for the environmental impact assessment and permitting of the ocean disposal of dredged material, including assessing potential impacts on the marine environment and other users
Darwin Harbour Water Quality Protection Plan (in prep.). *Towards the Development of a Water Quality Protection Plan for the Darwin Harbour Region – Phase One Report*, NRETAS (now DLRM) - Aquatic Health Unit, 2009.	Plan to identify and address key water quality risks to values of Darwin Harbour and its catchments. Follows the Commonwealth *Framework for Marine and Estuarine Water Quality Protection*. Phase One Report describes activities undertaken thus far in developing a Water Quality Protection Plan for the Darwin Harbour Region.
A Review of Environmental Monitoring of the Darwin Harbour Region and Recommendations for Integrated Monitoring, 2005. Darwin Harbour Advisory Committee (DHAC).	Facilitate the development of integrated environmental monitoring program for Darwin Harbour Region (in accordance with the Darwin Harbour Regional Plan of Management – now replaced by the Framework below).
AS 1289 Method for testing soils for engineering purposes series.	Comprises over 60 methods for: soil sampling and preparation; soil moisture content tests; soil classification tests; soil chemical tests; soil strength and consolidation tests; and soil reactivity tests.
AS 2436-1981 Guide to Noise Control on Construction, maintenance and demolition sites.	Guidance on noise control in respect of engineering construction, maintenance and demolition works, including guidance in investigation and identification of noise sources, measurement of sound, and its assessment, with a view to the planning of measures for noise control.
Australian Ballast Water Guidelines for Shipping, Australian Quarantine and Inspection Service –AQIS (now DAFF Biosecurity).	Sets ballast water standards.
Constructed Wetlands in the NT – Guidelines to Prevent Mosquito Breeding, Department of Health and Families	Guidelines for the siting and design of constructed wetlands to reduce potential for mosquito breeding. Wetlands include urban stormwater.

Policies and Guidelines	Relevance
(DHF), undated.	
Erosion and Sediment Control Guidelines; built environment, service corridors, transport corridors, rehabilitated old infrastructure, (undated), NRETAS (now DLRM).	Guidelines to inform activities that may impact on surface stability and sediment movement. Provides advice on developing Erosion and Sediment Control Plans.
Guidelines for Preventing Mosquito Breeding Associated with Construction Practice Near Tidal Areas in the NT, DHF,2005.	Checklist for planners, engineers or any supervisory officers, responsible for the planning, impact assessment or implementation of any construction activity near tidal areas, in order to prevent the creation of mosquito breeding sites.
Darwin Harbour Strategy, DHAC, 2010.	A comprehensive guide for the responsible stewardship and sustainable development of the Darwin Harbour region. It sets out goals, principles and guidelines for all users and stakeholders of Darwin Harbour and its catchment to embed in their planning for any action which could have an impact on the region. A key objective is to achieve a balance between environmental, social and economic values.
Darwin Harbour Regional Management Strategic Framework 2009 – 2013, DHAC	Policy framework and guidelines for management of environment, social, cultural and economic values and uses of the Darwin Harbour. Sets goals and guidelines for the Harbour waters.
Darwin Harbour Water Quality Protection Plan (in prep).	Plan to identify and address key water quality risks to values of Darwin Harbour and its catchments. Follows the Commonwealth *Framework for Marine and Estuarine Water Quality Protection*.
DPC Environmental Management System (EMS), Environment Policy and Occupational Health and Safety Policy.	Basis on which DPC manages and operates the whole of the Port of Darwin with due regard to safety and the environment.
DPC Cyclone Procedures (2008-2009).	Actions undertaken during cyclone warning and threat.
Mangrove Management in the Northern Territory, Department of Infrastructure, Planning and Environment, 2002.	Direction for the research and management of mangrove ecosystems.
Environmental Guidelines for Reclamation in Coastal Areas (NRETAS), 2006.	Developed by the NRETAS (now DLRM) to provide practical environmental advice to developers planning to undertake reclamation work in coastal regions of the NT. They apply to activities such as foreshore filling, in coastal areas and along rivers, marina and port developments, and development occurring on coastal floodplains. Includes management of ASS and removal of mangroves.
Land Clearing Guidelines, NT Planning Scheme, 2006.	Technical advice for planning and conduct of land clearing.

Appendix 3 - NT Environmental Assessment Process



Appendix 4 - Dredging Approvals Process in the Northern Territory