Report and recommendations of the Environmental Protection Authority

Mid West Aquaculture Development Zone

Minister for Fisheries

Report 1593

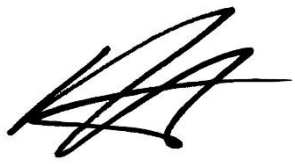
April 2017

Public Environmental Review
Environmental Impact Assessment Process Timelines

Date	Progress stages	Time (weeks)
13/05/2013	Level of assessment set	
24/07/2013	Final Environmental Scoping Document (ESD) approved	9
18/07/2016	Public Environmental Review (PER) document released for public review	155
15/08/2016	Public review period for PER document closed	4
20/12/16	Final proponent Response To Submissions report approved	18
19/01/17	EPA meeting	4
15/02/2017	Response from proponent regarding outcome of EPA meeting	4
29/03/2017	EPA report provided to the Minister for Environment	6
3/04/2017	Publication of EPA report (three working days after report provided to the Minister)	3 days
18/04/2017	Close of appeals period	2

Timelines for an assessment may vary according to the complexity of the project and are usually agreed with the proponent soon after the level of assessment is determined.

In this case, the Environmental Protection Authority did not meet its timeline objective in the completion of the assessment and provision of a report to the Minister due to procedural constraints associated with the State General Election caretaker period.



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Executive Summary

Overview

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for Environment on the key environmental factors and principles for a strategic proposal by the Minister for Fisheries (the proponent) to establish an aquaculture development zone in the Mid West region of Western Australia (WA). The proposal is known as the Mid West Aquaculture Development Zone (MWADZ).

The MWADZ strategic proposal is located at the southern end of the Abrolhos archipelago between the Pelsaert and Easter groups of islands (Figure 1). The proposal is also within the *Abrolhos Islands Fish Habitat Protection Area*. Both the waters in the proposal and the broader Abrolhos region have high conservation status owing to their near-pristine marine environmental qualities, the diverse and unique range of marine plants and animals and the high socio-economic importance of the area.

In its assessment the EPA has considered the proponent's Public Environmental Review document (PER), public submissions on the PER and the proponent's response to submissions.

Through this assessment EPA has concluded that environmental impacts are acceptable and the identified future aquaculture proposals may be implemented, provided the implementation of the future proposals are carried out in accordance with the recommended conditions and procedures set out in Section 4 of this report.

In assessing the MWADZ as a strategic proposal the EPA is able to consider the cumulative impacts of future aquaculture proposals, rather than assessing impacts on a case-by-case basis as individual aquaculture projects are proposed. The MWADZ will thus provide for future aquaculture operators to refer new aquaculture proposals to the EPA for consideration as derived proposals. In doing so, the proposal would not need to be assessed by the EPA. Instead, the operators would need to implement Environmental Management Plans, prepared by the Department of Fisheries (DoF) on behalf of the proponent, as required by the recommended conditions.

Summary of the proposal

The Strategic Proposal is to declare and establish the MWADZ under the *Fish Resources Management Act 1994* for the purpose of large-scale sea-cage aquaculture of finfish at the Abrolhos Islands. Future proposals have been identified as aquaculture operations which include the feeding, growing and husbandry of marine finfish in floating sea cages.

The Zone encompasses 3,000 hectares (ha) of marine waters and is divided into two separate areas. The southern area comprises an 800 ha existing licensed aquaculture site and the northern area comprises a 2,200 ha site.

The maximum standing stock biomass within the zone at any one time will be 24,000 tonnes of fish. The species to be cultured will be limited to marine finfish that naturally occur within the West Coast bioregion of WA.

Environmental factors

The DoF has undertaken extensive environmental surveys and studies and prepared the PER documentation on behalf of the Minister for Fisheries. The DoF has developed an Environmental Management and Monitoring Plan (EMMP) for future operators in the MWADZ. The Plan is underpinned by extensive environmental studies and modelling

The EPA identified the following key environmental factors as relevant to the proposal and requiring detailed evaluation in the report:

1. Marine Environmental Quality;
2. Benthic Communities and Habitat; and
3. Marine Fauna.

The outcomes of the evaluations are summarised below. Other environmental factors relevant to the proposal which the EPA determined not to be key environmental factors are discussed in the Appendix 3 of this report.

1. Marine Environmental Quality

The DoF's modelling and technical studies identified the key potential impacts to marine environmental quality, the significance of those impacts and the likely effects of management and mitigation controls designed to address them.

The major environmental impact to marine environmental quality from the proposal is to the sediments immediately beneath and adjacent to the sea cages, namely deposited organic material from fish faeces and uneaten fish feed.

The proponent's modelling of aquaculture production scenarios indicated that the extent, severity and duration of impacts, including the time required for full recovery of the sea bed, can be reduced and managed by limiting standing biomass, stocking density and production duration.

Additionally, it is noted that the predicted impacts to marine environmental quality described in the PER represented the 'most likely worst-case' outcome and with proposed operational management the extent and severity of the residual impacts are significantly reduced. The EPA considers the proposed management measures, set out in the Environmental Monitoring and Management Plan (EMMP), to be reasonable and appropriate for reducing organic deposition.

The EMMP is presented within the context of the EPA's environmental quality management framework (EQMF) and is consistent with the EPA's Technical Guidance – Protecting the Quality of Western Australia's Marine Environment.

The EMMP sets out how proponents of aquaculture operations must monitor and manage the potential impacts of stocking up to 24,000 tonnes of marine finfish across the proposed MWADZ in order to protect its environmental values.

The EPA expects that with good adaptive farm management, such as fallowing, and limiting standing biomass and stocking density, future derived proposals should be able to achieve at least a moderate level of ecological protection within a distance of 300 metres (m) from the sea cages, and a high level of ecological protection outside that 300 m boundary (i.e. at least 50% of each aquaculture lease within the MWADZ). The EPA considers this an acceptable environmental outcome.

Proponents of derived proposals will be expected to demonstrate that they are meeting these levels of ecological protection for the life of their projects. The EPA also expects the DoF, as the zone manager, to coordinate monitoring and annually demonstrate that the EMMP is being correctly implemented by future aquaculture operators in the zone.

2. Benthic Communities and Habitat

Data from the proponent's own and historic surveys were used to assess the coverage of benthic communities and habitat within the proposal area, which mostly consist of bare sand with some mixed assemblages and reef.

The most severe impacts to these habitats are predicted to occur directly under the sea cages, potentially leading to smothering and reduced oxygen levels in bottom waters and sediments.

Predicted irreversible impacts were isolated to the vicinity of the sea cages and where recovery of the fallowed sites after relocation was expected to be greater than five years. The proponent notes that this is based on its conservative model, which presented the 'most likely worst-case' outcome and that 'actual' impacts to benthic communities and habitat are likely to be significantly less following proposed management measures to reduce organic loading to the marine environment.

The measures presented in the EMMP are designed to generate a comprehensive dataset confirming over time that impacts to benthic communities and habitat are restricted to local-scale areas, within 300 m of the cages.

The EPA considers the estimated cumulative loss of benthic communities and habitat to be acceptable as it is unlikely to have any significant consequences for biological diversity or ecological integrity within or outside the MWADZ proposal area. The EPA accepts that the proposed management measures, including the strategy to periodically relocate sea cages and fallow the seabed, will be effective and that actual losses will be less than predicted.

3. Marine Fauna

The proponent has described the diverse and abundant marine fauna of the Abrolhos Islands, and has undertaken environmental risk assessments for key marine fauna groups. The Abrolhos Islands is the most significant seabird breeding location in the eastern Indian Ocean and also supports a small isolated population of Australian sea lions at the northern limit of the species range.

Marine predators, including seabirds, are likely to be attracted to the sea cages due to the artificial habitat they provide, the high fish stocking densities and presence of fish feed. The proponent accepts that although the probability of adverse interactions can be reduced by limiting the potential sources of attractants, some marine predators in the vicinity of the MWADZ may occasionally attempt to access the stock behind the barriers or the food sources underneath. This could lead to adverse interactions, including behavioural changes, and injury or mortality from entanglement.

Potential risks can be minimised by eliminating opportunities for marine fauna to interact with aquaculture gear through a number of practical management measures. The proponent has committed to mandatory sea-cage design and operation management measures, based on industry best-practice design and strategies, to reduce this risk. Proposed monitoring and management measures are outlined in the Marine Fauna Interaction Management Plan (MFIMP).

The EPA's assessment of this factor focused mostly on populations of seabirds and the Australian sea lion, which it identified as being most at risk from the proposal. The Australian sea lions at the Abrolhos Islands are identified as particularly vulnerable to potential impacts from activities within the MWADZ.

The EPA considers that, without targeted mitigation and management, the potential for behavioural changes and mortality among seabirds and Australian sea lions interacting with the aquaculture facilities could be significant. Although it is not possible to completely eliminate aspects that could attract marine fauna to the sea cages, the likelihood of adverse interactions can be substantially reduced.

The EPA notes the proponent's proposed measures to reduce the risk of fauna interactions, including key strategies to reduce levels of attractant signals and opportunities for provisioning, and preventing cage access and entanglement. The EPA has confidence that residual impacts to seabirds and Australian sea lions from the proposal will be acceptable as long as industry contemporary best-practice standards are implemented to reduce risks to very low levels.

The EPA considers that future aquaculture proponents should submit tailored MFIMPs to demonstrate that contemporary and relevant best practice is being applied in their design and operations particularly in relation to sea-cage design and maintenance, and predator exclusion measures.

This will enable the EPA to determine with confidence that the MFIMP proposal-specific objective, which is to *ensure that there are no adverse impacts on the viability and persistence of the Abrolhos Islands populations of Australian sea lions*

and seabirds, can and will be met. The EPA also expects the DoF, as zone manager, to annually demonstrate that the MFIMP is being properly implemented across the zone.

Conclusion

The EPA has assessed the potential maximum residual cumulative environmental impacts and risks from future derived proposals based on the proponent's mitigation, the level of confidence in the predictions, and the degree of risk to the environmental values of the MWADZ proposal area and surrounding Abrolhos Islands, and concluded that the proposal is environmentally acceptable.

Proponents of future derived proposals will need to demonstrate how they will meet the environmental objectives defined in this strategic assessment, and how contemporary best-practice design, management and mitigation measures, particularly in relation to marine fauna, will be applied.

Submitting sufficient information at the referral stage will enable the EPA to determine with confidence whether the environmental outcomes defined through the assessment of the strategic proposal can and will be met.

Conditions

The EPA recommends a set of conditions be imposed on the implementation of derived proposals if the Minister for Fisheries' proposal to declare and establish an aquaculture development zone for large-scale sea-cage aquaculture of finfish at the Abrolhos Islands is approved.

Matters addressed in the conditions include the following:

- Condition 6, which requires the implementation of the Environmental Monitoring and Management Plan:
    - to protect the Environmental Values and achieve the Environmental Quality Objectives and Levels of Ecological Protection as described in the EMMP and Schedule 2 of the recommended conditions;
    - to ensure adequate monitoring and management responses within the aquaculture lease(s) are undertaken so that the moderate and high levels of ecological protection are not compromised;

- Condition 7, which requires the preparation, submission, and implementation of a derived proposal Marine Fauna Interaction Management Plan that contains measures and monitoring to meet the principles and strategies in the DoF's overarching Marine Fauna Interaction Management Plan, to ensure that the proposal will be implemented in a manner that:
    - protects marine fauna so that biological diversity and ecological integrity are maintained; and
    - ensures no adverse impacts on the viability and persistence of the Abrolhos Islands populations of Australian sea lions and seabirds.

Recommendations

That the Minister for Environment notes:

1. that the strategic proposal being assessed is to declare and establish an aquaculture development zone for large-scale sea-cage aquaculture of finfish at the Abrolhos Islands. Future proposals that have been identified in the assessment include aquaculture operations as set out in Table 2 of this Report;
2. the key environmental factors of Marine Environmental Quality, Benthic Communities and Habitat and Marine Fauna, as identified by the EPA in the course of its assessment set out in Section 3;
3. the EPA has concluded that environmental impacts are acceptable and the identified future proposals may be implemented, provided the implementation of the future proposals are carried out in accordance with the recommended conditions and procedures set out in Appendix 4 and summarised in Section 4; and
4. the EPA's Other Advice in Section 6 of this report on the role of the DoF as the zone manager in coordinating annual zone compliance reports and reporting to the Office of the EPA.

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1. Introduction and background

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for Environment on outcomes of the EPA's environmental impact assessment of the strategic proposal by the Minister for Fisheries to establish an aquaculture development zone for commercial sea-cage finfish aquaculture at the Abrolhos Islands in the Mid West region of Western Australia (WA). The Minister has nominated the Minister for Fisheries as the proponent responsible for the strategic proposal.

Section 44 of the *Environmental Protection Act 1986* (EP Act) requires that the EPA prepare a report on the outcome of its assessment of a proposal and provide this assessment report to the Minister for Environment. The report must set out:

- what the EPA considers to be the key environmental factors identified in the course of the assessment; and
- the EPA's recommendations as to whether or not the proposal may be implemented, and, if the EPA recommends that implementation be allowed, the conditions and procedures to which implementation should be subject.

The EPA may also include any other information, advice and recommendations in the assessment report it deems fit.

The procedures followed by the EPA in its assessment of this proposal are set out in the previous *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2012* (Administrative Procedures 2012).

The proponent referred the proposal to the EPA in April 2013. In May 2013 the EPA set the level of assessment at Public Environmental Review (PER) with a four-week public review period. This was one of the levels of assessment available under the previous *Administrative Procedures 2012.*

The Environmental Scoping Document (ESD) for the proposal was approved in July 2013 and the PER was released for public review from 18 July 2016 to 15 August 2016.

Appendix 5 contains a summary of submissions from the public review period and the proponent's response to submissions, which was prepared by the Department of Fisheries (DoF) on behalf of the proponent (on CD at the back of this report and at www.epa.wa.gov.au). It is included for information only and does not form part of the EPA's report and recommendations. Relevant significant environmental issues identified from this process have been taken into account by the EPA during its assessment of the proposal.

This report provides the EPA advice and recommendations in accordance with section 44 of the EP Act.

2. The proposal

The MWADZ is characterised as a strategic proposal under the *Environmental Protection Act 1986* because it identifies one or more future proposals that if implemented singly or in combination may have a significant effect on the environment.

In the case of the MWADZ, future proposals are defined as the implementation of aquaculture operations of finfish using floating sea cages.

In assessing the MWADZ as a strategic proposal the EPA is able to consider the cumulative impacts of future aquaculture proposals, rather than assessing impacts on a case-by-case basis as individual aquaculture projects are proposed. In this regard, the MWADZ would provide for future aquaculture operators to refer new proposals to the EPA for consideration as derived proposals.

A derived proposal applies strategic consideration of the cumulative environmental impacts of future projects and guides overall development.

The EPA may refuse to declare a referred proposal as a derived proposal if it considers that:

- the environmental issues raised were not adequately addressed when the strategic proposal was assessed;
- there is significant new or additional information that justifies the reassessment of the issues raised by the referred proposal; or
- there has been a significant change in the relevant environmental factors since the strategic proposal was assessed.

Location and setting

The Abrolhos Islands are located approximately 75 km west of Geraldton, WA. They are clustered from north to south into the Wallabi, Easter and Pelsaert groups and extend over approximately 100 km.

