



ENVIRONMENTAL GUIDELINES

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FOR
RECLAMATION IN COASTAL AREAS



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DISCLAIMER

These guidelines provide assistance in the assessment and management of developments in coastal areas. The guidelines are not exhaustive and while they have been prepared in good faith, exercising all due care and attention, no representation or warranty, express or implied, is made as to the accuracy, completeness or fitness for purpose of the guidelines in respect of any user's circumstances. Users of the guidelines should undertake their own investigations and seek appropriate expert advice where necessary in relation to their particular situation. These guidelines may be updated when new information is made available or when land reclamation techniques change.

1.0 INTRODUCTION

These guidelines provide practical environmental advice to developers who are planning to undertake reclamation work in coastal regions of the Northern Territory. The guidelines apply to activities such as foreshore filling in coastal areas and along rivers, canal estate, marina and port developments, coastal aquaculture developments and development occurring on coastal floodplains. In order to minimise environmental impacts it is important to consider planning requirements before reclamation begins.

1.1 Why Have Coastal Reclamation Guidelines?

The object of the guidelines is to minimise the impacts of reclamation on coastal habitats and coastal water quality. The main environmental issues associated with land reclamation in coastal areas include the loss of natural habitat and the subsequent potential reduction in biodiversity, erosion of the coastline and pollution of the marine environment especially from acid sulfate soils. Issues related to land reclamation in the coastal zone include those associated with biting insects and engineering considerations such as subsidence and corrosion of building foundations.

The Northern Territory coast has extensive areas of mangrove lined estuaries and freshwater floodplains. Mangrove communities:

- sustain the commercial and recreational fishing industry, by acting as nurseries and feed areas for a wide variety of fish and crustacean species;
- provide protection of the shoreline and maintain water quality by stabilising sediments, preventing erosion and filtering run-off from the land;
- offer a range of recreational activities such as boating, fishing, bird watching, wildlife observation and photography as well as educational opportunities; and
- provide the environment for scientific research on the unique adaptations and ecological systems associated with mangroves.

In other areas of Australia the impact of population growth has had a significant adverse effect on the coastal zone, the Northern Territory is fortunate that much of the coastal zone is largely in its natural state. This provides the opportunity to learn from experience and plan for future development to minimise the impact on the natural coastal environment providing for the expected increase in population and the associated demand for coastal development.

1.2 Planning Requirements

1.2.1 Aboriginal land claims and native title claims

Before any coastal reclamation is undertaken, the status of the area with respect to Aboriginal land claims and native title claims must be clarified. Even in the absence of a specific native title claim over an area, there may be native title implications.

If the area is subject to either an Aboriginal land or a native title claim, certain procedures must be followed before reclamation is undertaken. These procedures will vary according to the nature of the claim. General guidelines are provided in Table 1. Further information can be obtained from the Aboriginal Land Branch of the Department of Planning and Infrastructure.

Table 1: Aboriginal Land Claims and Native Title Claims

| AREA | SUBJECT TO: | DEVELOPMENT PROCEDURES |
|--|--|---|
| All land between low water mark and NT territorial limits. | Aboriginal land claim under the <i>Aboriginal Land Rights (NT) Act</i> . | Land Claims must be resolved and be finally disposed of before development can proceed. |
| Intertidal zone between low and high water marks in areas adjacent to pastoral leases. | Aboriginal land claim under the <i>Aboriginal Land Rights (NT) Act</i> . | Land Claims must be resolved and be finally disposed of before development can proceed. |
| Some parts of coast | Native title under the <i>Native Title Act</i> . | According to the <i>Native Title Act</i> |

1.2.2 Control Plans and Consent Authorities

The planning requirements for a project depend on the area in which the development is to occur. All foreshore filling in areas covered by the Darwin Town Plan 1992 (as amended), for example, requires consent from the Development Consent Authority. All development covered by the East Arm Control Plan requires Ministerial consent. Development Assessment Services, Department of Planning and Infrastructure can provide more information regarding planning requirements.

Other approvals may be required from the Authorities outlined in Table 2.

Table 2: Coastal development requiring specific approval by NT Government Authorities

| Area or Type of Development | Consent Authority |
|-------------------------------------|--|
| Below high tide in Darwin Harbour | Darwin Port Corporation |
| Above low tide in NT Coastal Waters | Marine Branch, Department of Planning and Infrastructure |
| Aquaculture | Fisheries Group, Department of Primary Industries, Fisheries and Mines |
| Mineral or oil and gas exploration | Mines and Petroleum Management Division, Department of Primary Industries, Fisheries and Mines |
| Dredging Operations | Environment Protection Agency, Department of Natural Resources, Environment and the Arts |

1.2.3 Environment and Heritage Planning

A number of environmental and heritage issues must be considered prior to undertaking any reclamation. Table 3 provides a checklist of these issues and the appropriate procedures for addressing them.

