Technical Guidance

Protection of Benthic Communities and Habitats

Environmental Protection Authority

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1 PURPOSE

The EPA's objective for the Factor Benthic Communities and Habitats is “to protect benthic communities and habitats so that biological diversity and ecological integrity are maintained”. The purpose of this Guidance is to explain how impacts on benthic communities and habitats (BCH) are considered during Environmental Impact Assessment (EIA) and to set out the type and form of the information that should be presented to facilitate the assessment of impacts on BCH in Western Australia's marine environment.

This Guidance supersedes Environmental Assessment Guideline No.3 (EPA 2009), which mainly focused on protection of the primary producer component of BCH, and sets out:

a) the EPA's contemporary approach for considering activities which may directly or indirectly cause impact or serious damage to, or irreversible loss of, benthic communities and habitats;
b) considerations for impact mitigation and how they should be applied;
c) a framework for considering cumulative loss of benthic communities and habitats and the potential consequences for marine ecological integrity and biological diversity;
d) the EPA's expectations for information to be supplied by proponents for EIA; and
e) the boundaries of a local assessment unit for the Port of Port Hedland that replaces Environmental Protection Bulletin 14 (EPA 2011) and is to be used when assessing benthic impacts and cumulative losses of benthic communities and habitats in the area.

The geographic scope of this Guidance includes all Coastal Waters of Western Australia to the high water mark of the intertidal zone associated with the continental mainland and offshore islands.

2 CONTEXT AND GENERAL ADVICE

Human disturbance to habitats is a significant threat to the structural and functional integrity of whole ecosystems, on land and in the sea (Biodiversity Working Party 1991). The most recent Western Australian State of the Environment Report (EPA 2007) identified degradation of marine environments (including marine habitats) as a high priority issue and noted a trend toward further deterioration, mainly around existing development centres. Since this report was published there has been a number of large scale coastal infrastructure developments along our coastline, including in previously undeveloped 'greenfields' sites, and most involve the loss of some seabed habitat.

This Guidance has been developed in recognition of the fundamental ecological importance of BCH, particularly benthic primary producers, and the potential consequences of their loss for marine ecological integrity and biological diversity. As would be the case for any impact assessment, proponents should predict, evaluate and demonstrate manageability of the impacts of their proposals on all relevant environmental factors. This Guidance sets out how predicted impacts to benthic communities and habitats should be expressed and presented for EIA.
2.1 Benthic communities and their habitats

Benthic communities play important roles in maintaining the integrity of marine ecosystems and the supply of ecological services. There is strong evidence that benthic communities are important for the maintenance of biological diversity by providing structurally complex and diverse habitat, refuge for vulnerable life stages and a varied and increased food supply. The direct and indirect services benthic communities and habitats provide to humans are also significant. Benthic primary producer habitats are particularly important in the Western Australian context because of the nutrient poor status of our coastal waters. In the absence of significant upwelling of nutrients from deep water, which would support pelagic primary producers such as phytoplankton, it is the benthic primary producer communities that form the foundation of many of our coastal food webs which in turn support productive and economically-important fisheries. Some benthic communities form three dimensional structure that can attenuate wave and current energy which helps protect shorelines and coastal infrastructure. Maintaining healthy and viable benthic communities may also bolster the resilience of the marine and coastal environment generally in the face of increasing human use and the challenges associated with climate change.

Benthic communities are biological communities that inhabit the seabed and are important for primary or secondary production. Benthic habitats are areas of seabeed that do or ‘can’ support these communities.

The term ‘seabed’, when used in the context of the definition for BCH above, includes seabeed substrates in the intertidal and subtidal zones of WA's coastal waters.

General examples of BCH include filter feeder communities growing on hard or soft substrates that may include sponges, ascidians, soft corals or hydroids; soft substrate infaunal communities that may include worms, molluscs and crustaceans; and hard and soft substrate benthic primary producer communities such as coral reefs, algal-dominated biogenic reefs, algal-dominated rocky reefs, seagrass meadows and mangrove forests. Algal mats and salt marshes growing on intertidal sand/mud flats are also classed as benthic primary producer communities. Benthic habitats are areas of seabeed that have the necessary attributes, such as substrate type, water depth and clarity, degree of exposure to wave energy, to support these communities.

The intent of including areas of seabeed that ‘can’ support benthic communities is to recognise areas that may support benthic communities on a seasonal or ephemeral basis, or which have been subject to the effects of a natural perturbation and do not support benthic communities at the time of the assessment, but which are most likely to support those biota again in the future following a period of recovery. Examples of this include:

- areas of coral reefs which have suffered high mortality of live coral due to impacts of a tropical cyclone or thermal bleaching event;
- areas of seabeed known to support ephemeral seagrass communities or seagrass that are known to show measurable spatial variability in their meadows over several years to decades; and
- areas where maintaining opportunities for recovery of benthic communities is considered important.
Habitat classification systems are scale dependant and subjective to a large degree. Accordingly, it may be possible to define different specific benthic communities and their habitats at different levels of resolution and at different scales. The general examples of benthic communities outlined above would constitute the coarsest scale. However, at finer scales, any one of the general examples of benthic communities could include a number of different, more specific benthic communities and habitats definable by local arrangements of species. These different BCH are often linked to the physical characteristics of the area. For example, different mangrove communities are distinguishable by different species composition and canopy cover and these are often linked to environmental factors such as the degree and frequency of tidal inundation. Similarly, discrete areas within a coral reef community may be differentiated by their characteristic local arrangements of prominent coral species or functional groups (e.g. thickets dominated by branching corals in more sheltered areas and massive or encrusting corals in more exposed higher-energy areas).