The MWADZ strategic proposal (the proposal) is located at the southern end of the Abrolhos archipelago between the Pelsaert and Easter groups of islands (Figure 1). The proposal is also within the Abrolhos Islands Fish Habitat Protection Area. All of the Abrolhos below the high water mark, including the adjoining State territorial waters, was declared a Fish Habitat Protection Area in 1999 and vested with the Minister for Fisheries under the *Fish Resources Management Act 1994* for the:

- conservation and protection of fish, fish breeding areas, fish fossils or the aquatic eco-system;
- culture and propagation of fish and experimental purposes related to that culture and propagation; or
- management of fish and activities relating to the appreciation or observation of fish.

Both the waters in the proposal and the broader Abrolhos region have high conservation status owing to their near-pristine marine environmental qualities and the high socio-economic importance of the area.

Summary of the proposal

The purpose of the MWADZ is to provide a management precinct and establish a management framework for prospective future proposals involving floating sea cages for large-scale intensive marine aquaculture of finfish.

The proposal encompasses 3,000 ha of marine waters and is divided into two separate areas (Figure 2). The southern area comprises an 800 ha existing licensed aquaculture site to the north of Sandy Island in the Pelsaert Group. The northern area comprises a 2,200 ha site east of Wooded Island in the Easter Group and north of Gee Bank reef.

The maximum standing stock biomass within the MWADZ at any one time will be 24,000 tonnes. Species cultured within the zone will be limited to marine finfish that naturally occur within the West Coast region of WA.

If approved, this will be WA's second aquaculture development zone, with the Kimberley Aquaculture Development Zone declared by the Minister for Fisheries on 22 August 2014.

The main characteristics of the strategic proposal and identified future proposals are summarised in Tables 1 and 2 below. A detailed description of the proposal is provided in section 2 of the PER document (Department of Fisheries, 2016).

Table 1: Summary of key characteristics of strategic proposal

Strategic Proposal Title	Mid West Aquaculture Development Zone
Short Description	This proposal is to designate areas of waters, located approximately 75 kilometres west of Geraldton within the Fish Habitat Protection Area of the Abrolhos Islands, as described below, as an aquaculture development zone under the *Fish Resources Management Act 1994* for the purpose of carrying out marine finfish aquaculture (Mid West Aquaculture Development Zone).
Detailed Description	**Zone boundaries** As delineated in Figure 1 and defined by spatial co-ordinates listed in the Legend in Figure 1. **Area** Northern Area: 2,200 ha Southern Area: 800 ha **Zone Manager** Department of Fisheries, on behalf of the Minister for Fisheries. **Aquaculture Lease minimal spatial separation distance** Separation distance between aquaculture leases owned by different entities is to be ≥1 km.

	Aquaculture Species Marine **finfish** of a species that occur naturally within the West Coast region of Western Australia **Stocking limits** Maximum cumulative total standing stock biomass in the Zone is not to exceed 24,000 tonnes of marine finfish at any time. Maximum stocking density in the Zone is not to exceed eight tonnes of marine finfish per hectare in any aquaculture lease.

Table 2: Description of identified future proposals

Element	Specification / Description
Floating sea-cage provisions	Deployment of industry best practice sea-cage design and predator exclusion devices and features including: • durable, high tensile sea-cage netting (single barrier) or durable, high tensile external anti-predator nets (double barrier) capable of withstanding attempted breach by marine predators including seabirds; • above-water perimeter fencing capable of withstanding attempted breach or access to sea cages by Australian sea lions; • high-visibility seabird exclusion netting; and • all sea-cage gear designed and maintained to avoid and/or minimise mortality and/or injury of seabirds and Australian sea lions by minimising potential for entanglement.
Maximum stocking density	Not to exceed eight tonnes of marine finfish per hectare in any aquaculture lease.
Species to be cultured	Marine finfish species that naturally occur within the West Coast bio-region of Western Australia.
Seed stock	From a facility certified by the Supervising Scientist Biodiversity and Biosecurity, Department of Fisheries or with a health certificate issued or approved by the Department of Fisheries.
Feed inputs	Only commercial pellet feeds manufactured within Australia to the standard specified in the Mid West Aquaculture Development Zone Management Policy or if imported fish feed or ingredients to be used then only with the approval of the Australian Quarantine Inspection Service.
Decommissioning	Permanent removal of all sea cage and associated infrastructure.

The potential impacts of the proposal on the environment identified by the proponent in the PER document (Department of Fisheries, 2016) and the proposed management are summarised in Table ES (Executive Summary) in the PER document.

Three agency submissions and two public submissions were received during the public review period. The key issues raised relate to:

- potential impacts from aquaculture infrastructure and operations on marine fauna;
- proposed management of potential impacts to marine fauna (Marine Fauna Interaction Management Plan);
- potential impacts from aquaculture operations on marine environmental quality; and
- proposed management of potential impacts to marine environmental quality (Environmental Monitoring and Management Plan).

Issues raised were addressed by the DoF, on behalf of the proponent, in the Response to Submissions document that was endorsed by the EPA on 6 December 2016 (Appendix 5).

In assessing this proposal, the EPA notes that the proponent has sought to avoid, minimise, and rehabilitate environmental impacts associated with the proposal by:

- limiting standing biomass to 24,000 tonnes and stocking density to 8 tonnes per ha of lease;
- applying the EPA's environmental quality management framework, through the EMMP, that limits the level and spatial extent of impacts to marine environmental quality across the zone;
- where practical, avoiding locating sea cages over areas of benthic communities and habitat;
- locating the sea cages in well-flushed locations with good water circulation and dispersion;
- allowing sea bed recovery through fallowing; and
- adopting best-management practices in relation to infrastructure design, installation, maintenance, feeding techniques, animal husbandry and marine fauna interactions.

DoF Site Selection Process

The EPA also notes that prior to the identification of the MWADZ DoF undertook a site selection process, which took into account existing uses and values in the region. Multi-criteria evaluation was used to assess a number of potentially suitable locations between Port Denison (Dongara) and Shoal Point, north of Port Gregory. DoF also consulted with stakeholders to establish where the proposal was likely to have the least impact on existing activities and values.

The areas were initially evaluated by the proponent using selection criteria such as:

- biological and physical features (e.g. water depth and circulation);
- fish health and productivity;
- minimal influences on marine flora and fauna;
- reduced proximity to socially and culturally significant sites, and

- reduced potential interactions with other activities (both commercial and recreational users).

This process identified areas at the Abrolhos Islands to be the most suitable for the proposal. Further evaluation of these areas took into account environmental, economic and social significance, such as prime fishing grounds and shipwreck locations. The management objectives and values of the Houtman Abrolhos Islands Management Plan were also taken into consideration during site selection.

The final location of the proposal (northern and southern areas) was chosen due to adequate depth, good water circulation and location away from areas of highest conservation value. However, the ultimate decision on the location was substantially influenced by stakeholder advice.

The suitability of the final location was initially verified by underwater video “ground-truthing” of the proposed sites conducted to ensure the benthic habitat was predominately sandy bottom. Once the general location of the sites was decided, a technical environmental study finalised the boundaries of each area as the basis for the environmental impact assessment and for seeking environmental approval.

Figure 1: Strategic Proposal location within the Fish Habitat Protection Area

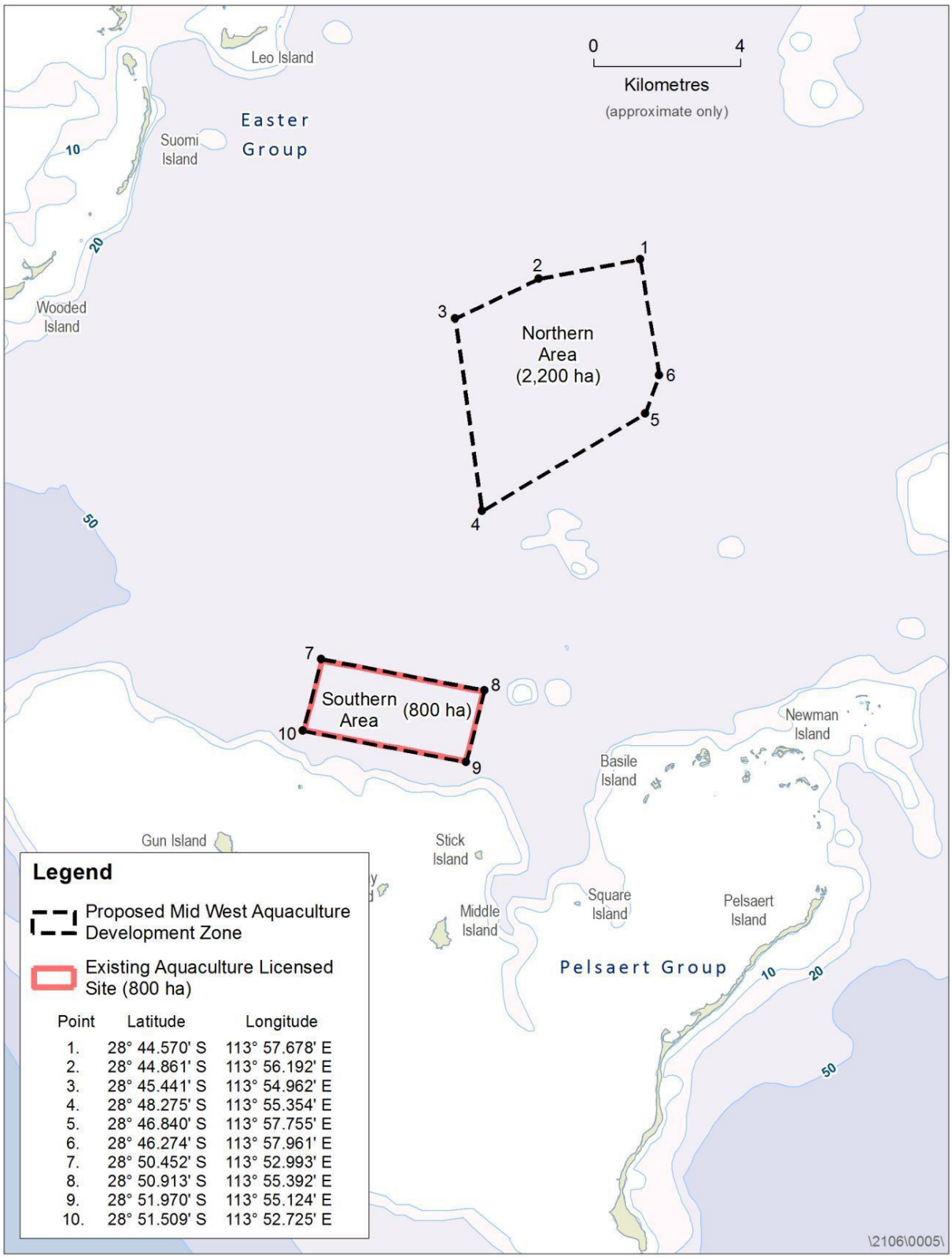

Figure 2: Location of Proposed areas in the Mid West Aquaculture Development Zone

3. Key environmental factors

In undertaking its assessment of this proposal and preparing its report and recommendations, the EPA has had regard for the object and principles contained in s4A of the EP Act to the extent relevant to the particular matter being considered. Appendix 3 provides a summary of the principles and how the EPA applied the relevant principles in its assessment.

On 13 December 2016, the EPA released a new suite of environmental impact assessment policy and guidance documents replacing those current at the time of referral and preparation of the Public Environmental Review (PER) document. The DoF has been consulted (on behalf of the proponent) on the application of the current environmental impact assessment policy and guidance documents relevant to its environmental review and the EPA's assessment of the proposal.

In its assessment of the proposal the EPA has considered and given due regard where relevant to current and applicable former environmental impact assessment policy and guidance documents.

Having regard to:

- the EPA's Environmental Scoping Document;
- the proponent's PER document;
- public and agency comments on the PER document;
- the proponent's response to submissions;
- the EPA's own inquiries;
- the EPA's *Statement of Environmental Principles, Factors and Objectives* (EPA, 2016a); and
- the EPA's Factor Guidelines,

the EPA identified the following key environmental factors during the course of its assessment:

1. Marine Environmental Quality;
2. Benthic Communities and Habitat; and
3. Marine Fauna.

These are discussed in sections 3.1 to 3.3. The description of each factor shows why it is relevant to the proposal and how each would be affected. These sections outline the EPA's conclusions as to whether or not the proposal can be managed to meet its objective for a particular factor and, if so, the recommended conditions and procedures that should apply if implemented.

Other environmental factors relevant to the proposal which the EPA determined not to be key environmental factors are discussed in the PER document (Department of Fisheries, 2016).

Appendix 3 contains the environmental factors identified through the course of the assessment and the EPA's evaluation of whether an environmental factor is a key environmental factor for the proposal. This includes environmental factors that were identified as preliminary key environmental factors at Level of Assessment which were included in the Environmental Scoping Document and addressed in the PER.

3.1 Marine Environmental Quality

The EPA's environmental objective for this factor is *to maintain the quality of water, sediment and biota so that environmental values are protected.*

Relevant EPA policy and guidance

The EPA considers that the following policy and guidance is relevant to its assessment of the proposal in relation to this factor.

- Environmental Factor Guideline – Marine Environmental Quality (EPA, 2016b).
- Technical Guidance – Protecting the quality of Western Australia's marine environment (EPA, 2016e).
- Technical Guidance - Environmental Impact Assessment of Marine Dredging Proposals (EPA, 2016f).

Appendix 3 details the relevant considerations for environmental impact assessment (EIA) under both the EPA's new Environmental Factor Guideline and the EPA's former suite of policies and guidelines.

In summary, to address the considerations within the EPA's Environmental Factor Guideline – Marine Environmental Quality (EPA, 2016a) the proponent has:

- described the existing marine environment at the MWADZ location that will potentially be affected and the significance of the environmental values that it supports;
- demonstrated application of the mitigation hierarchy to avoid or minimise impacts on marine environmental quality, where possible;
- provided options for avoiding or reducing the potential effects on the environmental values;
- undertaken modelling to predict the extent, duration and intensity of impacts under normal and 'most likely' best and worst case scenarios;
- proposed additional practical mitigation strategies to be implemented and described the predicted residual impacts;
- presented potential impacts on the factor within the context of an environmental quality plan (EQP); and
- demonstrated that all analyses are undertaken consistent with EPA and other published guidance.

This is described in more detail in the EPA's assessment of Marine Environmental Quality.

How this factor links with other environmental factors

The EPA recognises that the key threats to marine environmental quality from sea-cage aquaculture are similar to those described in Section 3.2 for benthic communities and habitat, which highlights the high degree of connectivity between the two factors. These threats are related to the generation, release and subsequent deposition on the seabed of organic waste.

EPA Assessment

Description of the Marine Environment

The proponent has undertaken investigations to characterise background marine environmental quality in the MWADZ study area and to place that into a regional context. This overview of the study area is supported by metocean and baseline water and sediment quality surveys conducted by the proponent between May 2014 and March 2015 within the MWADZ proposal study area and the surrounding waters. The purpose of the monitoring program was to effectively capture the seasonal and spatial variability in a range of water and sediment parameters.

The MWADZ is characterised by relatively strong prevailing winds from the southerly quadrant, frequent storms and squalls. The Abrolhos region is occasionally subject to cyclonic activity from December to May, with more than half the recorded cyclones occurring between March and May. On average since 1915, a cyclone has passed through coastal waters within 400 km of the region approximately every 2.5 years.

The region surrounding the Abrolhos is a dynamic system influenced by large-scale regional currents (e.g. Leeuwin current, Capes current), wind stresses, upwelling and wave dynamics (Pearce & Pattiaratchi 1999, Feng et al. 2007, Waite et al. 2007, Woo & Pattiaratchi 2008, Rossi et al. 2013). The Leeuwin current is a well-studied oceanic flow of warm, low salinity tropical water that travels southwards along the WA coast, usually stronger in winter and weaker in summer. The Capes current is a nearshore, northward-flowing current, strongest in summer (Pattiaratchi & Woo 2009).