1.2.4 Site Management Planning

Before commencing reclamation activities, an environmental management plan should be prepared. The plan should consider the purpose of the reclamation, the physical constraints of the site (such as storm surge, reclamation extent, erosion and siltation) and significant natural or cultural features. Potential acid sulfate soils should be identified at this stage. Consideration of these issues during the design stage will have long term environmental and economic benefits, whereas mitigation of problems after they have arisen is often time consuming and costly.

Development that requires direct access to the sea should be designed to ensure that only the minimum required amount of reclamation is undertaken. This can be achieved by confining most site development to above the intertidal zone and retaining as much of the natural land/sea interface as possible.

Reclamation in coastal areas can affect the local hydrodynamics (water movement) and lead to erosion or siltation in unexpected areas. The Natural Resource Management of the Department of Natural Resources, Environment and The Arts should be contacted early in the planning stage for advice in this area.

Table3: Environmental and Heritage issues to be considered in reclamation developments and the appropriate development procedures.

| Environmental Consideration | Development Procedure |
|--|--|
| Does the development have potentially significant environmental impacts? | The proposal may be required to undergo formal assessment under the NT <i>Environmental Assessment Act</i> . This will be decided by the Minister for Natural Resources, Environment and Heritage, following consideration of a Notice of Intent or formal development application.* The proposal may also require assessment under the Commonwealth's <i>Environment Protection and Biodiversity Conservation Act</i> , if the proposal has a potential impact on matters of national environmental significance. The Commonwealth's Department of Environment and Heritage should be contacted for further information. |
| Is the development within a National Park or Conservation Reserve? | Development must be undertaken in accordance with the provisions of the <i>Territory Parks and Wildlife Act</i> . |
| Will the development encroach on any sacred sites? | An Authority Certificate must be sought from the Aboriginal Areas Protection Authority under the NT <i>Aboriginal Sacred Sites Act</i> . |
| Will the development affect any heritage or archeological places or objects? | Heritage Clearances must be sought from the Minister for Natural Resources, Environment and Heritage through the Heritage Conservation Services of the Department of Natural Resources, Environment and The Arts. |
| Does the development impact on any Beneficial Uses? | Potential impacts on water quality will be managed by issue of a Waste Discharge Licence under the <i>Water Act 1992</i> .@ |

* Further information about the environmental assessment process can be found in *A Guide to the Environmental Impact Assessment Process in the NT*.

@ Further information on Beneficial Uses can be obtained from the Controller of Water, Natural Resource Management, Department of Natural Resources, Environment and The Arts. Beneficial uses have been declared for several coastal areas including Darwin Harbour and are Recreation and Aesthetics and Aquatic Eco-systems protection.

2.0 ENVIRONMENTAL MANAGEMENT ISSUES

The following sections suggest management techniques that can be used to avoid or minimise potential adverse impacts of reclamation works.

2.1 Acid Sulfate Soils

Sediments that contain iron sulfides and with a potential to oxidize and produce acid following disturbance are found in low-lying coastal areas, such as mangrove forests, salt marshes, estuaries, tidal lakes and coastal floodplains. Management and rehabilitation of an area badly affected by acid leachate will most likely be time consuming and costly, if indeed it is possible. In some areas of Australia, soils drained 100 years ago are still releasing acid.

- Potential acid sulfate soil

This is the name given to a layer of permanently waterlogged iron sulfide soil. It is given this name because it has the potential for the iron sulfide to oxidise and produce sulfuric acid. If left undisturbed the water keeps oxygen away from the iron sulfides and prevents oxidation. In this waterlogged state the sediment is inert and harmless to the environment. Potential acid sulfate soils are usually dark gray in colour.

- Actual acid sulfate soil

If potential acid sulfate soil is exposed to the air through land drainage or excavation, the iron sulfides in the soil react with oxygen in the air and produce sulfuric acid as a by-product. The resulting soil is then known as acid sulfate soil. Some of this acid may be neutralised by other minerals in the soil; however, most of the acid moves through the soil contaminating the surrounding ground and surface waters.

Potential Environmental impacts of sulfuric acid leachate include:

- the release of highly acidic water into the marine or freshwater environment resulting in the death of fish and other marine organisms;
- the reduction of bicarbonates from seawater resulting in potential deformities in shellfish development;
- the release of toxic and heavy metals from the sediment further degrading the marine environment; and
- corrosion of metals and weakening of concrete structures resulting in significant impact on infrastructure and /or engineering works.