2.2 Values of benthic communities and habitats

It is important to note that at the highest level this Guidance addresses the issue of cumulative loss of area of a particular BCH ‘type’ on a unit-area basis, without taking into account the relative ‘quality’ of the benthic community. For example, coral reef communities can have variable levels of live coral cover, and two reefs in close proximity could have average live coral covers of 10% and 50%, but still be classified as ‘coral reef’. The loss of 5ha of ‘coral reef’ habitat from either of the two reefs would carry the same ‘weight’ when considered solely on a unit area basis. Although this is a simplistic approach, it is reasonable in the first instance, particularly if cumulative losses of BCH are small.

However it is recognised that the functional ecological value of BCH varies within and between designated BCH ‘categories’. It varies depending on factors such as what species are present/dominant, geographic location, temporal patterns of abundance, structural complexity, productivity, nutritional value and recovery potential. For example, greater significance may be placed on BCH dominated by structurally-complex primary producers (e.g. an algal reef community) compared to structurally-simple primary producers (e.g. an algal mat community) even though they are major contributors to overall primary productivity for the local ecosystem. As another example, a specific area of BCH at a particular location and time of year may be important on a regional scale as it is associated with a critical life cycle process of a species of ecological or social importance. An example of this is the Halodule dominated seagrass meadows in eastern Shark Bay that support lactating female dugong and their neonatal calves during the summer months.

Proponents should consider differing functional ecological values of different benthic communities (e.g. importance for critical life cycle processes or communities with differing cover) after initially describing the overall context and magnitude of impact in spatial terms.

While not included among the general examples above, it is important to recognise the roles and functional importance of subtidal/intertidal sandy seabed areas that support benthic microalgae or microphytobenthos (MPB, micro-algae which live amongst or on sediment particles). Although MPB communities are relatively inconspicuous and lack three dimensional structure, they are significant contributors to overall benthic primary productivity, and can provide habitat for short range endemic fauna. In general, MPB communities have considerably greater potential for recovery from disturbance (generally in the order of days to weeks) than macrobenthic communities dominated by sponges, hydroids, macrophytes or hard corals for example. In view of these issues, proponents should describe the extent of impacts of their proposals on sandy MPB-dominated habitat, however it is unlikely that impacts on these communities will be a significant consideration for most assessments unless they support high densities of marine invertebrate fauna or there has been significant permanent loss of MPB habitat.
2.3 Representativeness of benthic communities and habitats

Not all benthic communities are widely distributed and some may only be found in very localised areas where conditions are suitable. Proponents should identify any BCH that are likely to be impacted and that are not well represented elsewhere and discuss their distribution at both local and regional scales and the potential implications of any impacts or losses.

For example, mangrove communities tend to occur in wet tropical monsoonal environments globally where a combination of tidal and regular freshwater exchanges maintain the soil salinity conditions. The Pilbara region of WA has an arid-tropical climatic regime which does not experience the regular monsoonal ‘wet’ but nonetheless some extensive mangrove communities have developed along parts of that coastline. The combination of species present in the arid-tropical setting (their habitat) is atypical, and not well represented outside of the region, and as such are considered to be of global significance from a biological diversity conservation perspective (see EPA (2001)).

Most species have windows of tolerance for environmental factors such as temperature regimes which in turn control their geographic distribution. The genetic diversity within species means that some genotypes may be more resilient to environmental extremes (e.g. low or high water temperature) than others. Natural selection processes will tend to favour the genotypes most suitable to the ambient conditions, hence high temperature-tolerant forms would have an advantage at the lower latitude end of the natural range. If potentially impacted BCH are located towards the extremities of their geographic ranges, this should also be clearly identified and the implications of loss or impact on biological diversity considered and discussed in the assessment.

3 IMPACT ASSESSMENT AND MANAGEMENT

Environmental Impact Assessment is fundamentally based on predictions of the extent, severity and duration of any residual changes to the environment caused by a proposed activity after mitigation. The assessment is of the specific proposal in question, but it takes into account the cumulative effect of the proposal in concert with previous impacts or approvals, and considering the interconnectedness of the environment. This process can be complicated by using inconsistent terminology and undefined or subjective terms. This Guidance sets out key considerations and is designed to provide a level of consistency in the way the environmental impacts of proposals that have the potential to significantly impact BCH are determined, expressed and presented for EIA.

This technical guidance specifically applies to the environmental impact assessment of development proposals that are predicted to cause impact or serious damage to, or permanent loss of, benthic communities and habitats.

The environmental impact assessment of any damage/loss of, and impact to, benthic communities and habitats will give particular attention to:

- the proponent’s approach to impact mitigation,
- the calculations of predicted cumulative loss of each benthic community and habitat type,
- the extent, severity and duration of recoverable impacts,
- the tenure and any conservation, ecological and social values of the area, and
- the overall impacts and risk to biological diversity and ecological integrity at local and regional scales.
3.1 Irreversible loss

The terms ‘permanent loss’ and ‘serious damage’ used in the definition above warrant some clarification. Permanent loss refers to direct removal or destruction of benthic communities and/or their habitats. Permanent loss of benthic communities and their associated habitats would commonly be associated with activities such as excavation or burial. In almost all cases these activities directly modify the benthic community and its habitat so significantly that the impacted community would not recover to the pre-impact state. ‘Serious damage’ means damage to benthic communities and/or their habitats that is effectively irreversible or where any recovery, if possible, would be unlikely to occur for at least 5 years. Serious damage is most often associated with indirect effects of development activities such as alteration of natural groundwater hydrology (e.g. leading to impacts on dependent mangroves) or chronically elevated suspended sediment levels in the water column (e.g. leading to reduced benthic light and impacts on dependent seagrass or coral communities).