The MWADZ is located on the edge of the WA continental shelf, in the pathway of the Leeuwin current. The waters of the MWADZ are 25-50 m deep, well flushed and with high levels of circulation and dispersion. Their position within the Zeewijk Channel means that the area is exposed to significant westerly currents, which expel large volumes of water out of the zone toward the continental shelf slope (Maslin 2005).

Results from monitoring programs established that the waters inside the project area are clean and well mixed. Water currents in the study area are variable, ranging between 5.8 and 14.4 cm/s. Maximum and minimum water temperatures were achieved in autumn (23.5°C) and winter (20.8°C), respectively. Salinity and dissolved oxygen levels were consistent through the

water column with little evidence of stratification. The water was highly oxygenated, achieving surface oxygen saturation levels between 98 and 99% and bottom oxygen saturation levels between 95 and 98%. Light attenuation in the MWADZ was low which is indicative of very clear water, with excellent light penetration.

Concentrations of ammonium (2.7 µg/L) and chlorophyll-a (0.43 µg/L) were low, pointing to an overall oligotrophic (nutrient poor) environment.

In general, sediments in the Zeewijk Channel, where the MWADZ proposal area is located, are predominantly composed of calcareous sands of varying proportions of different particle sizes. Studies suggest some differences in time – fine to coarse sand dominate in the winter season, while fine clays and silts dominate in the summer season. Overall, this reflects the general high level of seasonal variability across all locations within the channel.

The benthic environment in the MWADZ proposal area consists generally of a shallow (~15 cm thick) layer of sediment overlying rocky substrate. Higher current speeds in the northern area (13-14.5 cm/s) compared to the southern area (8.7-11 cm/s) are reflected in the tendency toward larger sediment grain sizes in the northern reaches of the MWADZ. Sediment conditions are also variable, with seasonal fluctuations in nitrogen, phosphorus and total organic carbon which tend to be higher in the warmer months.

Results demonstrated that benthic infauna assemblages are diverse and dominated by polychaetes (marine worms). Higher levels of infauna diversity and abundance are observed in the summer months.

Potential impacts to marine environmental quality

The key threats to the environment from the marine sea-cage farming operations foreshadowed in this strategic proposal are related to the utilisation (and potential overfeeding) of supplementary feed and the subsequent likely release of nutrients, and sedimentation from waste food and faeces. Impacts on marine environmental quality can also occur from the use of chemicals and pharmaceuticals associated with antifouling, fish health and biosecurity. Sea cages can also result in local changes to hydrodynamics, which can exacerbate the effects of impacts to water and sediment quality.

Potential impacts from these key threats include organic enrichment of the sediment, reduced dissolved oxygen and a decline in the health of benthic infauna as well as other invertebrates such as filter feeders (potential impacts to benthic communities and habitats are discussed further in Section 3.2).

The key impact pathways of concern to marine environmental quality from sea-cage aquaculture are summarised below.

Organic Deposition: Sediments

It is known that sea-cage finfish aquaculture impacts on the sediments beneath or in close proximity to the cages through the settlement of increased suspended organic matter in the water from faeces and uneaten feed.

This organic loading on sediments within the deposition footprint of each cage can lead to local organic enrichment (eutrophication). Secondary effects relate to low sediment dissolved oxygen (hypoxia) and high sulphide content, both of which can occur if increased respiration caused by the high organic loading depletes oxygen in the lower water column faster than it can be replenished. Sediment infauna communities may become increasingly degraded as levels of organic enrichment increase and sediment hypoxia events become more frequent.

Another physical pressure on the sediment and benthic communities is the effect of smothering caused by organic particles settling on the sea-floor and associated sessile organisms. Smothering occurs when the volume of organic material reaching the seafloor exceeds the shedding capacity of marine organisms, or their limit of tolerance. Smothering impacts are also discussed under the factor Benthic Communities and Habitat.

Inorganic nutrients – water quality

Sea-cage aquaculture also contributes dissolved inorganic nutrients (ammonia, nitrite + nitrate, and orthophosphate) to the water column from excess feed or through direct excretion by fish through the gills, skin and faeces. This natural excretion is intensified through the high stocking density and biomass within the sea cages. Nutrients are also released into the water column through organic matter deposition and remineralisation in the sediment.

Nutrients are biostimulants which can affect ecosystems by promoting the growth of particular organisms. Plant nutrients such as inorganic nitrogen may be assimilated directly by phytoplankton and/or macroalgae leading to shading effects, phytoplankton blooms or the proliferation of ‘nuisance’ algal epiphytes. These algae can then shade or smother benthic primary producers or other slower growing organisms.

Metals and other contaminants

Metals and other contaminants can come from antifouling paints on the sea-cage equipment (e.g. copper), from trace elements within commercial fish feed (uneaten or excreted as faeces e.g. zinc and iron) or as antibiotics used to treat or prevent bacterial infections in the fish.

Toxic or harmful effects on benthic marine organisms and bacterial communities are likely when metals and contaminants in the sediment exceed certain levels. If any of these chemicals are known to bioaccumulate, bioconcentrate or biomagnify then exposed biota could take up, retain or concentrate these chemicals through the food chain.

Assessment of predicted impacts

In various modelling and technical studies the proponent has identified the key potential impacts from the MWADZ proposal, their significance and the likely effects of the management and mitigation controls designed to address them. The predicted impacts on marine environmental quality have been addressed consistent with the EPA's factor guidelines and technical guidance. This is described in more detail in Appendix 3.

Cause-effect pathways

The proponent's technical studies helped to determine the type, magnitude and likely effects of environmental pressures introduced by the proposal. The proponent then developed a conceptual diagram identifying key cause-effect (or pressure/response) pathways for each threat and pressure identified in its risk assessment of the proposal (Figure 3).

Figure 3 shows the relationship between the most important stressors, ecosystem components, effects and biological receptors. It is hierarchical in nature, with the stressors and their sources shown in the upper strata of the model. The receptors are shown in the middle and the effects in the bottom strata of the model.

This approach allowed the proponent to identify the cause-effect pathways most likely to be affected by the MWADZ, and those likely to exhibit measurable changes in response to stressor inputs. Knowledge gained from this process was used to identify key indicators and develop the thresholds used to interrogate the integrated ecosystem model described below.

Integrated ecosystem model

An important part of the proponent's assessment for this factor was to develop an integrated model capable of simulating and predicting the effects of organic and other wastes from sea-cage aquaculture on the marine environment. This also allowed predictions to be made about the rate of recovery of the impacted benthic environments after fallowing.

This required the incorporation of several discrete environmental models that accounted for wave energy, fish waste, particle transport and hydrodynamics, within a model of the sediment biogeochemistry and water quality of the site. Its purpose was to predict the cumulative environmental effects of potential aquaculture production scenarios within the proposed MWADZ. The ecosystem model could simulate regional oceanographic water movements, the deposition and dispersal of wastes from sea cages, the effects of these wastes on the marine environment, and the rate of environmental recovery.

The model was used in a 'conservative mode' to examine the likely benthic footprints of the sea cages under a total of six production scenarios (shown in Table 3). This approach was taken, in part, to account for the inherent uncertainty and to reduce the likelihood of understating the possible impacts. Modelling was based on the assumption that wastes from sea cages exhibit

adhesive properties (partly due to its mucus content) which reduced their resuspension potential relative to other inorganic particles (Nowell et al. 1981; Masalo et al. 2008). This acted to retain and concentrate organic material in the vicinity of the cages.

The model simulation was based on production of yellowtail kingfish using industry best-practice farming methods. The extent of benthic footprints was presented after two, three and five years of production and the extent of water quality impacts after one year of production.

Table 3: Modelled Production Scenarios

Scenario No.	S1	S2	S3	S4	S5	S6
Total standing biomass (tonnes)	15,000		24,000		30,000	
Standing biomass north (tonnes)	10,000		16,000		20,000	
Standing biomass south (tonnes)	5,000		8,000		10,000	
No. clusters south	3	2	3	2	3	2
No. clusters north	6	4	6	4	6	4

Risks associated with organic waste inputs and benthic impacts were examined in the context of sediment organic enrichment and changes to sediment chemistry, with the level of impact (i.e. reversible or irreversible) determined by the recovery period during fallowing. At the completion of the two, three and five year periods of production, the sea cages were fallowed to allow recovery of the sediments.

Risks associated with the selected key water column contaminants (dissolved inorganic nitrogen [DIN] and suspended particles) were examined after one year of production. Suspended particles were examined in the context of smothering and interruption to filter feeding processes, and DIN in the context of algal growth potential, nutrient enrichment and shading.

Predicted impacts to the sediment were presented in the context of the EPA's Technical Guidance - Environmental Impact Assessment of Marine Dredging Proposals (EPA 2016f). Although the proposal doesn't involve dredging, this approach is appropriate due to similar levels of uncertainty when predicting the deposition footprint including the extent, severity and duration of impacts from organic waste associated with uneaten fish feed and faeces. In order to take account of this uncertainty the EPA expects the final set of predictions to describe the lower and upper ends of the likely range of impacts associated with the proposal (i.e. the likely best case and the likely worst case). This range should be realistic and based on understanding of probable scenarios and their associated environmental outcomes.

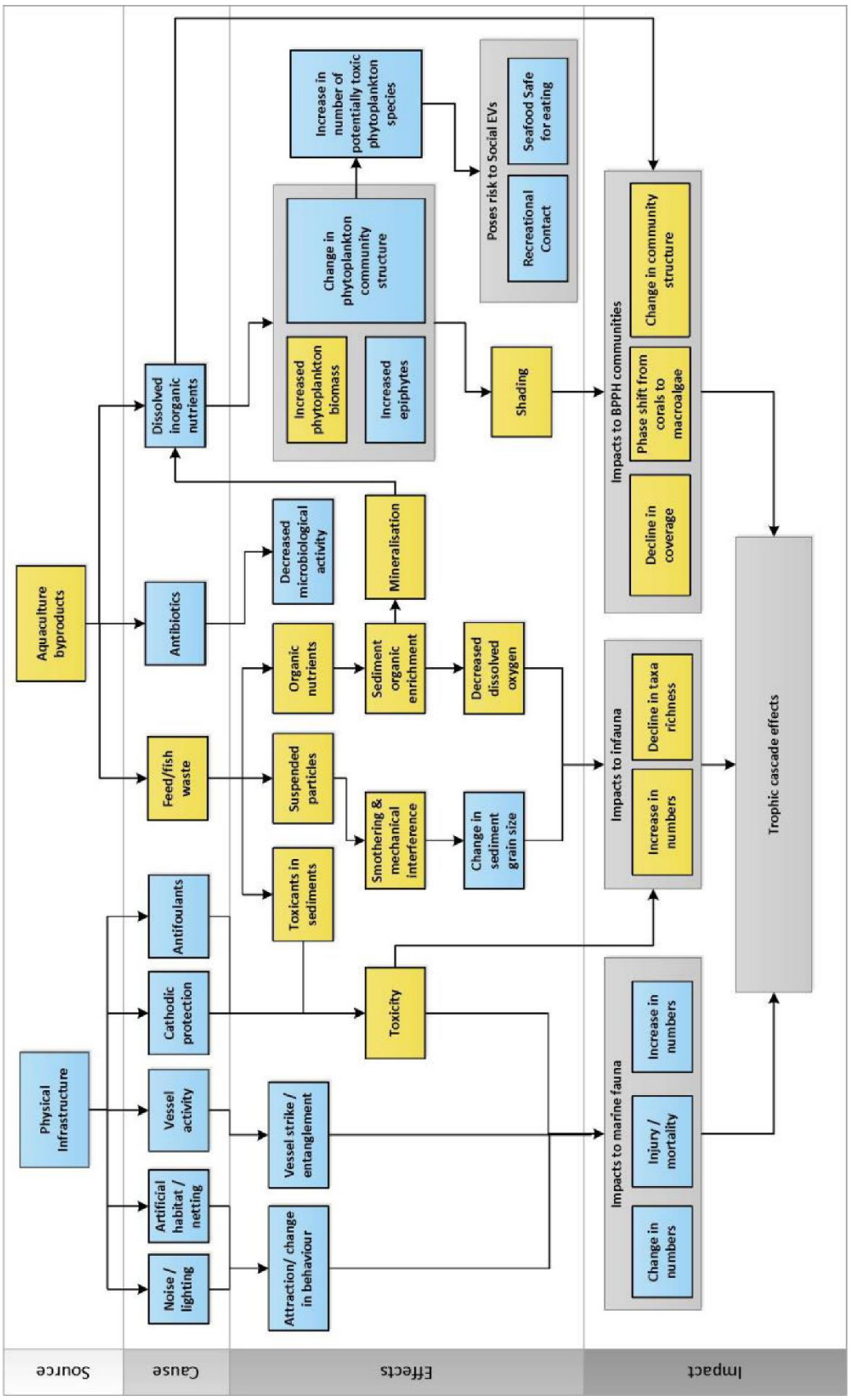

Figure 3: Key Cause-Effect Pathways

Pathways shown in yellow represent those captured by the integrated modelling and those for which thresholds were developed.

The potential extent and severity of impacts in the water column were simulated and the outputs presented in the context of the EPA's Technical Guidance – Protecting the Quality of Western Australia's Marine Environment (EPA 2016e).

Accumulation of organic material occurred rapidly under each modelled scenario. The rate of organic deposition (expressed in grams per square metre per year) increased with greater standing biomass (shown in Figure 4) and greater stocking density. The highest organic deposition levels were beneath the sea cages corresponding with the highest levels of standing biomass. The modelling also showed the highest concentrations of deposited organic waste occurred directly under, or in the immediate vicinity of, the sea-cage clusters.

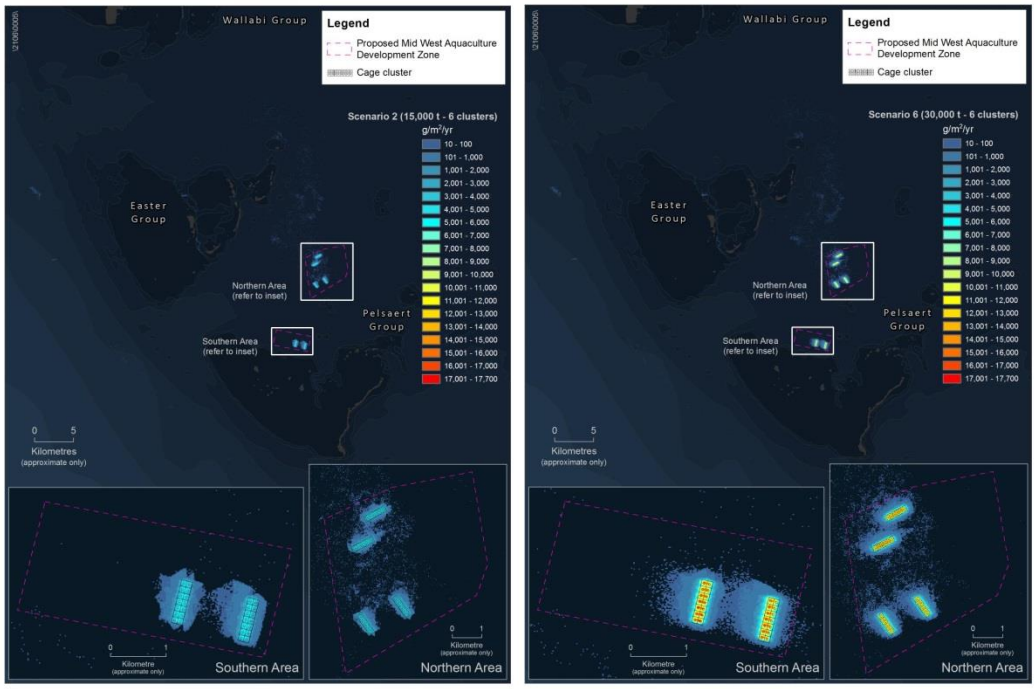

Figure 4: Organic deposition rates under Scenario 2 (6 clusters, 15,000 tonnes) and Scenario 6 (6 clusters, 30,000 tonnes)

After three and five years of finfish production across the full range of production scenarios, the modelling identified zones of impact and influence based on the predicted time required for oxygen and sulphide concentrations in the sediment to return to baseline levels.

