ntepa Northern Territory Environment Protection Authority

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

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Version 1.2

1 Foreword

Dredging involves the excavation, lifting and transport of underwater 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 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

These guidelines provide information for those planning to dredge in the marine and estuarine waters of the Northern Territory. The issues for proponents to consider in submitting their proposals for environmental assessment, for the acquisition of the necessary statutory instruments and the development of appropriate Environmental Management Plans for their projects are outlined. The guidelines apply to Northern Territory marine waters that generally extend to the three nautical mile limit from the coast. Most dredging activities in the Northern Territory occur within NT Government jurisdictional waters.

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 and Notice of Intent.

The NT EPA assesses dredging proposals under the NT *Environmental Assessment Act*. It is expected that proponents for any dredging activity submit a Notice of Intent (NOI) to the NT EPA that must include:

- the location of the site to be dredged;
- the quantity and physical and chemical characteristics of the spoil;
- the site for disposal of the dredge 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.

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 Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) assess and regulate proposed dredging activities outside of NT waters and where the activity may impinge on matters of national environmental significance. This is conducted under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. A Sea Dumping Permit issued under the Commonwealth administered Sea Dumping Act may be required if dredge spoil from a dredging project within NT waters is to be disposed of outside of NT waters. To provide guidance for planning dredging and offshore disposal activities, the Commonwealth has issued *"National Assessment Guidelines for Dredging" (2009).*

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.

This Guidance is designed to ensure that a proposed dredging project, its predicted severity, extent and duration of impacts, are outlined effectively. A dredging proposal may be subject to formal environmental impact assessment by the NT EPA.

2.2 Limitations of this Guidance

This Guidance:

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

Dredging is the excavation, transport and relocation of solid matter from the seabed of any marine, coastal or estuarine waters. Dredging generates dredge spoil and requires disposal of spoil to land, dedicated spoil grounds, or side-casting at a distance removed from the dredging activity. Dredging is required to create and maintain channels, berths and turning basins for shipping and boating. 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. The cost and effectiveness of measures to reduce impacts need to be considered.

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 is generally done underwater. There are situations where it can be carried out largely above water, either in intertidal areas during low tide or behind bunds 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 at existing 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.

Dredging for marine mining operations that target mineral resources is yet to be proposed for NT waters. Access to the Fannie Bay sand bar for construction material associated with the development of Cullen Bay Marina in 1992-93 would be considered a dredging operation.

Dredge spoil can be handled in a number of different ways. Dredged material 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.

Material dredged for pipeline trenches may be placed on the seabed adjacent to the trench before being placed back into the trench after the pipe has been laid.

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. Information regarding the operation of different types of dredges and the factors that influence their selection can be found at web sites that include the following:

http://www.iadc-dredging.com/ ; http://www.boskalis.com/ ; http://www.jandenul.com/ ; http://www.vanoord.com/

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.

3 Legislative and Administrative Requirements

There is a range of legislative and administrative requirements that relate to dredging operations. These need to be identified and completed before any dredging project commences operational activity. The time for 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.

3.1 Legislation

3.1.1 Marine & Coastal Waters Jurisdiction

A package of legislation known as the Offshore Constitutional Settlement (OCS) provides the Northern Territory Government with jurisdiction of waters within three nautical miles seaward of the territorial seas baseline. NT jurisdiction extends to Coastal Waters (3 nautical miles measured seaward from the territorial sea baseline) and includes Van Diemen and Beagle Gulfs. Additionally, in the context of fisheries the OCS arrangements also provide for the NT to manage (under NT legislation) all aquatic life resources in the Adjacent Area (i.e. Coastal Waters out to the Australian Fishing Zone).

Geoscience Australia has a major role in the delineation of Australia's maritime boundaries and the Maritime Boundaries Unit maintains the Australian Maritime Boundaries Information System (AMBIS). This is a geographic information system encompassing maritime boundaries. For more information and detailed maps on maritime boundaries refer to:

http://webmap.ga.gov.au/pdf/auslig/geoambis.pdf

3.1.2 Northern Territory Legislation

Dredging proposals in NT waters are subject to consideration under the *Environmental Assessment Act.* Additional NT legislation that may apply to dredging activities is included below:

Conservation, Cultural & Heritage

- *Northern Territory Aboriginal Sacred Sites Act*
- *Territory Parks and Wildlife Conservation Act*
- *Heritage Act*