3.2 Recoverable impacts

While this Guidance focusses on the description and evaluation of permanent, cumulative losses of BCH, it is also designed to ensure that shorter term, recoverable impacts associated with development proposals are also clearly presented and considered in the EIA process. The terms ‘reversible impacts or loss’ refer to the situation where impacts or losses of benthic communities occur, but there is confidence that the community, and the ecological services it provides, will fully recover within five years. By definition, the recoverable impacts are not cumulative over long time periods, but they can have cumulative effects over shorter time periods and within a local or regional area. Proponents should present the implications of the recoverable impacts to BCH in terms of the loss of structure (e.g. loss of habitat for associated motile fauna) and function (e.g. loss of production) at local and regional scales. There is existing guidance for considering short-term reversible impacts on benthic communities and habitats within the Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA 2016a). This Guidance sets out how proponents of dredging proposals should couch all predicted impacts on benthic communities and their habitats (i.e. reversible impacts as well as irreversible impacts). The recommendations and framework established for EIA of dredging proposals are generally transferable to other development activities.

3.3 Impact mitigation

Proponents should demonstrate through the EIA documentation how the following impact mitigation steps have been applied before any assessments of benthic community and/or habitat impacts and losses.

1. Consideration of options to avoid impacts on BCH, by providing the rationale for selection of the preferred site and layout.

2. Where impact avoidance is not possible, then the extent to which the proposal has been designed to minimise damage/loss of BCH (e.g. through iterative design and applying Principle 3 below). Proponents should justify that design in terms of operational needs and environmental constraints of the site.

3. How ‘best practicable’ design, construction and environmental management methods aimed at minimising further damage/loss of BCH and maximising potential for recovery, have and will be applied.
3.4 Accounting for uncertainty

There will always be a degree of uncertainty associated with predictions of indirect losses of BCH caused by anthropogenic pressures. For the purpose of assessing cumulative impact and loss, and when the degree of uncertainty in impact prediction is relatively low (e.g. the placement of a rock groyne), the proponent’s EIA documentation should describe a ‘most realistic’ impact scenario for BCH which will be the basis for the assessment of this factor.

A different approach may be needed where there is high residual uncertainty in impact predictions, as is often the case when assessing the impacts of large scale capital dredging in greenfields locations. The EPA has developed an approach for addressing uncertainty around impact prediction for dredging related activities (EPA 2016a) that involves determining and presenting the ‘most likely best case’ and ‘most likely worst case’ impact scenarios to understand the likely range of possible impacts. Although specifically developed to address the uncertainty associated with predicting impacts of dredging, the concepts and approaches in this document are equally suited to addressing uncertainty associated with other activities.

Proponents should not present unrealistic or unlikely ‘best and worst case’ impact scenarios. They are encouraged to present realistic most likely best and worst case scenarios when determining the impact and loss figure(s) to be presented for assessment. Any environmental management plans submitted as part of the EIA documentation should have biological diversity protection and maintenance of ecological integrity as primary objectives and, in practical terms, they should be designed to achieve the most likely ‘best case’ impact scenario, and also to ensure the most likely ‘worst case’ impact scenario is not exceeded.

Where there is significant uncertainty, proponents should present the ‘most likely best case’ and ‘most likely worst case’ scenarios for assessment of impacts on benthic communities and habitats associated with their proposals. When uncertainty is relatively low proponents should present a ‘most realistic’ impact scenario for assessment.

3.5 Identifying and protecting ecological values

Proponents should set out the current scientific understanding of the ecological role and value of the BCH likely to be impacted at local and regional scales. If total cumulative loss is likely to be significant then the supporting information should be more comprehensive with discussion around the levels of confidence and uncertainty. In all cases the significance of any losses on biological diversity conservation and ecological integrity should be clearly set out.

For areas where historical losses are already significantly large, proponents could consider strategies to achieve no net additional loss of BCH, or where possible, a net gain.

Where management plans already exist for areas with identified ecological, conservation and/or social value (e.g. marine parks and reserves, fish habitat protection areas and Rottnest Island Reserve), proponents should address any potential impacts and losses of BCH in the context of the relevant environmental objectives and targets.

In most cases where BCH are predicted to be impacted, proponents should develop and implement construction and/or operational environmental management plans that include all reasonable and practicable measures that will be taken to minimise the impacts or, where necessary, to rehabilitate the community and/or habitat.

This Guidance does not address any potential contribution that artificial or purposely-placed substrates (e.g. rock walls used to armour areas of seabed reclamation) may make to the area of specific benthic habitats. This is a complex issue and will be considered on a case by case basis and outside the framework of this Guidance.
4 METHODOLOGY

4.1 General approach

This section outlines the preferred general approach to be taken by proponents to express and present the cumulative residual loss of, or serious damage to, BCH that may arise as a result of their development proposals.

Before proponents apply the approach detailed in this section of the Guidance they should address the three impact mitigation steps set out in Section 3.3. The calculated percentage impact and loss figure(s) should be clearly highlighted and justified with supporting information demonstrating an understanding of the ecological role and value of the benthic community(s) at local and regional scales and the significance of the losses, and reversible impacts, on ecological integrity and biological diversity.