Three levels of impact; 'zone of high impact' (ZoHI), 'zone of moderate impact' (ZoMI) and 'zone of influence' (ZoI) were spatially delineated based mostly on exceedances of predetermined environmental thresholds for recovery of the sediment. The ZoHI was applied when sediment conditions (sulphide content, oxygenation and metal content) took more than five years to recover (considered irreversible); the ZoMI was applied when sediment conditions took less than five years to recover (reversible), and the ZoI was applied when

sediments received waste material, but not in proportions great enough to alter the sediment chemistry in any measurable way.

The confinement of the majority of organic deposition to the area immediately beneath the sea cages is evident in both stocking scenarios (Scenario 2 [15,000 tonnes] and Scenario 6 [30,000 tonnes]). However, the increased production associated with Scenario 6 led to a more than seven-fold increase in the rate of organic enrichment as indicated by the red colour under the cages compared to light blue under the lower Scenario 2 stocking regime (Figure 4). Areas beyond the sea-cage clusters maintained similar levels of organic deposition, regardless of the standing biomass.

The modelled ZoHI areas are located where the highest rates of deposition of organic waste occurred; that is directly under or in the immediate vicinity of the sea-cage clusters. This designation of these areas as a zone of high impact is due to the sediments requiring more than five years to achieve full recovery as modelled.

The key findings of the simulation modelling suggest that:

- the area occupied by the ZoHI increases in response to increasing standing biomass (this is illustrated in Figure 4);
- significant reductions in the areas of the ZoHI (i.e. the severity of impact) can be achieved by reducing the length of production from five to three years (this is shown in Table 4 below);
- reducing the number of sea-cage clusters while maintaining the same standing biomass (i.e. increasing stocking density), can reduce the total area occupied by the ZoHI across the zone (this is shown in Figure 6);
- reductions in both the standing biomass and the length of production also reduce the maximum extent of the ZoHI, as measured along the maximum radius down-current from the cage clusters;
- the areas occupied by the ZoMI are likely to increase in response to increased standing biomass but much less so compared with the ZoHI;
- the ZoI was the largest (in area) but does not change significantly in response to the different scenarios;
- Recovery times in the ZoHI and ZoMI ranged from one to more than seven years, depending on the scenario, duration of production and distance from the sea cages; and
- Sediments immediately under the sea cages are likely to require more than seven years to fully recover, irrespective of the standing biomass modelled. However, this recovery time is reduced when production duration is reduced from five to three years (shown in Figure 6).

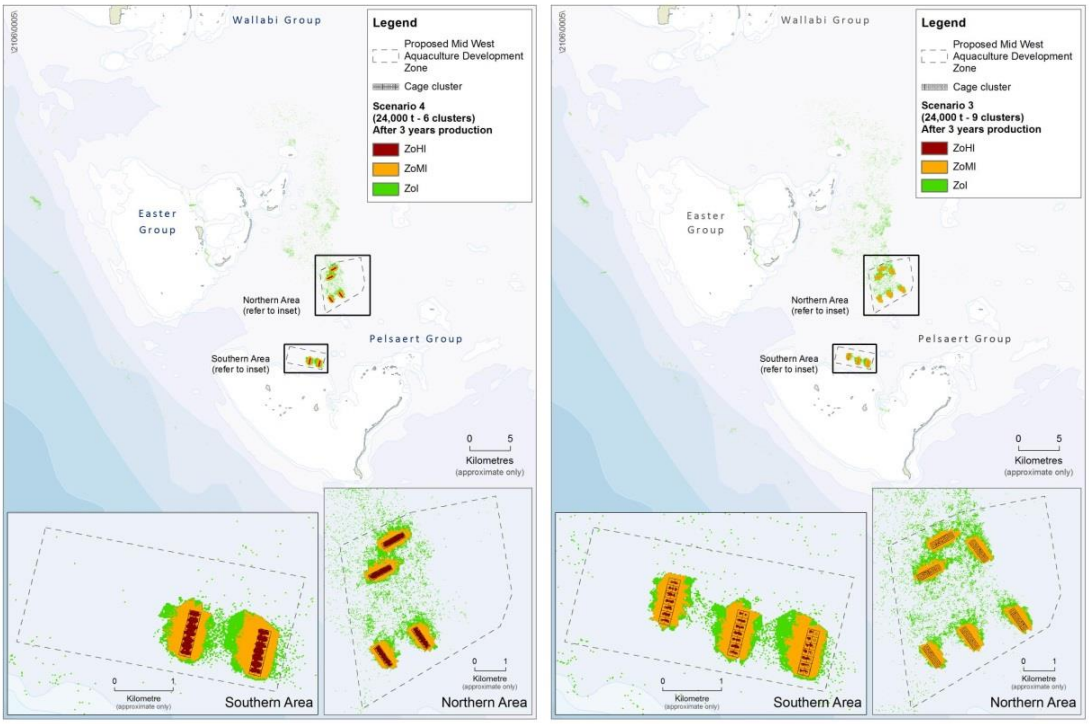

Figure 5: Organic deposition concentrations at 24,000 tonnes (Scenario 3&4) at different stocking densities: 6 clusters (higher stocking density, left) and 9 clusters (lower stocking density, right).

Table 4: Areas occupied by the zones of high and moderate impact and the zone of influence under scenarios S1, S3 and S5 after 3 and 5 years production

Years of production	Scenario No.	Standing biomass (t)	ZoHI (ha)	ZoMI (ha)	ZoI (ha)
5	S1	15,000	117	239	1,150
	S3	24,000	132	235	1,005
	S5	30,000	177	270	1,226
3	S1	15,000	1	346	1,159
	S3	24,000	11	349	1,012
	S5	30,000	105	334	1,235

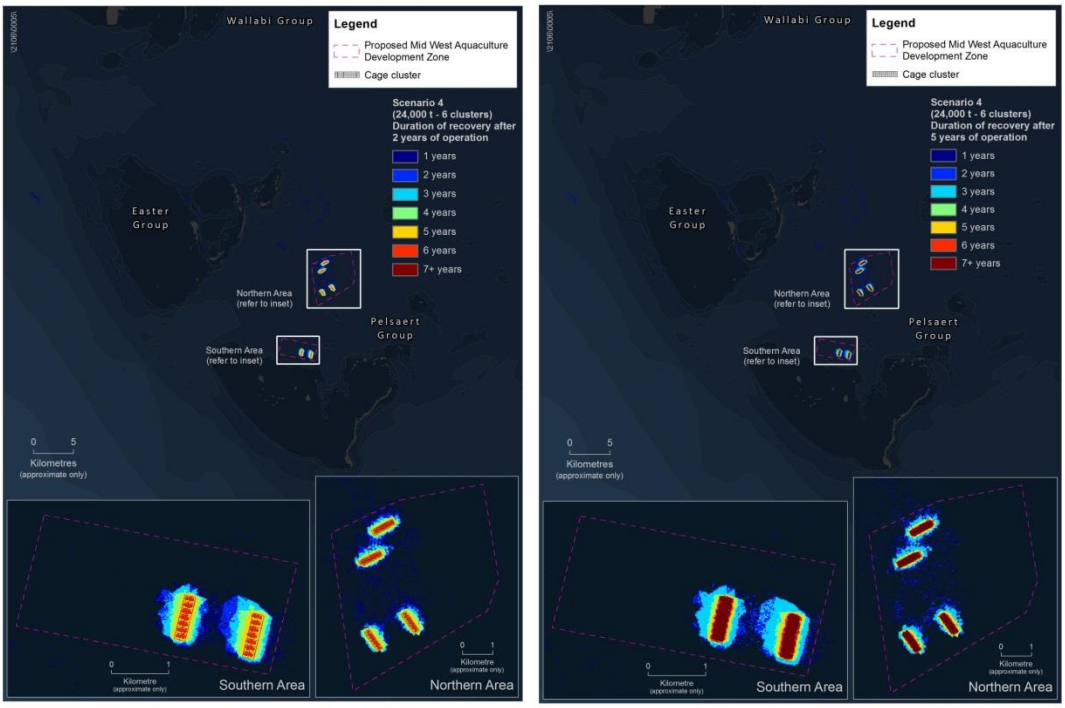

Figure 6: Fallowing recovery times for Scenario 4 (24,000 tonnes, 6 clusters) after 3 years production (left) and 5 years production (right)

In relation to effects in the water column, the proponent's model showed concentrations of DIN increased with increasing biomass and increasing stocking density down-current of the sea cages. However, the plumes dissipated rapidly and despite the level of input of DIN, none of the scenarios resulted in significant changes to the chlorophyll-a concentrations in the broader project area. Similar results were obtained with respect to water clarity and water column dissolved oxygen levels.

Shading is largely associated with the amount of particles in the water, a proportion of which is phytoplankton. Although the proposal presents conditions under which phytoplankton may be stimulated, none of the modelled scenarios resulted in significant effects on chlorophyll-a concentrations and sub-surface light conditions.

The proponent concluded that none of the production scenarios were likely to result in detrimental changes in water quality.

It also concluded that the primary environmental impact to marine environmental quality from the proposal is to the sediments immediately beneath and adjacent to the sea cages. Organic waste from uneaten fish feed and faeces deposited on the seafloor beneath the cages will result in changes to the oxygen and hydrogen sulphide concentrations in the sediment. Organic loading will lead to localised organic enrichment and changes to sediment chemistry.

Under 30,000 tonnes standing biomass, modelling predicted no adverse changes to water quality and only localised impacts to the sea-floor beneath the sea cages. The greatest severity and extent of impacts occurred at 30,000 tonnes standing biomass after five years' production, as represented by the ZoHI, which extended to 110 m from the cages. The extent reduced to 55 m and 50 m after three and two years' production, respectively. Further reductions to the area of impact were achieved by reducing the standing biomass to 24,000 tonnes under which the ZoHI extent from the cages was restricted to 15 m after three years' production.

The proponent predicts that areas outside, and at least half of the area inside, the proposed MWADZ will maintain sediment chemistry (in relation to oxygen and sulphide concentrations) equivalent to background levels, with no resulting changes in infauna diversity. Providing standing biomasses do not exceed 8 tonnes per hectare of lease, the proponent expects that impacts to infauna diversity will be maintained within acceptable limits.

The proponent accepts that in the rare event of a disease outbreak antibiotics may be discharged to the marine environment. It acknowledges this could have detrimental impacts to bacterial communities on the seafloor, but given that antibiotics are administered in feed and the majority of wastes in the proposed MWADZ would be deposited close to the sea cages, the extent of impacts would be constrained to relatively small areas. The more commonly used antibiotics in the industry may persist in the sediments beneath sea cages for a number of weeks. However, accumulation over multiple seasons is considered unlikely and the potential effects are considered negligible.

Similarly, although zinc and copper are present in commercial feeds (and therefore also present in fish faeces), the proponent predicts that low levels of zinc and copper in the fish waste would be insufficient to exceed acceptable limits, even after five years' production at the proposed standing biomass limit of 24,000 tonnes of marine finfish.

The proponent notes that these results represent a conservative approach which was adopted to ensure the outputs of modelling were equivalent to 'most likely worst-case' outcomes. As such the modelled impacts to sediments predicted in the PER are likely to be within the upper range of potential impacts.

A key factor in the proponent's modelling was the rate of sediment recovery. The modelling of recovery did not account for any extreme oceanic conditions associated with occasional intense low-pressure weather systems. Although infrequent, major storm events could result in substantial scouring of the seafloor that could 'reset' the sediments and advance their chemical recovery.

The proponent has thus also provided a 'most likely best-case' outcome based on the likely occurrence of events such as major storms and the implementation of management strategies that would result in less accumulation of organic material and faster chemical remediation.

In balancing the 'most likely worst-case' outcome (as predicted by the model) with the 'most likely best-case' outcome the proponent considers that the 'actual' environmental outcome will sit somewhere in between but will be less severe than that predicted by the conservative model. Furthermore, a range of zone planning strategies (see below) and adaptive management measures can be implemented in response to environmental monitoring of early warning indicators to minimise impacts to the sediment and ensure quality remains within acceptable levels. This approach is consistent with the EPA's technical guidance.

Model results indicate that reductions in the spatial extent of impacts (e.g. ZoHI, ZoMI and ZoI) can be achieved by concentrating finfish in individual cage clusters, without a corresponding need to reduce the total standing biomass across the zone. However, higher stocking densities increase both the intensity of impacts and the time required for sediment to fully recover.

In balancing this, the proponent has recommended a limit on stocking density at 8 tonnes of marine finfish per hectare of lease. Although no adverse effects to the regional environment are predicted at the upper range of the scenarios tested (i.e. 30,000 tonnes), 24,000 tonnes standing biomass is proposed as an interim limit, pending further validation of the model via monitoring 'pressures' and environmental responses concurrently. Controlling stocking density and standing biomass are considered effective contingency management measures.

The proponent has also identified that appropriate levels of standing biomass and three-year cage cluster site rotation will constrain the extent of the ZoHI. After more than three years of finfish production at any one location, the ZoHI is unlikely to breach the cage cluster perimeter. Cage relocation and fallowing, therefore, are considered effective management options.

Contingency management measures, such as those identified in the modelling, are proposed in the EMMP. By implementing the recommended management strategies the proponent has concluded that the impacts of the proposal can be constrained within small areas of the MWADZ (i.e. within 300 m of the cages), with no adverse effects to regional marine environmental quality.

Environmental Quality Management Framework

The EPA's Guideline for Marine Environmental Quality states that proponents are expected to present marine related development proposals that include waste discharges within the context of the environmental quality management framework (EQMF, Figure 7) recommended through the State Water Quality Management Strategy Report 6 (Government of Western Australia) and as modified through the EPA's Technical Guidance – Protecting the Quality of Western Australia's Marine Environment.

Although the proponent's predicted impacts to the seabed were addressed in the context of the EPA's Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA 2016f) the proposed methods for monitoring and managing impacts to marine environmental quality have been presented in the context of the EQMF and the EPA's Technical Guidance – Protecting the Quality of Western Australia's Marine Environment (EPA 2016e).