Land Use

- *Planning Act*
- *Aboriginal Land Act*

- *Aboriginal Land Rights (Northern Territory) Act 1976 (Cth)*
- *Native Title Act 1993 (Cth)*
- *Crown Lands Act*
- *Soil Conservation and Land Utilisation Act*

Industry

- *Fisheries Act*
- *Petroleum (Submerged Lands) Act* – where dredging is proposed for exploitation of petroleum
- *Energy Pipelines Act* - for example the laying of a submerged pipeline to convey product
- *Mining Management Act* - provide for the authorisation of mining activities, the management of mining sites, the protection of the environment on mining sites, the provision of economic and social benefits to communities affected by mining activities.
- *Minerals Titles Act (NT)*

Water Quality & Biodiversity

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

Air Quality, Noise and Waste Management

- *Waste Management and Pollution Control Act*

Safety and Navigational

- *Marine Act*
- *Darwin Port Corporation Act*
- *Workhealth and Safety (National Uniform Legislation) Act 2011*

3.1.3 Commonwealth Legislation

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

Commonwealth legislation *Environment Protection (Sea Dumping) Act 1981*) and associated guidelines are designed to give effect to the *London Protocol*. This is applied to regulate sea dumping in Australian waters, including in the majority of the NT's waters. This document will guide the NT in preparing any advice it may provide to the Commonwealth in relation to sea dumping proposals that have potential to impact the NT's marine environment.

Matters of national environmental significance listed in the EPBC Act may be relevant to dredging proposals in NT waters. The Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC), administers the *Environment Protection (Sea Dumping) Act 1981*, and the *EPBC Act 1999*. It is not usually appropriate for the

NT EPA to advise proponents on the Commonwealth's requirements. Proponents should ensure they make their own representations to SEWPaC as appropriate in relation to the *EPBC Act*, the *EP (Sea Dumping) Act* or any other federal legislative or policy requirement.

3.1.3.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth's EPBC Act provides protection for matters of national environmental significance (NES). The Commonwealth agency determines whether a dredging proposal could potentially affect a NES matter and whether it requires assessment and approval under the EPBC Act. The NES matters are:

- World Heritage properties;
- National Heritage Places;
- Ramsar wetlands of international importance;
- Nationally threatened animal and plant species and ecological communities;
- Internationally protected migratory species (including marine mammals and crocodiles);
- Commonwealth marine areas;
- Great Barrier Reef Marine Park; and
- Nuclear actions (including uranium mines).

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

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

3.1.3.2 Environment Protection (Sea Dumping) Act 1981

Dredging or disposal of spoil undertaken outside the NT sea boundaries requires Commonwealth approval under the *Environmental Protection (Sea Dumping) Act*. Areas such as Darwin Harbour lie within the limits of the Northern Territory and are not subject to this legislation unless dredging activities affect or could potentially affect waters outside this limit. A Sea Dumping Permit issued by SEWPaC may be required for dredging operations involving dumping of spoil at sea. Detailed guidance on how the Commonwealth will assess and permit dredging activities is available at:

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

3.1.3.3 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 and Heritage 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 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.

There are a number of sites in the Darwin Harbour subject to the NT *Heritage Act.* Works in submerged areas need to consider possible disturbance and protection of such sites.

3.2 Approvals and Permits

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.

3.3 Environmental Impact Assessment

The *Environmental Assessment Act (1982)* and *Environmental Assessment Administrative Procedures (1984)* form the basis of the environmental assessment process and are administered by the NT Environment Protection Authority (NT EPA).

Environmental Impact Assessment (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 Environmental Impact Assessment Process at 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 monitoring and management options.

If a project requires formal EIA, it is undertaken in a systematic and transparent manner with opportunities for public review and input. The proponent is required to prepare and submit documentation describing the proposal, the risks and potential environmental impacts and how the risks would be controlled and impacts managed. Concerns raised by Government and the public during the assessment need to be addressed by the proponent.

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

4 Environmental Issues

4.1 Potential environmental impacts

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 the dredging and 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;
- conflict with fisheries and impacts on fish, their habitats and fisheries production;
- changes to coastal processes and water circulation that impact on the community's use of the coast and coastal waters; and
- impacts on the behaviour and survival of aquatic life, including protected species.

Dredging may have implications for marine conservation reserves and heritage sites. In all cases, 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.

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

4.2 Sediment mobilisation

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 and land reclamation; and
- during dredge spoil disposal.

Physical interaction of dredging equipment with the seabed causes a mixture of sediment particles 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, 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 mostly of sediment-laden water with some coherent dredged solids. Dredge spoil may overflow from the vessels/dump 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.