For the purpose of this Guidance, cumulative loss is defined as the sum of all irreversible loss of, and serious damage to, BCH caused by human activities since European habitation of Western Australia (approximately 200 years ago). Cumulative losses in this context do not include changes to BCH caused by natural disturbances such as severe storms or effects of freshwater inundation from river flow, or climate change.

4.2 Local Assessment Units

This guidance is spatially-based, meaning that it is based on evaluation of areas of BCH which have been lost historically or are currently present and proposed to be lost or impacted within defined areas. The areas within which to calculate cumulative losses are termed Local Assessment Units (LAUs). There is no standard LAU size or shape - they need to be clearly defined on a case-by-case basis.

Local assessment units are location specific and should be configured to take into account aspects of the local marine environment such as bathymetry and position of offshore reefs/islands, substrate type, water circulation patterns, exposure to waves and currents and biological attributes such as habitat types. Wherever possible, other variables related to the functional ecology of the system, (e.g. the length scales of key ecological processes such as trophic connectivity and larval dispersion) should also be considered when defining LAU boundaries. Other relevant information such as administrative (e.g. zoning schemes within marine conservation reserves) and jurisdictional (e.g. State coastal waters) boundaries should also be taken into account.

All things considered, in WA's marine environment LAUs would typically be approximately 50 km² (e.g. a rectangular area defined by a 10 km stretch of coastline extending 5 km offshore (or to the limit of State Waters)). Larger or smaller LAUs will be considered if well justified. Furthermore, for some proposals that are large-scale or predicted to cause extensive impacts that are discontinuous with infrastructure footprints, it may be necessary to define more than one local assessment unit.

Because of the number and scale of infrastructure proposals for the export of iron ore from the Port of Port Hedland, the EPA has defined an LAU for the Port to bring consistency and clarity to the assessment of BCH losses and impacts in the area. The LAU has been defined in Appendix 1 and replaces Environmental Protection Bulletin 14 (EPA 2011).

In all cases, proponents should determine and describe the reversible impacts, as well as the cumulative loss of, and/or serious damage to, each different benthic community or habitat type within each LAU. This approach provides a basis for considering the degree to which the natural proportionality of the different benthic community and habitat types will be maintained in the LAU.
Where there are specific targets or objectives for benthic habitats established through statutory processes, proponents should also couch the impacts and losses in those terms. To assist in this process, proponents of proposals within, or with potential to impact, existing or proposed marine conservation reserves should consult the Department of Parks and Wildlife. The Department of Fisheries (DoF) should be consulted on proposals that may impact BCH within or adjacent to areas managed by that Department.

Proponents should seek the advice of relevant Government agencies on the appropriateness of the proposed local assessment unit boundaries and, where necessary, discuss compatibility of proposals with marine reserve management objectives/targets as early as possible in the design of proposals.

Once the LAU(s) has been defined, it establishes the spatial context for the calculation and assessment of recoverable impacts and cumulative losses. Calculating cumulative losses relies on three fundamental pieces of information – 1) estimates of the areas of benthic communities and their habitats present before European habitation, 2) estimates of the extent of historic and approved losses, and 3) predictions of the additional losses associated with the current proposal (this is covered in greater detail in section 4.5). A benthic habitat map is an essential tool for addressing each of these requirements. Where different benthic community and habitat types (including different communities of the same general type) can be distinguished for the purposes of producing a benthic habitat map, then the different habitat types should be mapped separately to allow the cumulative loss of each habitat type to be presented.

4.3 Benthic habitat maps

When preparing benthic habitat maps, proponents are encouraged to use rectified aerial photography or other remote sensing techniques, coupled with targeted field work to ground-truth the interpretation of remote sensing, to produce full-coverage benthic habitat maps. Where there are inherent difficulties in using remote sensing techniques (e.g. due to deeper or very turbid water) and proponents are able to demonstrate that there is an adequate level of knowledge about local biophysical conditions required to support various types of benthic communities, the use of surrogates such as geomorphic features, sediment type, degree of exposure to waves/currents and water depth may be considered to infer the locations and estimate the original areas of benthic communities and their habitats within LAUs. Obviously there will be significant effort in the field to ground-truth and validate the predicted distributions (i.e. more so than where there is good water penetration imagery). Similarly, where there are existing ground-truthed benthic habitat mapping data these could be used along with other biophysical information (e.g. degree of exposure to wave/current energy) and knowledge of the biology of benthic communities to help predict the likely presence and distribution of habitat beyond the surveyed areas in a defined LAU.

Proponents should be aware that there are likely to be high levels of residual uncertainty associated with habitat modelling approaches based on assumptions/surrogates. Proponents are advised to take steps to reduce uncertainty particularly where risks of serious off-site damage to benthic communities or habitats become evident through the assessment.