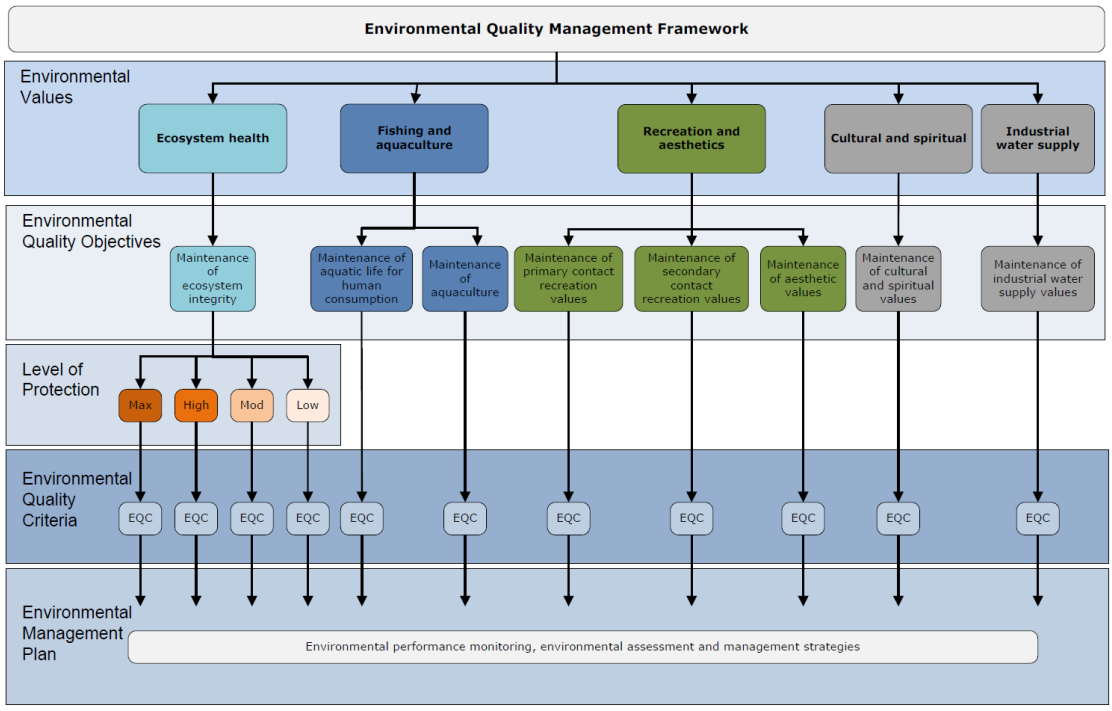

Figure 7: Conceptual overview of the environmental quality management framework applied to Western Australia's marine environment

The environmental values (EVs) form the basis of the EQMF developed for the proposal and, in combination with associated environmental quality objectives, represent marine environmental quality outcomes desired by community and other stakeholders. All five of these EVs (shown in Table 5) are generally expected to apply to the proposal.

Environmental quality objectives (EQOs) are high level management objectives that describe what must be achieved to protect each EV within the proposal. These are listed in Table 5. EQOs are defined spatially and are measurable. EQOs and the levels of ecological protection are spatially defined on a map of the development area and its surroundings, which is termed an environmental quality plan (EQP). The EQP for the proposal is shown in Figure 8. It forms the basis of the EMMP for the proposal.

Table 5: Environmental values and environmental quality objectives that apply in the MWADZ and surrounds.

Environmental Values	Environmental Quality Objectives
Ecosystem health	Maintain ecosystem integrity at a high level of ecological protection Maintain ecosystem integrity at a moderate level of ecological protection This means maintaining the structure (e.g. the variety and quantity of life forms) and functions (e.g. the food chains and nutrient cycles) of marine ecosystems to an appropriate level
Recreation and aesthetics	Water quality is safe for primary contact recreation (e.g. swimming and diving). Water quality is safe for secondary contact recreation (e.g. fishing and boating). Aesthetic values of the marine environment are protected.
Cultural and spiritual	Cultural and spiritual values of the marine environment are protected.
Fishing and aquaculture	Seafood (caught or grown) is of a quality safe for eating. Water quality is suitable for aquaculture purposes.
Industrial water supply	Water quality is suitable for industrial use.

Environmental Monitoring and Management Plan

To ensure that the EVs and EQOs for the proposal are being achieved the proponent, in consultation with the Office of the EPA, has developed an EMMP to apply to proponents of future proposals. Its key aim is to ensure that future aquaculture proposals in the zone are managed to achieve all the relevant EVs and EQOs set out in Table 5 and Figure 8.

The EMMP provides an EQP to manage the potential impacts of stocking up to 24,000 tonnes of marine finfish across the proposed MWADZ to protect water, sediment and biota quality to levels commensurate with the agreed levels of ecological protection.

While all the EVs (both ecological and social) shown in Table 5 and associated EQOs apply to the proposal, the EMMP focusses mainly on the EV for ecosystem health and the EQO for maintenance of ecosystem integrity.

This is because none of the indicators affected by the environmental pressures for this development are specific to the social values and, for those indicators that are affected, the environmental quality guidelines (EQG) for ecosystem health generally have more conservative thresholds than the EQG for the other social EVs. As these EQGs are harder to meet it is generally accepted that if ecosystem health is protected, the other social EVs are likely to be protected by default. In other words, most of the EVs and their associated EQOs can be demonstrably met if the EQG for ecosystem health are met.

Levels of Ecological Protection

For sea-cage aquaculture, the EPA recommends that ecological protection areas around sea cages should be set at 'Moderate'. The following limits of acceptable change are generally accepted in areas assigned as a Moderate level of Ecological Protection (MEPA):

- small changes in rates but not the type of ecosystem processes;
- biodiversity as measured on both local and regional scales remains at natural levels;
- small changes in abundances and/or biomasses of marine life; and
- moderate changes in the quality of water, sediment and biota beyond limits of natural variation.

The proponent has presented the predicted impacts and modelling results in the context of levels of ecological protection described in the EPA's factor guidelines and technical guidance for marine environmental quality. A key outcome of the proponent's modelling was that while changes to the sediment chemistry and resident biological assemblages are expected to occur, these are predicted to be locally constrained and non-detectable beyond 100 m from the cages. Furthermore, any changes to the sediment chemistry and the resident invertebrate fauna are expected to be fully reversible under a program of routine fallowing.

By interrogating the conservative model (which presented the 'most likely worst-case' outcome) in the context of limits of acceptable change the proponent notes that a Low Ecological Protection Area (LEPA) would reflect impacts under the cages. However, the proponent also considered the 'most likely best-case' outcome where organic enrichment and associated levels of oxygen depletion/hydrogen sulphide production would probably not occur to the same extent as that generated through the conservative modelling. Under this more optimistic scenario, it is possible that the resultant environmental quality would more closely resemble a MEPA.

The proponent considers it is realistic to expect that future derived proposals, after good adaptive farm management is applied (e.g. limiting standing biomass and stocking density, and fallowing), should be able to operate and achieve a moderate level of ecological protection within a distance of 300 m from the sea cages, and a high level of ecological protection outside that 300 m boundary (i.e. at least 50% of each aquaculture lease within the MWADZ). This realistic approach based on applied management is consistent

with what the EPA considers to be an appropriate level of ecological protection around sea cages (i.e. MEPA within a HEPA).

Based on the above, three MEPAs are proposed, each of 300 m radius, within a HEPA; two in the northern area and one in the southern area. The proposed operational MEPAs will be complemented by an additional six recovery zones, which will also be assigned a MEPA when operational. A key strategy for mitigating the potential for organic enrichment is for operators to implement a program of routine (or reactive) fallowing, which may involve relocation of infrastructure to another site. Relocation of infrastructure for the purposes of fallowing will inevitably result in duplication of MEPAs, while the original sites recover. At the commencement of fallowing, the recovery zones will be monitored until recovery levels consistent with a HEPA can be demonstrated.

This has been presented spatially in the MWADZ Environmental Quality Plan (EQP) shown in Figure 8. The proposed MEPAs will be contained within the northern and southern areas of the MWADZ and will not exceed 50% of the area in each. In this regard it is proposed to restrict the total area in the MWADZ occupied by operational and fallowed MEPAs to <1,500 ha.

Derived proponents will be expected to demonstrate they are meeting these levels of ecological protection for the life of their projects. For auditing purposes, derived proponents will be expected to demonstrate the total area occupied by MEPAs, encompassing both recovering and existing cage clusters sites, is less than 50% of each aquaculture lease area.

The cumulative area occupied by the MEPAs and the recovery zones is less than 5% of the area within a 10 km radius of the MWADZ (10 km radius is shown in Figure 8), which is consistent with EPA's Technical Guidance – Protecting the Quality of Western Australia's Marine Environment.

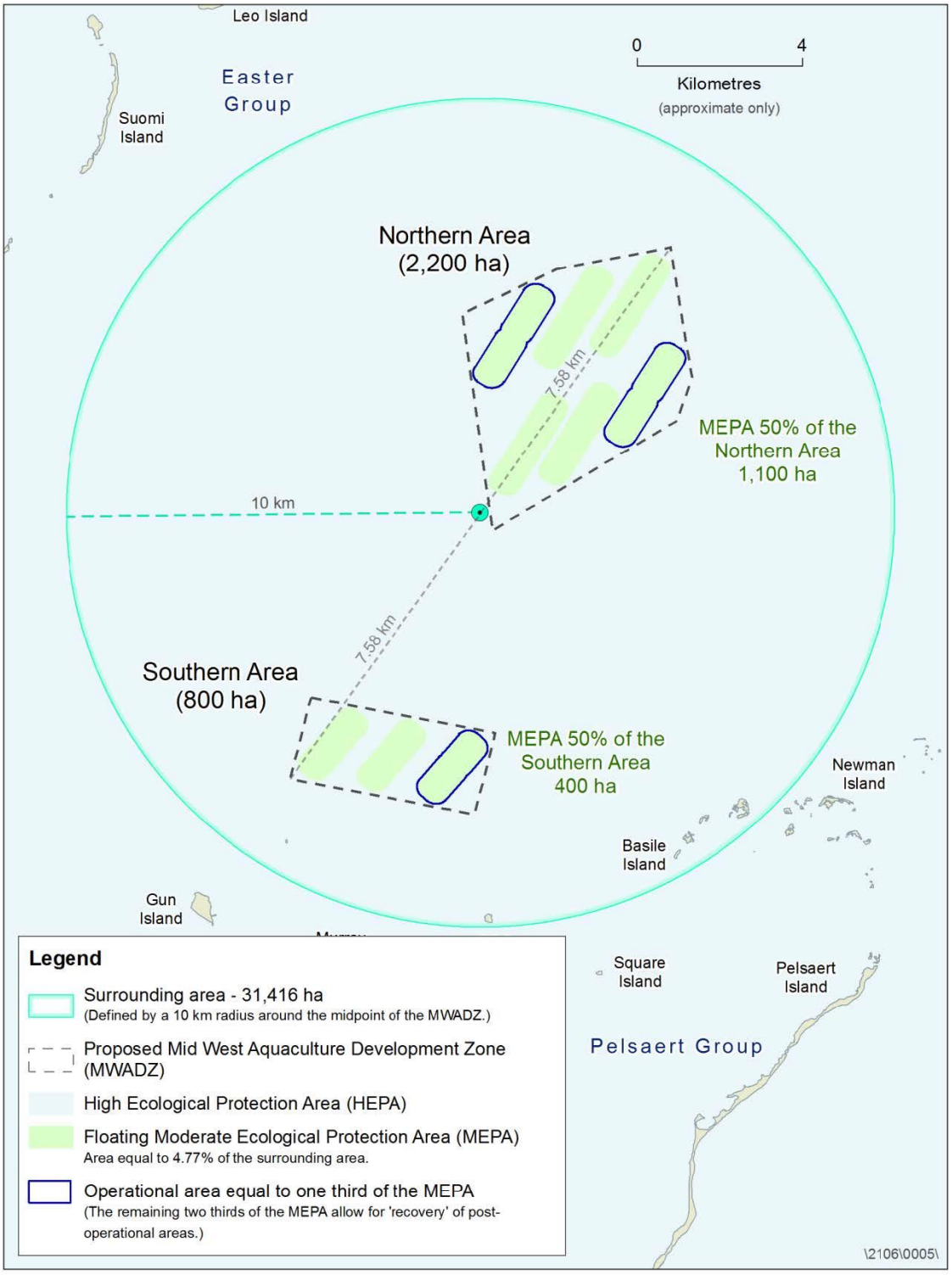

Figure 8: Environmental Quality Plan (EQP) for the MWADZ and surrounds

Note 1: The locations of the MEPAs are conceptual, but will be contained within the northern and southern areas of the MWADZ and not exceed 50% of the area in each.

Note 2: The MEPAs and HEPA shown in the EQP relate to the EV of 'Ecosystem Health'. All social use EVs ('Fishing and Aquaculture', 'Recreation and Aesthetics', 'Cultural and Spiritual' and 'Industrial Water Supply') apply throughout the MWADZ and surrounds.

Environmental Quality Criteria

The extent to which the EQOs in the MWADZ have been achieved will be assessed against a suite of Environmental Quality Criteria (EQC) selected by the proponent in consultation with the Office of the EPA to ensure consistency with the EPA's Technical Guidance – Protecting the Quality of Western Australia's Marine Environment.

EQC represent scientifically based limits of acceptable change to a measureable environmental quality indicator that is important for the protection of the associated environmental value. A fundamental requirement of EQC is that they should be clear, readily measurable and auditable. EQC comprise both Environmental Quality Guidelines (EQGs or alert levels) and Environmental Quality Standards (EQSs or alarm levels).

As explained in the EPA's Technical Guidance – Protecting the Quality of Western Australia's Marine Environment:

- EQGs are threshold numerical values or narrative statements which, if met, indicate there is a high degree of certainty that the associated environmental quality objective has been achieved. If the guideline is not met then there is uncertainty as to whether the associated EQO has been achieved and a more detailed assessment against an EQS is triggered. This assessment is risk-based and investigative in nature.

- EQS are threshold numerical values or narrative statements that indicate a level which, if not met, indicate there is a significant risk that the associated environmental quality objective has not been achieved and a management response is triggered. The response would normally focus on identifying the cause (or source) of the exceedance and then reducing loads of the contaminant of concern (i.e. source control) and may also require *in situ* remedial work to be undertaken.

Through its investigations the proponent developed a conceptual model which identifies the key cause-effect pathways for the MWADZ (described previously and summarised in Figure 3 above). This was used to identify the indicators and receptors for which EQC need to be developed and incorporated in the EMMP.

The proponent has developed EQC for water, sediment and biota quality based on the key environmental pressures, receptors and indicators identified previously. These are summarised below in Table 6.

Table 6: Measurable indicators used to derive the environmental quality criteria

Source / Cause	Monitoring	EQG	EQS
Aquaculture feeds Finfish wastes Inorganic nutrients Organic nutrients	Water quality	Light attenuation coefficient	BPPH community health; Infauna community diversity; Video assessment.
		Volatile suspended solids	
		Chlorophyll-a	BPPH community health
		Dissolved oxygen	Surface-bottom dissolved oxygen; BPPH community health; Infauna community diversity; Video assessment.
	Sediment	Total nitrogen	Surface-bottom dissolved oxygen; BPPH community health; Infauna community diversity; Video assessment.
		Total phosphorus	
		Total organic carbon	
		Copper	Infauna community diversity
		Zinc	
Physical infrastructure General operations Finfish and other wastes Litter and spills	Aesthetics	Nuisance organisms	Community perception
		Faunal deaths	
		Water clarity (qualitative)	
		Colour	
		Surface films / debris	
		Reflectance	
		Odours	

Monitoring program

Sampling will be undertaken at monthly intervals for three months in autumn (February to April) to capture the period of highest water temperature and low energy and again at monthly intervals for three months in late winter (July to September) to capture low water temperature and high-energy conditions. Sampling for benthic infauna will be undertaken at the beginning of autumn and again at the end of autumn.

The water, sediment and biota quality monitoring program aims to determine whether the EQC have been met in the MEPA generally, and at the HEPA boundary 300 m from the sea cages. A key element of the sampling will be undertaken along a transect bridging the high and moderate ecological protection areas, with three sites in the HEPA and seven in the MEPA. The framework is designed to measure along a decreasing gradient of effect between the sea cages and the HEPA boundary. The EPA supports this approach and the evidence base it will generate, provided that the sampling transects are located where the pressures from sea-cage aquaculture are greatest over the term of this EMMP.