The mechanical process of the dredge equipment may alter the characteristics of the sediment liberated into the water column.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 and a very good way 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.

5 Assessing Dredge Spoil Disposal

Sections 5.1 – 5.3 include dredging guidance material provided by the Commonwealth (2009) which can be adapted for use in the NT. The Commonwealth guidance is for proponents who may need to dredge in, and/or dispose of dredge spoil to, Commonwealth waters. This approach, specifically the process to characterise dredge spoil in terms of its physical and chemical status, has been adopted by the NT for the assessment, management and disposal of dredge spoil within NT coastal waters. This ensures consistency in environmental management and sediment characterisation across the jurisdictional boundary.

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 the NT guidelines to specific Appendices and Tables (which, when referred to, will be underlined in this document) associated with the Commonwealth guidance. 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 NT document.

5.1 Evaluating alternatives

All alternatives to marine disposal need to be evaluated, including the environmental, social and economic impacts of each disposal option. Potentially affected stakeholders or potential users of the dredged material are to be consulted.

Important elements of 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?
- 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).

Material unacceptable for ocean disposal is, in many cases, acceptable for onshore disposal. Contaminants of concern may not readily leach in land disposal sites and dredged material may gain a more benign inert or solid waste classification, rather than hazardous or industrial waste. Some of the principles applied in management of mine tailings can be applied to the management of dredge spoil on land.

5.2 Assessment of sediment quality

It is recommended that sediment quality data from the proposed dredge 'footprint' are considered using several lines of evidence (e.g. chemical testing, toxicity testing, bioavailability testing) to allow for a more informed assessment of the proposed spoil material contamination and its acceptability for marine disposal.

5.2.1 Phase I – Evaluation of existing information

Phase I involves reviewing existing information on the material proposed to be dredged. This may allow determination of which contaminants are of concern and whether existing information sufficiently characterises the sediments without further testing.

Existing chemical or toxicity data for the sediments of the area to be dredged have a maximum currency 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 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 should contact the NT EPA to seek 'exemption' from further testing if they believe further testing is not warranted.

Data need to be collated and analysed, with evidence and supporting advice provided to the NT EPA. The assessment moves to Phase II where there is insufficient valid information to identify and/or characterise potential contaminants.

Exemptions from some or all of the sediment testing requirements are possible under certain circumstances. All such exemptions will require endorsement from 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.

5.2.2 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. Sediments cannot be expected to be clean in inner harbour and berth areas, marinas or near outfalls and stormwater discharges.

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.

5.2.3 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.

5.2.4 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.

5.2.5 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 to see if impacts can be successfully mitigated where sediments are found to be unacceptable for unconfined marine disposal after the weight-of-evidence assessment, and should the proponent, after evaluating alternatives, still wish to consider marine disposal,

5.3 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 (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 Environmental Impact Assessment 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.

5.4 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.

5.5 General approach to predicted impact on benthic habitats

This assessment framework is designed to impart clarity and consistency to the way predicted impacts on benthic biota are 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);
- Integrating predictions with monitoring and management (Section 5.7.4 and 5.7.5).

5.5.1 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 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.

5.5.2 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.

5.6 Describing impacts

Environmental impact assessment 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 monitoring and management strategies.

The NT EPA expects that direct and indirect impacts are 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.

5.7 Generating predictions

5.7.1 General

Predicting direct impacts of dredging is relatively straightforward as these impacts are generally tightly 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.

5.7.2 EIA and modelling

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 all relevant proponent documentation is not provided, is ambiguous or includes unsubstantiated conclusions.

5.7.3 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.

5.7.4 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 minimise 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;
- a 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.

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

5.7.5 A risk-based environmental monitoring and management framework

The framework around which to design environmental monitoring programs should be risk-based using understanding of cause-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. Environmental management plans should reflect contemporary best practice and ideally be risk-based, using readily measurable indicators to trigger management responses to prevent unacceptable impacts.

5.7.6 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.

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).

5.7.7 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);
- 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.

6 Other Environmental Issues

6.1 Acid sulfate soils

'Acid Sulfate Soils' 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. Proponents should also refer to the *NT EPA Draft Guidelines for the Environmental Assessment of Acid and Metalliferous Drainage (2013)*.

6.2 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.

6.3 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 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.

6.4 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 must occur 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 must be 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.

6.5 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, or between underwater bunds. 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.