Some indications of the presence of acid leachate:

- cloudy green-blue water;
- excessively clear water;

- rust coloured stains and slime in the water; and
- yellow patches on the soil as it dries out.

2.1.1 Management techniques

Mangrove muds are typically potential acid sulfate soils. The best management technique for reclamation in tidal areas is to avoid exposing the mud to the air. Other techniques include re-covering the mud with water immediately after disturbance and/ or liming to neutralise any sulfuric acid formed (costly for large areas).

Some of the most common methods of land reclamation are:

- Filling over the mangroves and mud;
- Construction of bunds and filling the resultant ponds with dredged material or clean fill; and
- Removing mangroves and mud and placing the fill on the underlying rock/hard substratum below.

Each method has advantages and disadvantages. The first is possibly the best method with regard to minimising acid leachate generation; however, subsidence may occur, which may expose potential acid sulfate soils.

If using the second method and the dredged material contains mangrove mud, it must be kept covered with water during reclamation to reduce the potential for acid generation. The area will require long term consolidation, settlement and capping with an impervious layer (e.g. geotextile or clay) prior to construction taking place. Monitoring of leachate for acid generation may be required.

The latter method reduces the potential for subsidence but greatly increases the potential for creating acid leachate from the exposure of mangrove mud to air. If this method of reclamation is used, mud should not be allowed to dry out. Mangrove mud should not be used as fill material above 2.5 m AHD and should immediately be covered with clean fill. Where possible all potential acid sulfate soils should be managed within the footprint of the development. Advice regarding management options, analytical techniques and potential environmental impacts can be obtained from the Natural Resource Management of the Department of Natural Resources, Environment and The Arts.

During the design stage of the reclamation project the presence of potential acid sulfate soils should be determined by geotechnical investigation and analytical testing. A field pH and field peroxide pH test will help to determine the presence of potential acid sulfate soils. If they are detected, the volume of potential acid sulfate soils that will be disturbed during the reclamation and the soil's neutralising capacity should also be determined. It is recommended that soils be analysed according to the Total Oxidisable Sulfur (TOS) and the Peroxide Oxidation Combined Acidity & Sulfate (POCAS) methods adopted by the NSW Acid Sulfate Soils Management Advisory Committee (ASSMAC).

Acid sulfate soil management will need to be incorporated into the environmental management plan if potential acid sulfate soils are detected. The plan should include methods of reclamation, mangrove mud management and a monitoring regime that will allow for the early detection of acidic leachates. More detailed information regarding the analysis and management of potential acid sulfate soils can be found in: NSW ASSMAC (1998) Acid Sulfate Soil Manual; and QASSIT (1998) Guidelines for sampling and analysis of lowland acid sulfate soils (ASS) in Queensland.

Key Points

The following practices will assist management of acid sulfate soils:

- include acid sulfate soil management in the environmental management plan;
- avoid extraction of mangrove mud where possible;
- if mud is disturbed, cover as soon as possible with water or clean fill;
- when filling over mangrove mud, cap the reclaimed area with an impervious layer such as clay; and
- monitor reclamation activities for signs of acid generation.

2.2 Sediment and Erosion Control

Protection of fresh and marine water quality in the surrounding environment is one of the major concerns when reclaiming land in coastal areas. As indicated earlier, 'Beneficial Uses' under the *NT Water Act* have been declared for several coastal areas in the Northern Territory.

2.2.1 Siltation of Waterways

Water quality may be affected by erosion. Siltation of waterways can occur as a direct result of erosion of soil from the reclamation site. Stormwater should not be allowed to run through the reclamation site into nearby waterways and the sea without appropriate silt and erosion control measures being in place. There are several methods that can be used to manage the movement of water through reclamation sites. These include silt traps, retention of vegetation (buffer strips, grass) and construction of diversion walls or drains on the upstream side of the site to divert surface runoff towards appropriately controlled discharge points. Confining reclamation construction activities to the dry season will minimise problems associated with stormwater runoff.

If it is necessary to reclaim land adjacent to the sea where the face of the reclamation site is subject to tidal inundation, methods to stop inundation (while managing potential acid sulfate soils) such as a bund wall may be needed. Bund walls should be engineered to an appropriate design (depending on the construction material) and stabilised using techniques such as rock armoury and geotextile material.

2.2.2 Impacts to Coastal hydrodynamics

In addition, construction activities associated with reclamation may cause indirect siltation and sediment movement. For example, wharves and breakwaters can affect the hydrodynamics of the marine environment which may lead to erosion of adjacent foreshores and siltation of waterways. Excessive siltation may impact on local marine life (mangroves, molluscs, fish).