Transect sampling will be initially undertaken at fixed distances either side of the sea cages as the direction of the prevailing current is unknown. This may be limited to the direction of the identified prevailing current in a future review of the EMMP. For the first five years it is proposed to restrict this sampling to 25, 50 and 100 m from the edge of the sea cage (i.e. just in the MEPA) but this will be expanded out to 300 m (the HEPA boundary) in the event an exceedance is detected. The EPA supports this initial approach provided at 100 m there is also an assessment against the HEPA criteria to satisfy requirements in the recommended conditions and to provide confidence that the HEPA is being achieved. Under the proposed scenario, this would mean assessing the 100 m site against HEPA and MEPA EQG. If the HEPA EQG were exceeded then sampling would be required at the HEPA boundary to demonstrate compliance.

The initial three proposed MEPAs may eventually be complemented by an additional six recovery zones as the zone develops over time. At the commencement of fallowing, transect sampling will be undertaken at intervals in the recovery zones until it can be demonstrated that they have recovered to levels consistent with a HEPA.

The proposed water, sediment and biota quality monitoring for the MWADZ, along transects from the sea cages, is shown in Figure 9.

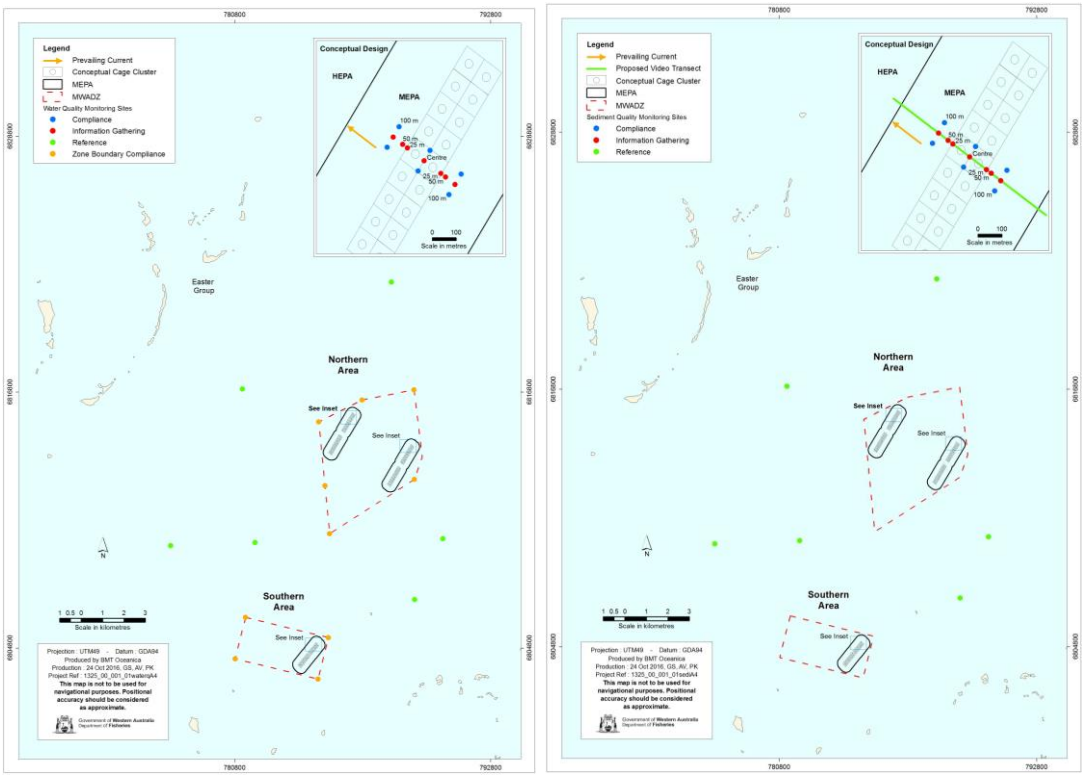

Figure 9: Water quality (left) and sediment quality and benthic infauna (right) monitoring sites

Proposed management measures

The EPA notes that the proponent has provided operational management measures designed to reduce organic loading to the marine environment, such as:

- use of contemporary feeding technologies and best-practice farming techniques to reduce feed wastage and optimise food conversion ratios (e.g. through setting a benchmark of less than 2% wastage);
- use of efficient delivery systems and real-time monitoring of environmental conditions and stock feeding responses;
- use of high-quality pellet feed to improve food conversion ratios and optimise consumption by stock;
- locate the sea cages in well-flushed locations with good water circulation, dispersion, with water depth below the sea cages exceeding 10 m; and
- routine fallowing following exceedance or based on best practice.

The proponent has also provided contingency management measures in the event of an exceedance of an EQS which would indicate there is a significant risk that the associated environmental quality objective has not been achieved.

Following exceedance of an EQS, the EMMP requires that one or more of the following contingency management measures be applied:

- relocation of cage cluster (fallowing);
- partial harvest of the stock (to reduce standing biomass);
- reduction in stock density; and/or
- reduction in feed input.

These measures have been identified over the course of the proponent's modelling and technical investigations and are also well established strategies within the sea-cage aquaculture industry. The EPA considers them as reasonable and appropriate management measures to reduce organic loading which has been identified as the key pressure from the MWADZ on marine environmental quality.

Zone management

The EPA notes in the proponent's draft Management Policy that the DoF, in its role as zone manager, is responsible for ensuring lease/licence holders comply with the EMMP.

The EPA notes that monitoring is to be undertaken at both compliance sites and information gathering sites. The EMMP explains that compliance sites are the responsibility of derived proponents, whereas information gathering sites will be the responsibility of DoF, on behalf of the MWADZ proponent.

The EPA recommends that, to demonstrate the EQOs have been achieved, data from the compliance sites as well as the corresponding information gathering sites should be pooled to assess against the EQG and EQS. The combined data should be collected, analysed and presented as a package to demonstrate compliance with the EQC.

The EPA notes that the DoF proposes to review the EMMP at the end of the five-year period, or when production reaches 30% of the allocated standing biomass of 24 000 tonnes, whichever comes first. The intent of the review is to utilise the monitoring data built through monitoring and management of pressures and environmental responses to ensure the program is appropriately scaled to the level of risk, which may increase with increasing production.

The EPA supports the proposed review of the EMMP to ensure it is commensurate with the level of risk. However it notes that the proponent can request to review the EMMP at any time if it is considered beneficial or deemed necessary based on gathered data or new information. Similarly the CEO of the Office of the EPA can request a review at any time.

As the EMMP was prepared by the proponent for the EPA's assessment, the EPA has recommended condition 6, which requires future operators to implement the EMMP during the implementation of derived proposals.

The EMMP is a clear and comprehensive document that is suitable to manage the cumulative environmental impacts of future aquaculture proposals in the proposed MWADZ. The EPA considers that marine environmental quality has been adequately addressed and that the implementation of future projects in the proposed zone can meet the EPA's objective for this factor provided that the EMMP is satisfactorily implemented.

Summary

The EPA has paid particular attention to the:

- considerations within the relevant EPA Factor Guidelines and Technical Guidance for marine environmental quality (described in Appendix 3);
- modelling and technical studies undertaken by the proponent to identify the key environmental impacts, pressures and receptors (i.e. organic loading on the sediment from uneaten fish feed and faeces) and effective management measures;
- predicted losses to marine environmental quality in the PER represent the 'most likely worst-case' outcome and with proposed management the actual impacts are likely to be less;
- predictions of no significant changes to water quality (will be maintained at levels consistent with a high level of ecological protection);
- predictions that changes to the sediment chemistry and resident biological assemblages will be locally constrained and fully reversible under a program of routine fallowing;
- management strategies limiting standing biomass to 24,000 tonnes and stocking density to 8 tonnes per ha of an aquaculture lease which should result in impacts to marine environmental quality being constrained within small areas of the MWADZ (i.e. within 300 m of the cages), with no adverse effects to regional marine environmental quality;
- proposed operational and contingency management measures; and
- development of an environmental quality management framework, applied through an approved EMMP.

Accordingly the EPA considers, having regard to the environmental principles (see Appendix 2) and objective for Marine Environmental Quality, that the impacts to this factor are acceptable, provided condition 6 is imposed requiring derived proponents to:

- implement the EMMP (Version 1, February 2017) to ensure adequate monitoring and management responses within the aquaculture lease(s) are undertaken so that the moderate and high levels of ecological protection are not compromised;
- submit reports to the Chief Executive Officer of the Office of the EPA when environmental quality criteria are triggered; and
- submit annual reports on the implementation and effectiveness of the EMMP to the DoF, on behalf of the Minister for Fisheries.

In addition to the recommended condition 6 on the proponents of derived proposals, the EPA has also had regard to governance of the proposed zone and the role of the DoF as zone manager. This is further set out in Section 6 of this report under Other Advice.

3.2 Benthic Communities and Habitat

The EPA's environmental objective for this factor is *to protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.*

Relevant EPA policy and guidance

The EPA considers that the following policy and guidance is relevant to its assessment of the proposal in relation to this factor.

- Environmental Factor Guideline – Benthic Communities and Habitat (EPA, 2016c).
- Technical Guidance – Protection of Benthic Communities and Habitat (EPA, 2016g).
- Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA, 2016f).

Appendix 3 details the relevant considerations for environmental impact assessment (EIA) under both the EPA's new Environmental Factor Guideline and the EPA's former suite of policies and guidelines.

In summary, to address the considerations within the EPA's Environmental Factor Guideline – Benthic Communities and Habitat (EPA, 2016c) the proponent has:

- described the existing benthic communities and habitat at the MWADZ location that will potentially be affected and the significance of the predicted losses;
- demonstrated application of the mitigation hierarchy to avoid or minimise impacts on benthic communities and habitat, where possible;
- provided alternative site location options, and the management measures and approaches to avoid and minimise impacts to benthic communities and habitats;
- undertaken modelling to predict the extent, duration and intensity of impacts under normal and 'most likely' best and worst case scenarios;
- described the spatial and temporal scale of the residual impacts to benthic communities and habitats from the proposal, in combination with historical and approved losses; and
- proposed additional practical mitigation strategies to be implemented and described the predicted residual impacts.

This is described in more detail below in the EPA's assessment of Benthic Communities and Habitats.

How this factor links with other environmental factors

The EPA recognises that the key threats to benthic communities and habitats from sea-cage aquaculture are essentially the same as those described in Section 3.1 for marine environmental quality, which highlights the high degree of connectivity between the two factors. These threats are related to the generation, release and subsequent deposition on the seabed of organic waste.

EPA Assessment

Description of the Marine Environment

The Abrolhos Islands supports both rich coral and macroalgal communities with corals dominant on the leeward reef sections and macroalgae dominant on the more windward reef sections (Wells 1997). The family Acroporidae (Acropora and Montipora) dominates the coral communities at the Abrolhos Islands. Corals at the Abrolhos Islands are at the southern limit of their latitudinal range but despite this corals are diverse, with 184 species, and coral cover is extensive.

The Abrolhos also has rich and diverse macroalgal communities, with 295 macroalgal species recorded. A dominant macroalgae is the kelp *Ecklonia radiata* which occurs in high density in lagoonal areas (Hatcher et al. 1987). Fleshy macroalgae also form a major component of the benthic communities of the Abrolhos, where the high-energy outer reef slopes support rich and dense macrophyte communities characterised by large brown algae mixed with fleshy red and green algae (Crossland et al. 1984).

Besides the dominant coral and macroalgal communities, ten seagrass species have been recorded at the Abrolhos. However, these are sparse and species poor compared to the mainland locations of Shark Bay and Geraldton (Brearley 1997).

The proponent undertook a benthic habitat survey with the objective of mapping accurately the spatial extent of benthic habitats within the MWADZ study area (including corals, macro-algae, seagrass, mangroves, filter feeders, microphytobenthos and presence of sediment infauna communities). The proponent also utilised historical and publically available data on benthic habitat composition and distribution at the Abrolhos Islands.

Surveys indicated that much of the seafloor consists of a flat layer of limestone reef overlain with a sand veneer (~15 cm thick). Biological communities were sparsely-distributed, comprising filter feeders (sponges, and bryozoans), macroalgae, rhodoliths and hard corals (although corals were observed infrequently). A classification of 'mixed assemblage' was applied to these communities when two or more biotic categories were found within one location (e.g. filter feeders, macroalgae and rhodoliths).

The proponent's studies indicated that benthic community cover within the proposed MWADZ is less than 13%, and the seafloor within the zone is currently a sand dominated habitat which is dynamic in nature. The proponent considers that, within the MWADZ, the composition of the benthic communities and habitats is naturally transient due to the effects of sand sheet movement and corresponding natural variability in the distribution of the available benthic habitat as the sand sheets move over time. This is supported by the observed differences between recent and historical surveys.

Northern habitats were more diverse, with the northern area comprising approximately 58% bare sand and 34% mixed assemblages. Small patches of reef were present near the north-east boundary but only comprised 8% of the total habitat. By contrast, the southern MWADZ comprised 95% bare sand and 5% mixed assemblage. Although ephemeral seagrass communities have been observed historically in the MWADZ, none were observed during the recent survey. This may be an artefact of the seasonal and ephemeral nature of many seagrass species. The spatial extent of the major habitat categories were interpolated to produce an indicative map of the benthic habitats across the study area (Figure 10).

The suitability of the proposal location was verified by underwater video "ground-truthing" of the proposed sites to ensure the benthic habitat was predominately sandy bottom.

Potential Impacts

Sea cage aquaculture generates organic particles from uneaten feed and faeces that deposit in the immediate vicinity of the sea cages. This settling of organic waste on the benthos within the deposition footprint of each cage can lead to direct smothering through burial. Smothering occurs when the volume of organic material reaching the seafloor exceeds the shedding capacity of marine organisms, or their limit of tolerance. This key potential impact is the focus of the EPA's assessment set out below.

Sea cage farming also has the potential to impact directly on benthic communities and habitats through cage anchoring systems causing direct and often irreversible loss. However, the proponent does not expect that the establishment and physical presence of aquaculture infrastructure will impact upon benthic communities and habitat. The anchoring points for the sea cage cluster will be low profile, and given the sparse coverage of benthic communities in the MWADZ generally, there is significant scope for avoidance.

Secondary impacts to benthic communities and habitats may also result from organic loading and nutrient enrichment causing changes to water and sediment quality (discussed in Section 3.1). These include:

- indirect smothering and/or shading due to increased organic suspended sediment loads and increased phytoplankton and epiphyte growth;

- oxygen starvation through anoxia caused by microbial activity; and/or
- toxicity due to the production of sulphides forming in the sediments or accumulation of metals and other chemicals (e.g. pharmaceuticals).

However, the proponent has predicted that the impact to sediment quality will be largely restricted to the vicinity of the sea cages and that no changes to water quality would result from the deposition of aquaculture-derived organic particles. The proponent concludes that it is unlikely the proposal will cause significant indirect impacts to benthic communities and habitats and the overall cover of benthic communities and habitat within the proposed MWADZ is unlikely to be significantly affected by the proposal.

Assessment of predicted impacts

The proponent has assessed the loss of benthic communities and habitat in the context of the EPA's Technical Guidance – Protection of Benthic Communities and Habitats (EPA, 2016g) and the EPA's Technical Guidance - Environmental Impact Assessment of Marine Dredging Proposals (EPA, 2016f).

An important part of this was to 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 agreed Local Assessment Units (LAUs). With assistance from the Office of the EPA the proponent defined two appropriate local assessment units within a one kilometre buffer around the northern and southern areas of the proposed zone.