Like all ecological systems, BCH can vary with respect to extent and composition spatially and through time. Wherever practicable, natural variation should be accounted for when estimating impact and cumulative losses. However it should be recognised that in the absence of human perturbation or catastrophic natural events (e.g. tropical cyclones) areas of ‘habitat’ are relatively static over time compared with the temporal and spatial variability that is sometimes observed in the abundance of the benthic organisms that make up the ‘communities’. Where change in the area of habitat does occur in the absence of these disturbances, it generally takes place over longer timeframes than similar magnitude changes in areas of communities, which can vary, sometimes significantly, over seasonal and inter-annual timeframes depending on the species in question.
Some proponents are working to improve understanding of losses and gains in areas of BCH in their areas of interest. Proponents that intend to use this understanding to interpret habitat dynamics for the purpose of applying this guidance, are encouraged to clearly differentiate between areas of habitat that are ‘vegetated’ or ‘inhabited’ by the benthic community and the areas of habitat that are not. In doing so, they should apply some caution particularly where understanding of the disturbance regimes and community dynamics (e.g. successional phases) has been developed from relatively short term time-series data.

To ease the burden of data collection during the EIA process, operators of existing marine facilities that have, or are likely to have, plans for expansion in the future would benefit from investments in strategic environmental data acquisition. For example, over a period of time, future proponents could implement staged survey programs targeted towards providing high-quality data on the current extent and temporal variability in the abundance of the different benthic communities in areas of interest (e.g. to capture seasonality of ephemeral species such as some tropical seagrasses), as well as studies to improve estimates of any losses that have occurred, and the reasons for those losses.

To provide confidence in predictions of cumulative loss, proponents should clearly describe how estimates of the original extent and cumulative losses of BCH within defined LAUs have been determined. Proponents should include technical documentation and spatial data sets relating to analysis of remote sensing data (e.g. aerial photography), benthic habitat mapping and infrastructure footprints, and explicit articulation of all assumptions made for the assessment of BCH loss/serious damage.

With respect to the information that should be provided to support EIA, as a guide, the level of understanding about the role and importance of the benthic communities and their habitats for the maintenance of ecological integrity and biological diversity, and the extent of survey work, should be risk-based. It should increase proportionately to a) the scale of the predicted total cumulative loss, b) the extent, severity and duration of recoverable impacts and c) the tenure and environmental significance of the area.

In general, the level of understanding about the role and importance of the benthic communities and their habitats, and the potential consequences of impacts or loss for maintenance of ecological integrity and biological diversity within the local assessment unit, should increase as the magnitude of the impact or cumulative loss, and the environmental significance, increases.

4.4 Impact recovery

Some communities and habitats exhibit natural resilience to certain stressors, or display reproductive and recruitment strategies, such that recovery can be expected to occur if the stressor is removed and environmental conditions return to, and are maintained in, the pre-impact state. Proponents should be mindful that some recruitment pathways that have been described in one location may not be transferable to other locations. For example, recent research has provided confidence that deepwater seagrass in the Kimberley can recover from large seed banks in the sediment. However similar research conducted in the Pilbara found very low levels of seed in the sediment and that the recovery pathway established for the Kimberley, although possible, should not be relied upon. Furthermore, even if a benthic community or habitat is known to exhibit a strong potential for recovery from an impact in the short term (i.e. < 5 years), in places where there are multiple consecutive or coincident development-related disturbances, or other external threats to recovery, these external factors should be taken into account when assessing realistic recovery rates.
4.5 Approach for determining cumulative impacts and losses and presenting the information for EIA

Proponents should use the approach set out below when presenting information for the EIA of a development proposal that may impact on BCH. The approach involves consideration of both direct and indirect impact and loss of benthic communities and habitats, and whether those impacts and losses are permanent or temporary. It also involves consideration of the extent, severity and duration of impacts that do not constitute ‘loss’. Where there is significant uncertainty around predicted impact and loss calculations proponents are encouraged to consider the ‘likely range’ of predictions. Any conservation, ecological or social values of the marine ecosystem within the bounds of the local assessment unit(s) identified for the proposal (see step 1 below) should be described as well as any tenure (e.g. port, fish habitat protection area or marine park). Proponents should discuss the representation of each benthic community, and any special or relevant considerations (see section 2) in both local and regional contexts.

The approach to determine cumulative losses within a defined LAU includes determining the spatial extent of benthic communities and habitats:

- prior to all human-induced disturbance;
- existing and approved at the time of the proposal; and
- remaining after implementation of the proposal.

Steps 1–8 set out below are designed to provide further guidance to proponents on how to perform the calculations and present the resultant information in a clear and consistent form.

Step 1. What is the ‘local assessment unit’?

Define an appropriate local assessment unit (LAU) boundary, taking into account key physical and biological ecosystem attributes such as bathymetry and position of offshore reefs/islands, water circulation patterns, habitat/substrate types and energy/material flows. A local assessment unit should be of the order of 50 km². Where coastal waters have been assigned a particular tenure, the boundaries of the local assessment units may (in part) follow the tenure boundaries.

Step 2. What is there now? What is the current area of each benthic community type and associated habitat within the LAU?

Determine the current spatial extent of each BCH in the LAU. This can often be achieved through analyses of suitable aerial or satellite imagery and data on bathymetry/rugosity and substrate type, to produce a map of the likely habitat and community types. This modelled distribution should be confirmed and amended where necessary based on an appropriate level of ground-truthing. Any areas of approved, but as yet un-realised, losses would be subtracted at this point to provide a realistic estimate of the area of each BCH remaining after all approved developments are completed.
Step 3. Do any of the benthic communities have any particular tenure or conservation, ecological or social values that should be considered?

Maps should be provided showing the boundaries of any ports, marine parks and reserves (including different zones), fish habitat protection areas or any other relevant administrative boundaries, over the existing benthic habitats in each LAU (from 2).