The best way to minimise changes to hydrodynamics of an area is to retain the existing natural environment at the land/sea interface. It is recommended that, wherever possible, the natural vegetation is retained to assist foreshore stabilisation. Some areas may benefit by recolonisation of mangroves in previously disturbed areas.

For further information on erosion and appropriate site drainage as well as hydrodynamics contact the Natural Resource Management of the Department of Natural Resources, Environment and The Arts.

2.3 Use of appropriate fill

Sulfuric acid is only one kind of leachate that may be generated by poor reclamation practices. Other harmful leachates can be produced when water comes into contact with contaminated fill materials. This is most commonly caused by infiltration of stormwater into the fill material and/ or percolation of seawater into an exposed reclamation face. This problem can worsen when combined with acid leachate generation. The acid leachate may provide ideal conditions for the mobilisation of contaminants such as iron, aluminium and heavy metals including cadmium, copper, lead and chromium which are highly toxic to fish and other marine life.

Contaminated fill material, especially household rubbish, can also pose serious health risks. Persistent pathogenic micro-organisms such as *Salmonella* bacteria are readily transferred by pests to food, humans or previously uncontaminated insect and animal populations.

Examples of material unsuitable for fill are as follows:

- liquid waste including sludge, sewage and grease trap waste;
- any material scheduled as a “dangerous good” under the provisions of the *NT Dangerous Goods Act* (contact the Work Health Authority for advice);
- pesticides and pesticide containers;
- hazardous wastes including asbestos, radioactive material and medical wastes;
- household and commercial garbage, putrescibles (eg. Plastics, cardboard/paper, kitchen wastes, carcasses);
- timber, corrugated iron and other metals;
- vegetation (depending on the purpose of the reclamation);
- oil drums and plastic containers;

- gas bottles;
- car bodies and other discarded household items such as white goods; and
- tyres.

Some thought should be given to securing the reclamation site to prevent unauthorized dumping.

If any material is found to be the cause of pollution action may be taken under the *Water Act* and/or the *Waste Management and Pollution Control Act*.

Reclamation materials must be solid, inert and non-hazardous. Materials may include uncontaminated soil, rocks and building demolition rubble such as bricks and concrete. Steel and timber ultimately break down and are therefore not considered suitable fill materials.

Construction methods may also involve filling bunded areas with uncontaminated dredged material. This may be suitable for areas that will be allowed to settle for some time or have other accelerated consolidation efforts applied. The use of dredged material in land reclamation should be incorporated into the environmental management plan especially if the dredged material contains potential acid sulfate soils (see previous section).

2.4 Removal and disposal of mangroves

At some reclamation sites, mangroves have been left in place and covered with fill material. Geotechnical advice should be sought to ensure land stability in the event that mangrove and other vegetation is not removed and covered with fill material. If removal of mangroves is necessary mangrove vegetation should not be stockpiled at the reclamation site because it can create breeding habitats for biting insects. Options for mangroves and/ or vegetation that are not salvaged include mulching, burning on site (in accordance with the requirements of the NT Police, Fire and Emergency Services or Bush Fires Council) or taken to the local waste disposal site with the approval of the local council.

2.5 Fire Management

Burning of waste can be a significant environmental hazard which has pollution, safety and nuisance implications. Burning-off is not permitted anywhere within a 130 km radius from the Darwin CBD without a permit from the NT Police, Fire and Emergency Services or the Bush Fires Council.

Legislation provides that the NT Police, Fire and Emergency Services must be informed if any fires start anywhere within the Darwin Emergency Response Area (ERA) which

encompasses all coastal regions between the mouths of Howard River around to the Elizabeth River. Outside this 'ERA' the Bush Fires Council need only be informed when a fire threatens life or property.

2.6 Dust Management

Dust management is an important environmental and public health issue on development sites during the dry season. The generation of dust is dependent on the soil/geological conditions and on the local weather conditions. In accordance with the *Public Health Act* and *Waste Management and Pollution Control Act* dust must be suppressed so as not to create a nuisance. This can be achieved by:

- minimising vegetation clearance;
- revegetating areas that are no longer required for reclamation or construction;
- ensuring that unsealed roads and exposed areas are watered at all times;
- applying speed restrictions; and
- ensuring reclamation and construction activities take into consideration the local wind conditions.

2.7 Site security and supervision

The acceptance and placement of reclamation materials should be supervised to prevent unauthorised dumping of wastes and unsuitable fill material. Unauthorised dumping may result in double handling of materials and the payment of disposal costs if the materials need to be removed. In addition, foreshore lands are generally highly visible and poor management may lead to public complaints and regulatory action under the *Water Act* and/or the *Waste Management and Pollution Control Act*.

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