The proponent considers that the benthic communities and habitats in the proposed MWADZ are relatively pristine and that their composition are naturally transient due to the effects of sand sheet movement and corresponding natural variability of the benthic habitat coverage over time. The proponent believes there is no evidence that historical human activities have caused lasting impacts that would contribute to cumulative loss.

The proponent's own and historic benthic habitat surveys were used to assess the most likely coverage of mixed assemblages, reef and bare sand within these LAUs (Figure 10).

Habitat surveys determined that at least 24% of the Northern LAU supports mixed assemblages consisting of algae and sessile invertebrates, while approximately 6% of the Southern LAU supports mixed assemblages consisting of algae, rhodolith and sessile invertebrates.

The benthic substrate classified as reef has some three-dimensional complexity and is the only substrate capable of sustaining coral reef habitat. Reef makes up less than 1% of the Northern LAU and less than 4% of the Southern LAU. The benthic substrate classified as bare sand makes up approximately 75% of the Northern LAU and 91% of the Southern LAU.

For the purposes of this assessment the proponent has categorized mixed assemblages and reef as benthic communities and habitats. Of the 4,420 ha in the Northern LAU, approximately 25% of this area (1,091 ha) comprises habitats capable of supporting macro benthic communities (i.e. around 0.29% reef and 24% mixed assemblages). Of the 2,315 ha in the Southern LAU, approximately 9% (208 ha) comprises habitats capable of supporting macrobenthic communities (3.4% Reef and 5.6% mixed assemblages).

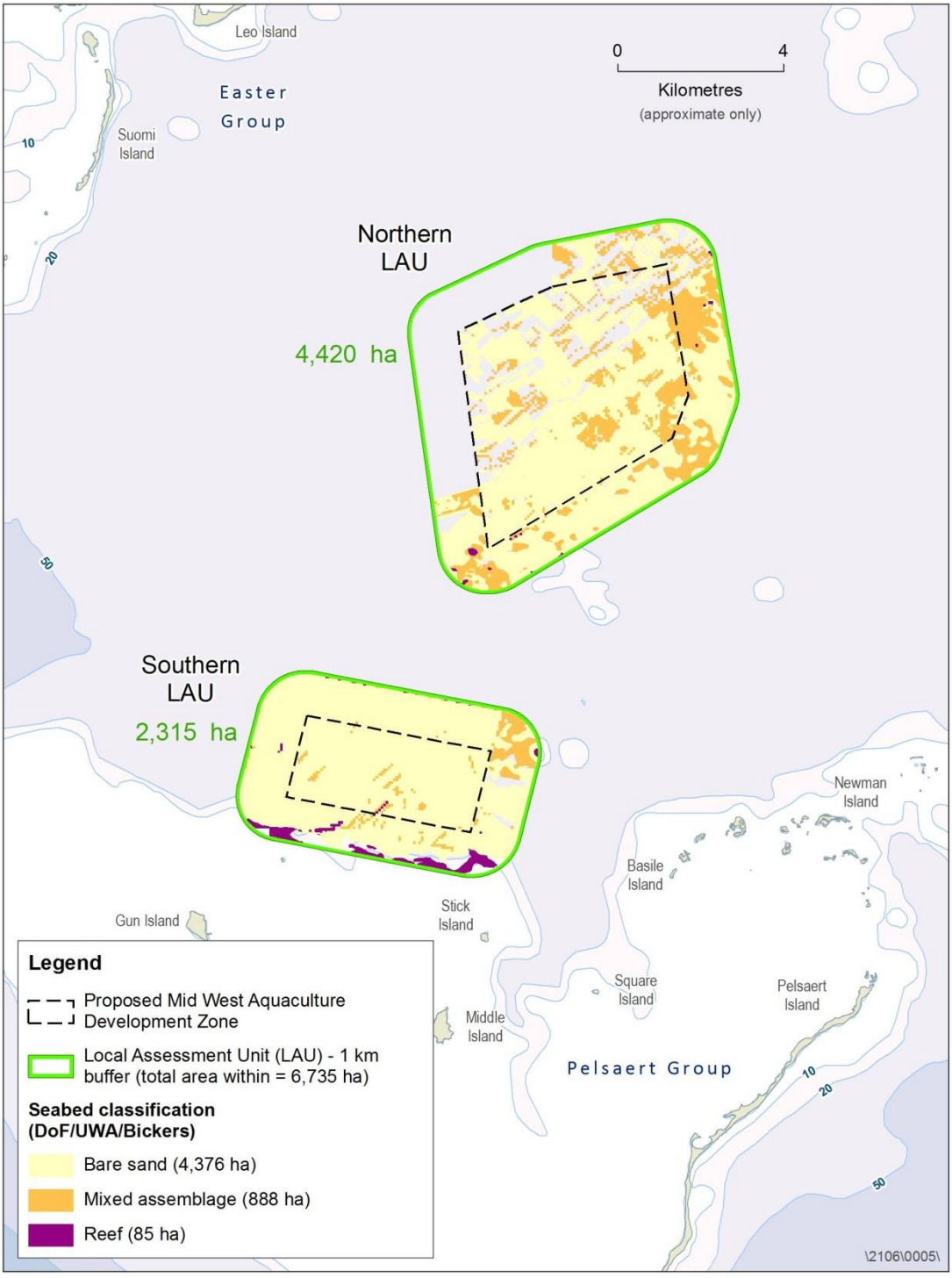

Figure 10: The Northern and Southern Local Assessment Units and the indicative benthic substrates in the vicinity of the MWADZ

Estimated loss of benthic communities and habitats

The proponent's modelling predicted that the zones of high impact (ZoHI) would occupy 41 ha and 21 ha in the Northern LAU and Southern LAU respectively (modelling predictions are discussed in more detail in Section 3.1). These figures were tripled to account for the one aquaculture impact 'footprint' and two 'recovering sites' that form over time as cages are relocated and the previous sites are fallowed. Fallowing is one of the proposed management measures to reduce impacts to the seabed from organic loading. It is proposed that cage clusters will be periodically relocated to allow sediments to return to the equivalent of baseline physical/chemical conditions and to allow impacted habitats to recover and shift from conditions representing a moderate level of ecological protection to conditions representing a high level of ecological protection.

As described in the EPA's technical guidance, ZoHIs are where impacts on benthic communities or habitats are predicted to be irreversible. In this context the term irreversible means 'lacking a capacity to return or recover to a state resembling that prior to being impacted within a timeframe of five years or less'.

In the proponent's modelling, the irreversible loss associated with these ZoHIs was caused by heavy organic deposition from uneaten fish feed and faeces released from the sea cages. The deposition of organic particles in the immediate vicinity of the sea cages was predicted to lead to some smothering and interruption to filter feeding processes within the operational area. However, irreversible impacts are isolated to the vicinity of the sea cages and where recovery of the fallowed sites after relocation was expected to be greater than five years.

The proponent's final predictions show that the ZoHIs beneath and immediately surrounding the sea cages within the proposed MWADZ will occupy approximately 123 ha (Northern Area) and 63 ha (Southern Area) respectively of the seafloor within the zone areas inside the Northern LAU and Southern LAU. Within these LAUs the ZoHIs are predicted to coincide with approximately 20.9 ha and 0.87 ha of mixed assemblages and reef within the Northern LAU and Southern LAU, respectively. While the proponent considers there has been no historical cumulative loss in the area, it estimated cumulative loss of benthic communities and habitats likely to result from the proposed sea-cage aquaculture in the Northern LAU and Southern LAU as 1.92% and 0.42% respectively.

The proponent notes that this is based on its conservative model, which presented the 'most likely worst-case' outcome, and that following proposed management measures 'actual' impacts to benthic communities and habitat are likely to be significantly less than predicted. This 'realistic' approach to predicting the expected environmental outcome is consistent with what is expected by the EPA when assessing sea-cage aquaculture impacts to benthic communities and habitat and in the relevant EPA technical guidance.

The EPA notes that the benthic communities and habitats within the MWADZ are naturally transient due to the effects of sand sheet movement and corresponding natural variability of the benthic habitat coverage. Major storm events and extreme ocean conditions can result in substantial scouring of the seafloor that can 'reset' the seabed communities and habitat. This is supported by the observed differences between recent and historical surveys.

The EPA accepts that the ephemeral nature of the benthic communities and habitat in the MWADZ indicate that they have a good capacity for recovery following disturbance or loss. This provides confidence that the proposed strategy to relocate sea cages and fallow the seabed will be effective and that actual irreversible losses will be less than those predicted in the conservative model which presented the most likely 'worst-case' environmental outcome.

The EPA notes a key management strategy to reduce impacts includes implementation of the EMMP, described in Section 3.1, which includes mechanisms to avoid and minimise direct and indirect impacts to benthic communities and habitats. These include:

- where practical, avoid locating sea cages over areas of benthic communities and habitats;
- locate the sea cages in well-flushed locations with good water circulation, dispersion, with water depth below the sea cages exceeding 10 m;
- setting of conservative environmental quality criteria that are expected to minimise impacts;
- fallow sites to allow seabed recovery;
- set stocking densities for aquaculture at conservative levels to help minimise organic loading of the surrounding environment; and
- maximise feeding efficiency to help minimise organic loading of the surrounding environment.

The EPA acknowledges that most of these measures are primarily for the maintenance of water and sediment quality as described in Section 3.1, but because the environmental quality standards in the EMMP are based on biological measures that protect biodiversity at local and regional scales and only allow for small changes in abundance and biomass of marine life, it expects impacts on benthic habitats to be minimal. Benthic communities are reliant on a healthy marine environmental and the two factors are highly connected.

These measures are described in the approved EMMP for the MWADZ. The EMMP is designed to generate a comprehensive dataset over time that confirms that impacts to benthic communities and habitat are restricted to local-scale areas within 300 m of the cages.

The EPA considers the estimated cumulative loss of benthic communities and habitat (1.92% in the Northern LAU and 0.42% in the Southern LAU), which is the likely 'worst-case' outcome, to be an acceptable level of loss as it is unlikely to have any significant consequences for biological diversity or ecological integrity within the MWADZ proposal area. The proposed

operational and contingency management measures to reduce organic loading to the marine environment (discussed in Section 3.1) should further minimise impacts to benthic communities and habitat.

As the EMMP has already been prepared by the proponent during the EPA's assessment, the EPA has recommended condition 6, which requires future operators to implement the EMMP in new derived proposals. The EPA has the expectation that the DoF as zone manager collates and interprets the monitoring data across the MWADZ and assesses overall performance and trends in benthic community quality and loss. It is also expected that the DoF demonstrates to the EPA that the EMMP is implemented correctly and reports overall compliance across the MWADZ.

The EMMP is a clear and comprehensive document that is suitable to manage the cumulative environmental impacts of future aquaculture proposals in the proposed MWADZ. The EPA considers that benthic communities and habitats have been adequately addressed and that the implementation of future proposals in the MWADZ can meet the EPA's objective for this factor provided that the EMMP is satisfactorily implemented.

The EPA has also recommended that all infrastructure associated with the MWADZ and its operation be decommissioned and removed to eliminate any legacy issues associated with abandoned infrastructure.

Summary

The EPA has paid particular attention to the:

- considerations within the relevant EPA Factor Guidelines and Technical Guidance for Benthic Communities and Habitat (described in Appendix 3);
- predicted losses to benthic communities and habitats in the PER represent the 'most likely worst-case' outcome and with proposed management the actual impacts are likely to be less;
- predictions of no irreversible loss from indirect impacts;
- predicted small amount of cumulative irreversible loss restricted to small areas under the sea cages;
- predictions that that the overall cover of benthic communities and habitat within the proposed MWADZ is unlikely to be significantly affected by the proposal; and
- management strategies (including implementation of the EMMP) to further reduce impacts and allow recovery to benthic communities and habitat.

Accordingly the EPA considers, having regard to the environmental principles (see Appendix 2) and objective for Benthic Communities and Habitats, that the impacts to this factor are acceptable, provided condition 6 is imposed requiring derived proponents to:

- implement the EMMP (Version 1, February 2017) to ensure adequate monitoring and management responses within the aquaculture lease(s)

are undertaken to minimise impacts to benthic communities and habitat; and
- submit annual reports on the implementation and effectiveness of the EMMP to the Chief Executive Officer of the Office of the EPA.

3.3 Marine Fauna

The EPA's environmental objective for this factor is *to protect marine fauna so that biological diversity and ecological integrity are maintained.*

Relevant EPA policy and guidance

The EPA considers that the following policy and guidance is relevant to its assessment of the proposal in relation to this factor.

- Environmental Factor Guideline – Marine Fauna (EPA, 2016d).

In summary, to address the considerations within the EPA's Environmental Factor Guideline – Marine Fauna (EPA, 2016d) the proponent has:

- described the marine fauna that may be found at the MWADZ location that will potentially be affected by the proposal;
- demonstrated application of the mitigation hierarchy to avoid or minimise impacts on marine fauna, where possible;
- provided management measures and approaches to avoid and minimise impacts to marine fauna;
- described the spatial and temporal scale of the residual impacts to marine fauna;
- proposed additional practical mitigation strategies to be implemented and described the predicted residual impacts; and
- described the risk posed to marine fauna should those predictions be incorrect.

This approach is described in more detail throughout the EPA's assessment of Marine Fauna.

For the purposes of EIA, the EPA is focussed on significant impacts to marine fauna, which can include:

- harm to individuals and/or declines in the population or geographic range of species protected under state legislation;
- reductions in populations of species of local and regional importance;
- impacts to species or groups of species that fulfil critical ecological functions within the ecosystem;
- loss or impact to critical marine fauna habitat, including habitats such as nesting beaches, nursery areas, sea lion haul out areas, specific foraging or breeding areas, and fish spawning aggregation areas;

- reduction in species diversity in an area, which may be due to factors such as migration or range contraction resulting from a decline in the quality of the local environment; and
- introduction and/or spread of invasive marine species or diseases.

The MWADZ PER document contains a substantial amount of information on marine fauna that may occur in the proposal area as well as potential impacts to these marine fauna groups and species.

The EPA's assessment of this factor has focused on marine fauna which have been identified through the MWADZ PER process as being at most risk from the proposal. Predicted significant impacts that relate to adverse interactions between marine fauna and sea-cage aquaculture are addressed first.

The EPA's assessment has also considered the important issue of fish translocation and biosecurity, as it has the potential to significantly impact on marine fauna, particularly wild fish populations. Potential impacts that relate to biosecurity are addressed separately.

How this factor links with other environmental factors

The EPA recognises that there are inherent links between the marine fauna and other environmental factors as they rely on a range of ecological conditions, physical and chemical properties of the marine and coastal environment and specific habitats during key stages of their lifecycle.

Marine fauna are generally reliant on good marine environmental quality and are often supported by critical benthic habitats. As a result they can suffer indirectly from pressures associated with sea-cage finfish aquaculture, which impact on marine environmental quality and benthic communities and habitats.

The key pressures identified by the proponent are inputs of nutrients and organic material derived from finfish metabolic processes and feeding. Given the hydrodynamics of the proposal area (i.e. strong current flow, well flushed with high levels of water circulation and dispersion) and proposed management and mitigation strategies to reduce organic waste (described in Section 3.1) the proponent considers it is unlikely that impacts to water quality would be to the extent, severity or duration to also significantly impact marine fauna.

Similarly any risks to marine fauna related to the potential use of treatment chemicals or accumulation of trace metals are deemed low due to restricted use, limited spatial distribution, rapid dilution and decomposition in the environment.

The proponent identified that the primary environmental impact from the MWADZ proposal is to the sediments and any benthic communities immediately beneath the sea cages. However, the proponent considers that impacts from the proposal can be constrained through effective farm management within small areas of the MWADZ (i.e. within 300 m of the

cages), with no adverse effects to regional marine environmental quality or benthic communities and habitat.