Some specific benthic habitats, in specific locations, may have functional ecological roles that are important for the maintenance of ecological integrity, biological diversity and/or coastal values at local or regional scales. For example, a particular stand of mangroves may be important for the protection and stabilization of a fragile section of coast that contains vulnerable infrastructure, or a particular seagrass meadow may be an important feeding ground for conservation significant fauna because it is close to a breeding colony. Similarly, certain locations may be seasonally important. Proponents should identify any particular values that are known, or likely, to be associated with a benthic community that will be impacted by the development (see Section 2 for further explanation).

Proponents should clearly identify any BCH that are likely to be impacted and that are not well represented outside the LAU(s), or are located towards the extremities of their geographic ranges, and evaluate and discuss the implications of these impacts on biological diversity.

Step 4. What area of each community and habitat was originally present within the LAU? (i.e. original baseline)

An estimate of the spatial extent of each benthic community type and its associated habitat that existed in the LAU prior to European habitation is used to set the baseline from which to determine cumulative loss. Historical aerial photography may be available in some cases to assist in these determinations but where this is not available, or the losses pre-date aerial photography, it may be necessary to use alternative means.

In many cases, the majority of historical irreversible loss will have been caused by excavating and/or burying benthic habitat or modifying key sustaining processes such as water flow regimes on which benthic communities depend for growth, survival and reproduction. Hence, in such cases it would be reasonable to equate areas of BCH loss to areas occupied by infrastructure footprints and accounting for any ‘halo’ effects around infrastructure perimeters and considering the environmental tolerances of the relevant benthic communities. By adding areas of loss determined using this type of approach to the currently mapped areas of different BCH, and by applying clearly articulated assumptions as necessary, proponents can generate reasonable estimates of areas of benthic communities and associated habitats that are likely to have been present in the local assessment unit prior to development.

There will be situations where considering only infrastructure footprints and their ‘halos’ to evaluate loss will not be sufficiently accurate or appropriate. Locations where BCH have been lost due to indirect impacts of poor water quality are examples (e.g. seagrass in Cockburn Sound or Princess Royal Harbour). Proponents may also need to assess the spatial extent of benthic habitat that is currently unoccupied, by taking into account knowledge of environmental requirements as well as the knowledge gained through establishing the current spatial extent of the benthic communities (in 2 above). This approach will be particularly useful where habitats are subject to episodic but severe natural disturbance (e.g. coral reefs in the Pilbara), or where the distribution is naturally dynamic and changes may be gradual but significant (e.g. temperate Posidonia coriacea seagrass meadows on Success Bank near Fremantle) or dependent on annual recruitment (e.g. tropical seagrasses in the Kimberley).
Step 5. **What percentage of the original area of each benthic community and its associated habitat is present now?**

Express the current spatial extent of each benthic community and its habitat separately (considering areas that do, once did, or can support the dominant benthic communities) in the LAU (from 2 above and accounting for any approved but as yet unrealised losses), as a percentage of pre-existing conditions (from 4 above) and not including the current proposal.

Step 6. **How much more will be impacted and lost if this proposal was implemented?**

Determine the area of each benthic community and habitat type in the LAU that would be impacted after the mitigation hierarchy has been applied. Determine what proportion would recover, and what proportion would be lost as a result of the proposal and express the irreversible losses and reversible impacts as percentages of pre-existing conditions (from 4 above) separately. Describe the expected severity and duration of the reversible impacts.

Step 7. **How much would be lost in total if the proposal proceeds?**

Re-determine the potential cumulative loss in aerial extent of each benthic community and associated habitat in the LAU to include the irreversible impacts of the current proposal and express as a percentage of pre-existing conditions (from 4 above). Note that this is an additive approach and provides a way of viewing the proposal from a cumulative impact perspective.

Step 8. **What will be the consequences for biological diversity and ecological integrity if the proposal proceeds?**

Proponents should evaluate and discuss the potential consequences (i.e. impacts and risks) their proposal will and could have on ecological integrity and biological diversity at local and regional scales, taking into account:

- the predicted cumulative irreversible losses of BCH (from 7),
- the likely severity and duration of shorter-term (reversible) impacts of the proposal on BCH (from 6), and
- the local and regional values and distributions of the affected BCH (from 3).

Where there is significant uncertainty, the discussion should consider the ‘most likely best case’ and ‘most likely worst case’ impact scenarios and the potential risks to ecological integrity and biological diversity of these impact scenarios. Where there is higher confidence, proponents should couch the evaluation and discussion in the context of the ‘most realistic residual impact scenario’ after mitigation.
5 RESPONSIBILITIES

Environmental Protection Authority responsibilities
This Guidance is intended to inform the EPA’s assessment of proposals under Part IV of the Environmental Protection Act 1986 where Benthic Communities and Habitats is identified as a key environmental factor.

Proponent responsibilities
Proponents should adopt the recommendations in this Guidance when designing their proposals and preparing documentation for EIA.

All spatial data used in the assessment for mapping and calculating predicted reversible and irreversible losses of benthic communities and habitats, and for showing the sizes and locations of infrastructure footprints, should be supplied to the EPA in a suitable GIS compatible format (see Appendix 2).

The EPA supports greater public availability of environmental data collected for EIA, post-approval monitoring, management and compliance programs, as the information it contains can be used to reduce uncertainty and increase confidence in predictions of environmental impact and recovery. Proponents are encouraged to make these data publically available.