6.6 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.

6.7 Land disposal

Onshore disposal is preferable where spoil is either seriously 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).
- 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.

6.8 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.

6.9 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.

6.10 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 National Significance (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.

6.11 Maritime heritage sites

As mentioned in Section 3.1.3.3 there are a number of sites in Darwin Harbour subject to the NT *Heritage Conservation Act 2011* and *the Historic Shipwrecks Act.* 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, as outlined previously in Section 3.

6.12 Control of Noise and Odour

6.12.1 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 *Guidelines for Development Sites* at the following link:

http://www.ntepa.gov.au

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
- development 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.

6.12.2 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.

Marine noise modelling is a method that can be used to assist in determining underwater noise impacts and will allow for appropriate recommendations to be included in the EMP.

6.13 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.

7 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 minimise environmental impacts while 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.

8 References

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9 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 (SEWPaC)	A permit is required for dredging operations involving the dumping of spoil at sea outside the limits of NT waters. Appropriate form and guidelines to apply for a permit are available on SEWPaC website: http://www.environment.gov.au/coasts/pollution/dumping/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 NRETAS website: http://www.ntepa.gov.au
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 Anindilyakwa Land Council (Groote Eylandt) (08) 8987 6710	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. http://lands.nt.gov.au/land-admin/aboriginal-land-permits
Aboriginal Sacred Sites and Sea Closures	Aboriginal Areas Protection Authority (08) 8981 4700 or email enquiries.aapa@nt.gov.a	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

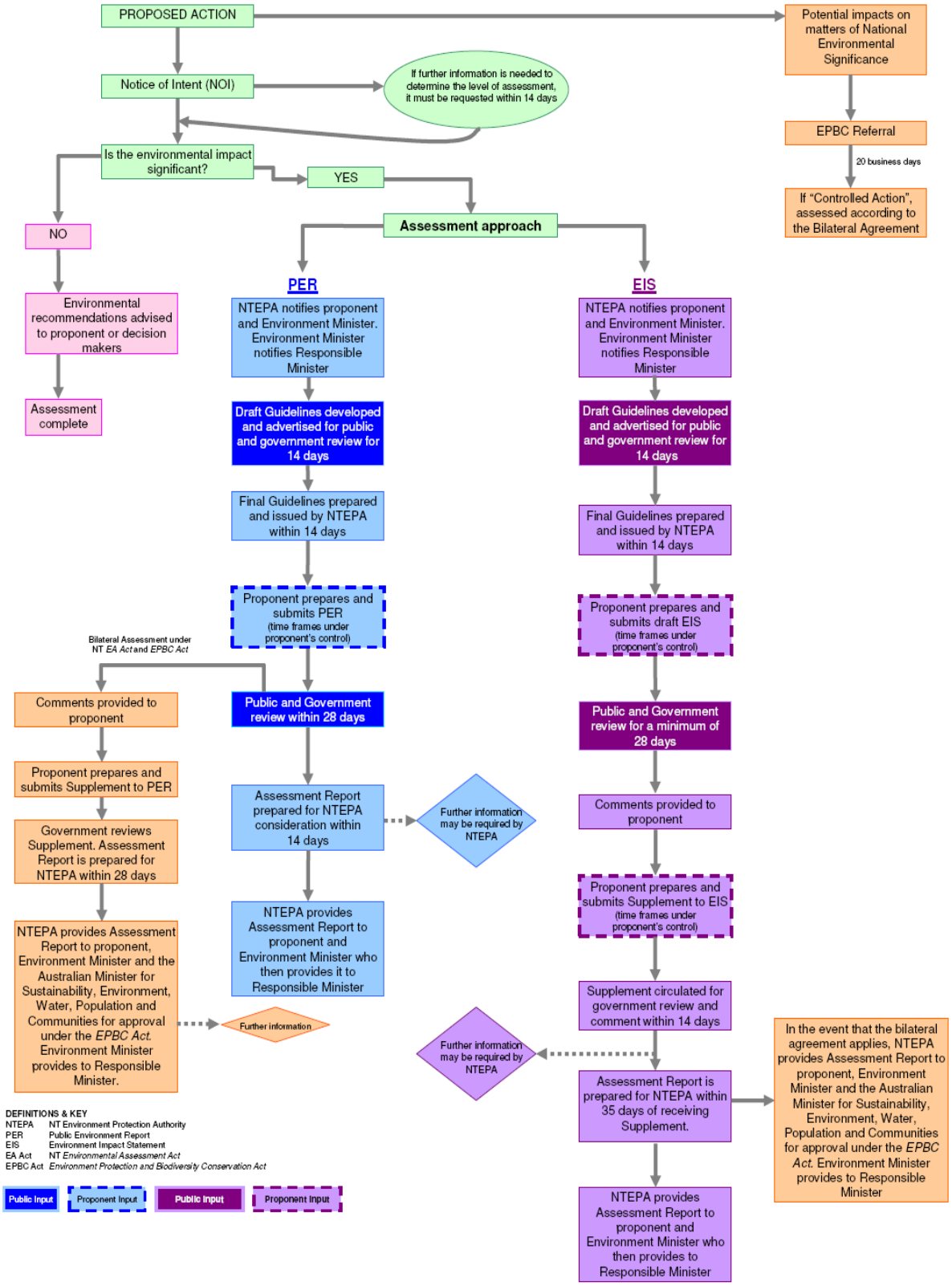
	u.	http://www.aapant.org.au/ If a person intends to carry out works enquiries should be made into obtaining an Authority Certificate. Information regarding sea closures is obtained from the Land Administration Branch of the DLPE (Land Services). http://www.lands.nt.gov.au/land-admin/aboriginal-land-permits
Sites protected under the NT *Heritage Act 2011; Historic Shipwrecks Act*	Heritage Branch 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. http://www.dlpe.nt.gov.au/heritage/about-us
Areas covered by NT *Planning Act*	Department Lands and Planning – Lands Division Ph: (08) 89 99 6046 das.dlp@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. http://www.lands.nt.gov.au/planning/planning
Crown Lands requiring a miscellaneous licence	Department of Lands and Planning – Lands Division 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 DLP Land Administration Branch should be contacted with respect to this licence. http://www.lands.nt.gov.au/land-admin/crown-land-management
Certificate of Survey, Certificates of Competency, Determination of the Safety Manning	Marine Safety Branch Ph: (08) 89 247100 marinesafety@nt.gov.au	Safety and navigational aspects of dredging operations are the responsibility of the Marine Safety Branch (MSB) of DLP (Department of Lands and Planning) http://www.transport.nt.gov.au/safety/marine/commercial-information