6 SUPPORTING INFORMATION

Protection of tropical arid zone mangroves along the Pilbara coast (Guidance Statement No. 1, EPA 2001)
This guidance statement provides information on the biological diversity of mangroves along the Pilbara coast. It provides spatial information on regionally significant and high conservation value mangrove distribution and is an important information sources where development proposals have the potential to affect mangrove communities in the Pilbara.

Environmental quality management
Benthic communities can be adversely affected by pollution, waste discharges and deposits. In Western Australia, the effects of pollution, waste discharges and deposits on environmental quality are considered and addressed in the context of an Environmental Quality Management Framework (EQMF) which is outlined in the State Water Quality Management Strategy Document No.6 (Govt. of WA 2004) and, for marine waters specifically, in the EPA’s Technical Guidance – Protecting the Quality of Western Australia’s Marine Environment (EPA 2016b). Proponents of development proposals that include waste discharges and/or deposits that may cause impact or serious damage to, or irreversible losses of, benthic communities should give attention to the Marine Environmental Quality technical guidance as well as this Guidance.

Marine Conservation
Marine Protected Areas (MPAs) are important tools for the conservation of Western Australia’s marine biological diversity. There are a number of different types of State-administered marine conservation reserves that have been, or can be, created under Western Australian legislation. The guidance set out here is designed to complement management frameworks that apply to benthic communities and habitats in MPAs and other specially-protected areas (e.g. management objectives, and long- and short-term targets in MPA Management Plans).
7 DEFINITIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Meaning in full</th>
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<tbody>
<tr>
<td>BCH</td>
<td>Benthic Communities and Habitats</td>
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<tr>
<td>DoF</td>
<td>Department of Fisheries</td>
</tr>
<tr>
<td>EQMF</td>
<td>Environmental Quality Management Framework</td>
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<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<tr>
<td>EPA</td>
<td>Environmental Protection Authority</td>
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<tr>
<td>LAU</td>
<td>Local Assessment Unit</td>
</tr>
<tr>
<td>MPA</td>
<td>Marine Protected Area</td>
</tr>
<tr>
<td>MPB</td>
<td>Microphytobenthos</td>
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<tr>
<td>WA</td>
<td>Western Australia</td>
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8 GLOSSARY OF TERMS

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Bathymetry</td>
<td>Measures of the underwater depths of the sea floor.</td>
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<tr>
<td>Benthic (zone)</td>
<td>The benthic zone is the ecological region at the lowest level of an ocean, including the sediment surface and some sub-surface layers. The benthic zone begins at the shore line (intertidal or eulittoral zone) and extends downward along the surface of the continental shelf out to sea.</td>
</tr>
<tr>
<td>Benthic Communities and Habitats (BCH)</td>
<td>Functional ecological communities that inhabit the seabed and the areas of seabed that support these communities (e.g. high relief reef, platform reef, sand, silt and the depth they occur at). The communities may include light dependent taxa (e.g. algae, seagrass, corals, some sponges, mangroves) or animals that obtain their energy by consuming live or dead organisms (e.g. ascidians, sponges, soft corals).</td>
</tr>
<tr>
<td>Community</td>
<td>Ecologically, any naturally occurring group of different organisms sharing a particular habitat.</td>
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<tr>
<td>Damage</td>
<td>Significant alteration to the structure or function of a community or habitat. Damage is considered serious if the timeframe for full recovery is expected to be longer than 5 years.</td>
</tr>
<tr>
<td>Direct loss</td>
<td>Activities causing immediate loss of benthic habitat and communities. In the context of this Guidance, direct losses relate primarily to human activities that have immediate consequences, such as the removal of habitat or communities from the ecosystem due to dredging or land reclamation.</td>
</tr>
<tr>
<td>Environmental Values</td>
<td>The particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health.</td>
</tr>
<tr>
<td>Ecological integrity</td>
<td>The composition, structure, function and processes of ecosystems, and the natural variation of these elements.</td>
</tr>
<tr>
<td>Ecosystem</td>
<td>Unit including a community of organisms, the physical and chemical environment of that community, and all the interactions among those organisms and between the organisms and their environment.</td>
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### Technical Guidance – Protection of Benthic Communities and Habitats

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Habitat</td>
<td>A specific type of environment inhabited either permanently or temporarily by organisms.</td>
</tr>
<tr>
<td>Indirect loss</td>
<td>Losses associated with far-field effects of an activity and not necessarily coincident with the footprints of infrastructure. In the context of this Guidance Statement, indirect losses relate to the effects of human activities that alter the suitability of habitats for growth and survival of benthic communities over varying time scales.</td>
</tr>
<tr>
<td>Loss</td>
<td>Refers to direct or indirect removal or destruction of BCH. Loss is considered to be irreversible and the term is intended to apply to BCHs that are so significantly modified (e.g. by activities such as excavation or burial) that the impacted BCH is not predicted to recover to the pre-impact state.</td>
</tr>
<tr>
<td>Local assessment unit</td>
<td>A specific geographical area which provides an effective boundary for the assessment and management of cumulative environmental impacts on benthic communities and habitats.</td>
</tr>
<tr>
<td>Photosynthesis</td>
<td>A process, operating in chlorophyll containing organisms, which uses solar energy to convert carbon dioxide and water into carbohydrate.</td>
</tr>
<tr>
<td>Primary producer(s)</td>
<td>Organisms (mainly green plants and algae) which can manufacture organic substances (food) from simple inorganic substances using photosynthesis. Includes animals such as some corals and sponges containing algal symbionts that contribute to meeting the animal’s energy requirements.</td>
</tr>
<tr>
<td>Species</td>
<td>Generally regarded as a group of organisms that resemble each other to a greater degree than members of other groups and that form a reproductively isolated group that will not normally breed successfully with members of another group.</td>
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### 9 REFERENCES


Appendix 1

Guidance for the Assessment of Benthic Community and Habitat Loss in and around Port Hedland

Summary
Development of the port and other industries at Port Hedland has resulted in incremental loss of benthic communities and habitats (BCH), including mangrove and other intertidal and subtidal BCH associated with the inner harbour, tidal creek systems and the adjacent intertidal zone.