Appendix 2 - Policies and Guidelines Applicable for Dredging Operations

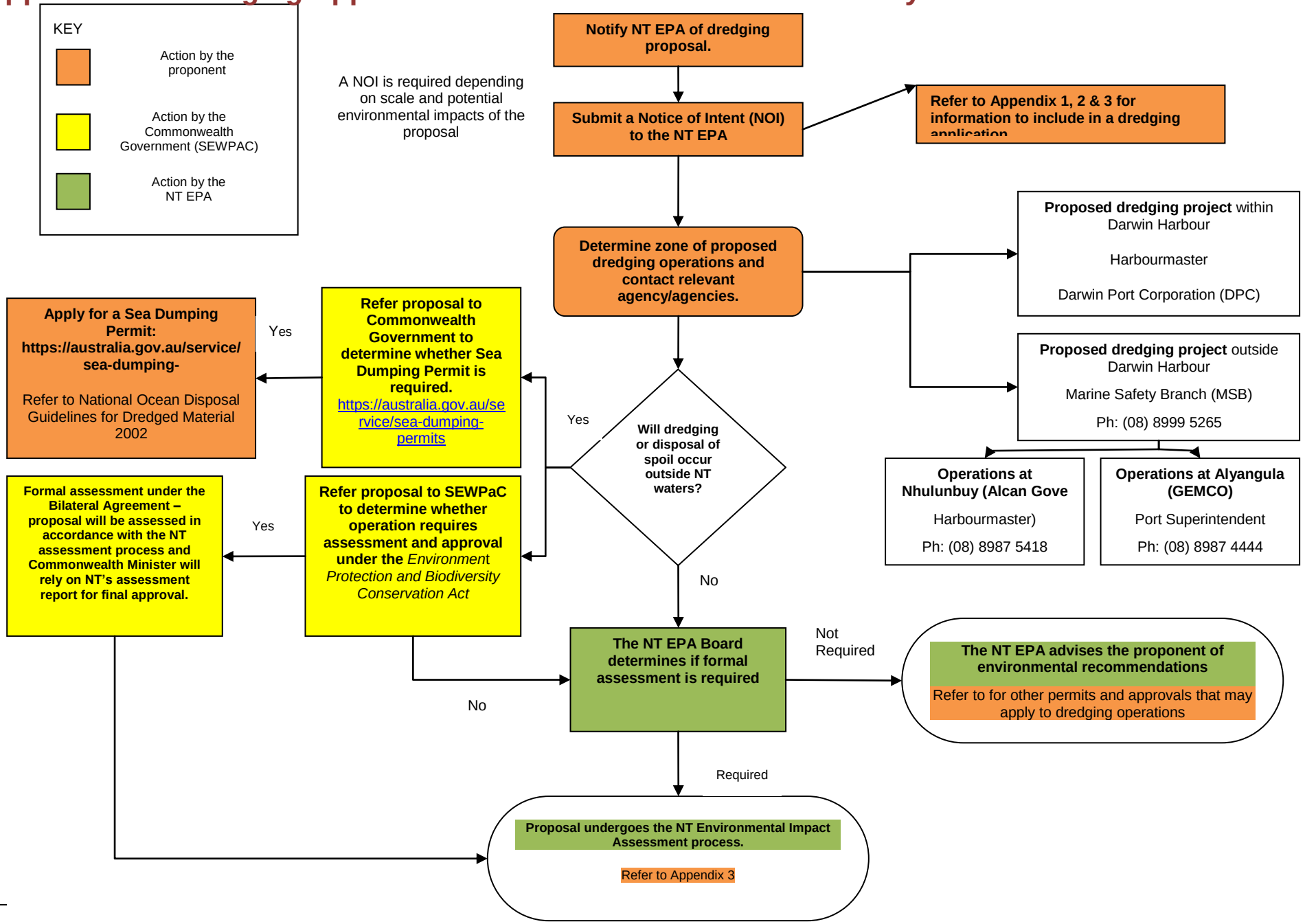
Policies and Guidelines	Relevance
Australia and New Zealand Environment Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) Guidelines for Fresh and Marine Water Quality (2000) National Water Quality Management Strategy (1994), (SEWPaC) 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 (DHF), undated.	Guidelines for the siting and design of constructed wetlands to reduce potential for mosquito breeding. Wetlands include urban stormwater.
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	Checklist for planners, engineers or any supervisory officers, responsible for the planning, impact assessment

Policies and Guidelines	Relevance
Practice Near Tidal Areas in the NT, DHF, 2005	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



Appendix 5 – Information Guidelines for a Notice of Intent (NOI)

The basic criteria for an NOI to meet the requirements of the *Environmental Assessment Act* consist of:

1. The name of the proponent and consultant on behalf of the proponent.

2. The address of proponent and contacts by phone, fax and email.

3. Location of proposal including all relevant information such as Lot/Section No., Town/Hundred, tenement details, registered owners of the site and ancillary information such as:

- adjacent roads;
- property and sea boundaries;
- detailed diagrams;
- aerial photographs; and
- topographic maps.

4. Description of a proposal in sufficient detail to permit a full understanding of the scope and scale of the proposal. Provision of attachments such as site designs and diagrams help in the evaluation of the proposal.

5. Outline of legislative consent and licensing requirements for approval of the proposal.

6. Brief description of site selection details and environmental factors such as geology, hydrology, land unit, land capability, water resources, flora and fauna habitats, coastal and marine environments.

7. Brief description of existing marine and land uses in and adjacent to the proposal.

8. Brief description of waste management and pollution control on and offsite.

9. Brief description of other environmental factors such as climate, heritage, feral and weed species, conservation, social, cultural, economic, endangered species and other relevant environmental issues.

10. Sacred sites clearance.

11. Description of timing of proposed action, including stages and decommissioning.

12. Brief description of proposed environmental commitments, safeguards, monitoring and management systems relevant to the proposal.

13. Brief description of proposed rehabilitation and decommissioning.

More specifically, a dredging proposal would require detailed information with regard to:

- **the location, timeframe and method for the proposed dredging activity;**
- **the affected project area,**
- **location of the proposed dredge spoil disposal site;**
- **the quantity, physical and chemical characteristics of the spoil, (including any potential spoil contaminants);**

- **potential environmental impacts of both the dredging activity and the spoil disposal on the surrounding environment;**
- **proposed environmental safeguards, including proposed modelling and monitoring programs during and post dredging operations (including disposal) plus baseline surveys in the absence of adequate existing information; and**
- **an Environmental Management Plan (EMP) that demonstrates how environmental issues and impacts will be effectively managed and mitigated.**

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 dredging design, safety and operational issues are satisfactory.