The EPA notes that different proponents have defined different LAUs for assessing the cumulative losses of BCH associated with their proposals in Port Hedland.

To improve the clarity, consistency and efficiency of EIA, the EPA has defined an LAU for Port Hedland and guidance for its use in assessing cumulative loss of BCH.

The EPA notes that:

- cumulative loss of BCH in and around Port Hedland is a significant issue for assessments of development proposals in the area;
- different proponents have used different local assessment units for the purpose of applying the assessment framework for BCH in the inner Port Hedland port area, leading to inconsistent application; and
- proponents of new development proposals that may cause impacts to, or loss of, BCH in and around Port Hedland should use the LAU and associated advice provided here.

Background
The Port of Port Hedland, in WA’s Pilbara region, is the world’s largest bulk export port. Figures for 2015/16 indicate that Port Hedland’s throughput was approximately 460 million tonnes in that year (Pilbara Ports Authority 2016). Iron ore handling and export capacity at Port Hedland is expected to increase further as infrastructure is developed.

The harbour is located within a mangrove-fringed tidal creek system with broad adjoining intertidal mud flats.

Development of the port and other nearby industries (e.g. solar salt production facilities) at Port Hedland has resulted in the incremental loss of BCH. The cumulative losses of mangrove and other intertidal habitats (e.g. algal mat communities) associated with development in and around Port Hedland harbour are significant issues for the EPA’s assessment of development proposals in the area.

Spatial analysis by the Office of the EPA has confirmed that different proponents have defined different LAUs for assessing cumulative losses of benthic primary producer habitat within the inner Port Hedland port area. Variation in LAU boundaries among proposals led to inconsistent application of EAG No.3 (EPA 2009) by proponents, which flowed through into the EIA process undertaken by the EPA. The overarching aim of this appendix is to establish a clear and common starting point for the evaluation and accounting of BCH losses and impacts in the inner Port Hedland port area. This guidance will, in turn, improve clarity, consistency and timeliness of EIA involving the assessment of impacts to BCH and cumulative loss of BCH in Port Hedland. Furthermore, it will allow evaluation of actual development-related losses against those predicted by proponents during EIA. It will also provide useful contextual information on the natural gains and losses that occur over time.
Local assessment unit for assessment of BCH impact and loss in and around Port Hedland

The LAU shown in Figure 1 is intended to be used as the common basis for evaluating the development-related recoverable impacts and cumulative losses of the different benthic communities and habitats associated with the inner harbour, tidal creeks, barrier islands and the adjacent intertidal zone, within the inner Port Hedland port area. These habitats are referred to as inshore benthic communities and habitats for the purpose of applying this advice. The LAU should not be confused with the port area vested in the Port Hedland Port Authority.

The northern boundary of the LAU is based on a combination of existing coastline data, assessment of imagery to capture the extent of inshore mangrove habitats and a recognition of temporal variation in the exact position and alignment of ‘soft’ erodable coastlines and the spoil ground located immediately east of the harbour entrance.

For assessments of new development proposals within the LAU shown in Figure 1, any losses of BCH should be addressed in the context of that LAU. Conversely, impacts and losses of BCH seaward of the northern boundary of the LAU should be addressed in the context of different LAUs for ‘marine’ offshore benthic communities and habitats.

Spatial data describing the LAU are provided on the EPA website at: http://epa.wa.gov.au/spatial-data

References


Figure 1: Local Assessment Unit for the assessment of benthic community and habitat impact and loss and in the inner Port Hedland port area.
Appendix 2

Submitting Proposal Boundaries and Benthic Habitat Information as Spatial Data for Environmental Impact Assessment

This Appendix describes the format of proposal boundaries and benthic habitat information required to be submitted as spatial data to the EPA as part of an environmental impact assessment proposal.

What are spatial data?
Spatial data are sets of digital information which can be used in computer mapping software; this information is also referred to as GIS or CAD data. If your organisation or environmental advisors/consultants have GIS or CAD personnel; or there are maps showing infrastructure and/or biological information, or engineering drawings associated with your proposal, then you have spatial data.

Why are proposal boundaries and benthic habitat information required to be submitted to the EPA as spatial data?
The EPA values proposal boundaries and benthic habitat information as spatial data and uses them to:

i) find what environmental assets and issues are on or near the proposal
ii) to serve as an administrative record
iii) to communicate where the EPA has made decisions to others and their processes
iv) conduct its own verification of predicted impacts.

What are the specifications required?
Proponents are required to submit geo-referenced GIS data in ESRI format conforming to the following parameters:

i) Coordinate System: GDA94 (datum) and projected into the appropriate Map Grid of Australia (MGA) zone
ii) Format: ESRI geodatabase or shapefile
iii) Attribution: a description of each feature of the spatial data (i.e. points, lines or polygons) should be included in the attribute table of the spatial data
iv) where a series of activities are proposed, each should be individually mapped.