It is accepted that impacts to the benthic environment will occur immediately under and in the close vicinity of the cages; however, this location and its environment were chosen as it does not support significant habitat and marine fauna populations. Indirect impacts on marine fauna, therefore, related to organic deposition are not considered significant, as these would be restricted to localised areas in close proximity to the sea-cage infrastructure. The proponent considers that the invertebrate or fish species that might be found and impacted under the MWADZ sea cages are likely to move elsewhere.

Through its assessment, therefore, the proponent predicts that none of the pressures on marine environmental quality and benthic communities and habitat are expected to impact on marine fauna (i.e. marine mammals, marine reptiles, seabirds and wild finfish and invertebrate populations).

EPA Assessment

Description of the Marine Environment

The proponent has described the diverse and abundant marine fauna found at the Abrolhos Islands, and potentially in the MWADZ proposal area in Section 9.2 of the PER Document.

This includes a number of species listed as migratory, vulnerable, endangered, specially protected or conservation dependent under State and Commonwealth legislation, as set out below:

Species Name		**EPBC Act Status***	***Wildlife Conservation Act 1950****
Mammals			
Humpback whale	*Megaptera novaeangliae*	V, M	Conservation dependant
Blue whale	*Balaenoptera musculus*	E, M	E
Pygmy blue whale	*Balaenoptera musculus brevicauda*	E, M	E
Southern right whale	*Eubalaena australis*	E, M	V
Australian sea lion	*Neophoca cinerea*	V	V
Dugong	*Dugong dugon*	M	Other specially protected
Reptiles			
Loggerhead turtle	*Caretta caretta*	E, M	E
Leatherback turtle	*Dermochelys coriacea*	E, M	V
Green turtle	*Chelonia mydas*	V, M	V
Flatback turtle	*Natator depressus*	V, M	V
Sharks and Rays			
Grey nurse shark	*Carcharias taurus*	V	V
Great white shark	*Carcharodon carcharias*	V, M	V

Whale shark	*Rhincodon typus*	V, M	Other specially protected
Green sawfish	*Pristis zijsron*	V, M	V
Birds			
Lesser noddy	*Anous tenuirostris melanops*	V	E
Fairy tern	*Sternula nereis nereis*	V	V
Southern giant petrel	*Macronectes giganteus*	E, M	-

*E: Endangered; V: Vulnerable; M: Migratory

In addition to the species above, surveys have found:

- almost 400 species of fish, including both tropical and temperate species (Hutchins, J.B 1997), which is why waters of the Abrolhos Islands are gazetted as a Fish Habitat Protection Area;
- 152 species of shark, skates and rays (DEWHA 2008);
- 492 mollusc and 172 echinoderm species (MBS Environmental 2006);
- four additional species of whales and dolphins including Indo-Pacific and common bottlenose dolphins, orca and Bryde's whale;
- two species of sea snakes; and
- 25 species of seabirds, most of which are listed migratory species in international agreements.

Assessment of significant impacts

The proponent based its assessment of potential impacts and key risk factors and threat pathways from the MWADZ proposal on literature reviews of scientific data and documented information on the adverse interactions between marine fauna and sea-cage aquaculture. The proponent also undertook a targeted EIA investigation on seabird communities at the Abrolhos Islands.

The primary identified risks associated with the MWADZ proposal that could have a potential impact on marine fauna were from:

- the physical presence of aquaculture infrastructure (e.g. resulting in collisions, entanglements, congregations of fish species and behavioural changes due to artificial structure and habitat, and barriers to movement);
- additional food source from uneaten feed, greater abundance of prey species or access to fish stock (e.g. species gaining reward causing behavioural changes and increasing visitation rates and abundance with potential flow on effects to other species);
- artificial lighting from routine, navigation or vessel lights that may cause attraction and/or disorientation leading to modification of behaviour, injury or death;
- vessel movements involving service or supply vessels and feeding barges that may cause disturbance leading to modification of behaviour or collisions leading to injury or death; and
- noise and vibration associated with vessel movements and machinery that may cause behavioural changes, stress response, habitat

displacement or disruption of underwater navigation, foraging or communication capacity.

The proponent has summarised its assessment of the potential impacts to marine fauna in Section 9.4 of the PER, which is based on the various risk assessments for marine fauna groups included in the PER appendices.

The key risks and threat pathways identified by the proponent that could result in significant impacts on marine fauna from the MWADZ proposal were:

- attraction/increased abundance associated with provisioning, due to the availability of stock feed and dead or moribund stock or increased prey availability;
- reward, behavioural changes or population growth due to provision of artificial habitat and supplementary feeding; and
- entrapment/entanglement/collision associated with the sea-cage infrastructure.

As described in the PER, marine fauna already in the vicinity of the MWADZ could detect signals associated with food and habitat that are likely to attract them to the source. The proponent acknowledges it is well established that marine fauna such as fish, sharks, seals, seabirds and dolphins are attracted to sea cages due to the high stocking densities and presence of fish feed.

The proponent also notes that clusters of sea cages with their three-dimensional structures can also attract fish, including bait fish, which utilise the artificial habitat. This can also attract wild predators that may increase the amount of time spent around these structures due to the reward gained.

It is noted in the PER that provisioning can be a powerful stimulus in changing feeding behaviours in wildlife. The provision of reward or advantage to wild animals has been shown to perpetuate the behaviours that contribute to the reward. The proponent acknowledges that an increased presence of predatory marine fauna in the MWADZ is likely to increase the probability that an individual will come into contact with the aquaculture operations and result in an adverse interaction.

The proponent considers that the probability of adverse interaction can be reduced by limiting the potential sources of attractants as much as possible. The proponent acknowledges, however, given that certain marine predators are likely to be present in the proposed zone, regardless of the presence of aquaculture, it is reasonable to expect that some will occasionally interact with the aquaculture structures and attempt to access the stock behind the barriers. The proponent also considers, however, that adverse interactions can be minimised by eliminating opportunities for marine fauna to interact with aquaculture gear through a number of practical management measures.

The proponent has committed to certain mandatory sea-cage design and operational management measures to reduce the level of risk to marine fauna associated with these key threats. It considers these are based on industry

best practice design and strategies to prevent negative marine fauna interactions. Proposed measures are outlined in the MFIMP and include:

Sea-cage design and maintenance

- appropriate design and predator exclusion mechanisms to prevent marine fauna access to, or entanglement with, sea-cage infrastructure which may result in injury or mortality;
- sea-cage netting to be inspected regularly to ensure its integrity is intact, free from debris and maintained to a standard that will minimise entanglement; and
- rigorous maintenance programs for all aquaculture infrastructure, particularly nets, ropes and cages, to be implemented to ensure there is limited capacity for entanglement.

Farm management/fish husbandry

- feeding protocols to be observed to minimise the amount of uneaten feed entering the surrounding water; and
- to discourage predation by marine fauna, dead or moribund fish are to be removed regularly.

Based on the information provided by the proponent in the PER and MFIMP, the EPA has confidence that the risk of adverse interactions to wild finfish, sharks and rays, marine reptiles and most marine mammals is low and acceptable. Potential impacts can be adequately managed provided the recommended management measures in the MFIMP to limit the potential sources of attractants (e.g. additional food sources) and eliminate opportunities for negative interactions (e.g. predator exclusion devices) are implemented.

However, the EPA notes that there is still some uncertainty about the predicted level of risk, potential impacts and proposed management measures in relation to marine avifauna species and the Australian sea lion. As such the assessment of potential impacts and effective management to ensure residual impacts are acceptable requires further consideration by the EPA.

Assessment of potential impacts to marine avifauna (seabirds)

The Abrolhos Islands is the most significant seabird breeding location in the eastern Indian Ocean: 80% of the brown (common) noddies, 40% of sooty terns and all lesser noddies found in Australia nest at the Houtman Abrolhos (Ross et al. 1995). It contains the largest breeding colonies in WA of wedge-tailed shearwaters, little shearwaters, white-faced storm petrels, white-bellied sea eagles, osprey, caspian terns, crested terns, roseate terns and fairy terns (Storr et al. 1986, Surman and Nicholson 2009a). The Abrolhos also represents the northernmost breeding islands for both the little shearwater and white-faced storm petrel.

There are 26 seabird species that are known or likely to occur at the Abrolhos Islands and have the potential to be found within the MWADZ proposal area.

Within the Pelsaert and Easter groups, 17 of these 26 species have been confirmed as breeding regularly. These are the white-bellied sea eagle, osprey, wedge-tailed shearwater, little shearwater and white-faced storm petrel, Pacific gull, silver gull, Caspian tern, crested tern, bridled tern, roseate tern, fairy tern, brown noddy, lesser noddy, Eastern reef egret, pied oystercatcher, and pied cormorant (Halfmoon Biosciences 2015).

Potential impacts

The potential impacts to seabirds generally associated with sea-cage aquaculture include entanglement, habitat exclusion, disturbance from farm activities, increased prey availability, creation of roosting sites, implications to foraging success and spread of pathogens (Sagar 2008, Lloyd 2003, Comeau et al. 2009).

The proponent undertook a threat identification, hazard pathway analysis and risk assessment for the MWADZ in relation to seabirds at the Abrolhos Islands. This process identified three species of seabird at the greatest risk from the MWADZ proposal due to their abundance, foraging behaviour and proximity to the MWADZ. These are the two gull species (Pacific gull and silver gull) and the pied cormorant. These three species are considered most at risk as they are likely to try and take advantage of any additional food supply provided by the sea-cage operations, particularly during periods when natural food availability is limited (Halfmoon Biosciences, 2015). It is noted that these three species are not considered threatened or protected.

The proponent notes that the food for the finfish raised in the cages will be pelletised, which will have negligible appeal to pursuit-diving seabirds such as cormorants. However, pied cormorants may be attracted to the cages to feed upon fingerlings themselves, and in doing so may attempt to reach fish through the mesh. This may present entanglement issues for this species.

The proponent has identified potential direct interactions to these species associated with attraction to sea-cage operations. These include:

- supplementary feeding from stock predation, fish food, waste material or food scraps;
- entanglement or entrapment in cage mesh, predator nets or protective bird netting;
- collisions with sea cages, other structures or vessels moored at night;
- attraction and disorientation due to inappropriate lighting on service vessels, pens or navigation markers at night;
- attraction of prey to vessels or sea cages due to “Fish Attraction Device effects” (FAD); and
- use of vessel or sea cages as roosting sites.

Potential indirect effects from the sea-cage operations have also been identified and are presented in Halfmoon Biosciences (2015) including the potential for:

- changes to seabird behavior;
- disruption to foraging patterns;
- decline in nesting habitat for vulnerable species;
- changes in foraging behaviour and reproductive performance with consequent predicted population changes and potential impacts to other seabirds; and
- increased mortality from associated predators or exposure to disease and contaminants.

Also, birds that have a negative interaction with sea-cage operations often regurgitate meals intended to be delivered to young at the nest, thereby depriving those nestlings of a single feed.

Pied cormorant, silver gull and Pacific gull populations at the Abrolhos Islands are currently reliant upon natural food sources only. If rewarded with food resources associated with sea-cage operations this could potentially lead to increased breeding effort and success leading to expanding populations, with potential detrimental impacts on other seabirds (including threatened species such as the lesser noddy) and island ecosystems in the area (Halfmoon Biosciences, 2015).

The proponent assessment of likely potential adverse interactions with the MWADZ identified key risks and threat pathways for seabirds. These risks were individually analysed with respect to both the inherent risk (i.e. baseline risk if no management measures aimed at mitigating the risk were in place) and their residual risk (i.e. remaining risk once one or a number of the proposed management measures have been implemented).

In its assessment of risk to seabirds, the proponent identified the highest level of inherent risk was associated with:

- entanglement: seabirds becoming entangled in sea-cage netting, bird netting or anti-predator netting during foraging or roosting, causing drowning; and
- food subsidy from fish feed: gulls or cormorants receiving food subsidy from sea cages and increasing population size.

The proponent considers, however, that through good mitigation and management measures the residual risk should be low or negligible i.e. best practices in the structure of sea cages, size and management of netting and protocols of reducing feed waste are likely to reduce the potential for exploitation by these species.

The highest residual risks identified, after proposed mitigation measures for the MWADZ, are from:

- attraction due to MWADZ location: seabirds attracted to sea cages from nearby colonies, resulting in changes to foraging behaviour, reproductive performance or mortality; and
- FAD effects: attraction of baitfish, crustaceans and predatory fishes due to FAD effects of sea-cage infrastructure which may result in changes to seabird's natural foraging behaviour.

These risks are difficult to mitigate against as they relate to the three dimensional structure of the cages. As such the residual risks remained as moderate, the same as the inherent risk.

Proposed management measures

The proponent has prepared a DoF Mid-West Aquaculture Development Zone MFIMP which contains objectives, strategies and measures relevant to minimising impacts to sea birds. The proponent believes that these are commensurate with the perceived level of risk to seabirds and are consistent with an industry best practice approach whereby proponents will be required to maintain the integrity of their aquaculture gear and keep records of seabird interactions. The proposed strategies and measures include:

- appropriate bird exclusion mechanisms for example taut overhead bird netting to prevent access to stock and feed;
- sea-cage netting to be inspected regularly (weather permitting) to ensure its integrity is intact, free from debris and maintained to a standard that will minimise entanglement;
- rigorous maintenance programs for all aquaculture infrastructure, particularly nets, ropes and cages, to be implemented to ensure there is limited capacity for entanglement or entrapment of wildlife;
- all practicable measures taken to prevent seabirds from gaining access to, or reward from, the aquaculture operation;
- feeding protocols to be observed to minimise the amount of uneaten feed entering the surrounding water;
- to discourage predation by marine fauna, dead or moribund fish are to be removed regularly; and
- reducing light and noise emissions from aquaculture infrastructure and operations.

The EPA notes that the proponent advised in its Response to Submissions that it will not be implementing all measures proposed in the PER for monitoring interactions between seabirds and the sea-cage infrastructure. This includes monitoring of seabird numbers and types, training of staff in seabird monitoring and identification and the use of underwater and motion detector cameras to record activity. The main reason given for this is that it is likely aquaculture activities will commence in stages with incremental increases in production (a few individual cages initially, rather than large clusters of cages). The proponent advised that in hindsight some of the

measures in the PER were excessive and not commensurate with the risk at the early stages of the proposal.

The EPA acknowledges the proponent's view that if the MWADZ takes time to reach substantial production the likelihood of interactions with seabirds will initially be less due to smaller sources of attraction and potential reward from the sea cages. However, the EPA considers monitoring of seabird activity around the sea cages at the early stages of the MWADZ development would be critical in understanding the likely level of interaction in the future as aquaculture production increases and therefore provide valuable information to inform future sea-cage design and management.

In this regard, the EPA notes that the MFIMP also includes routine monitoring of seabirds (protected species only), and other marine fauna, within 50 m of the sea-cage infrastructure. The EPA considers, however, given the highest level of risk was to pied cormorant, silver gull and Pacific gull populations, none of which are protected, that routine monitoring of all seabird activity within 50 m should be undertaken. The EPA also notes training for farm staff to identify protected seabird species is not proposed therefore monitoring of all seabird activity rather than just for protected species is a more appropriate requirement.

The EPA considers this is reasonable given one of the residual risks identified by the proponent was potential secondary impacts to threatened seabirds caused by increasing population size of gulls and cormorants through food subsidy from the sea cages (Halfmoon Biosciences, 2015).

The EPA also notes that it is proposed to review the monitoring program after two years of aquaculture operations in consultation with the Office of the EPA. The EPA supports this review, which could see changes to the monitoring and management framework depending on the data gathered, and the levels, types and consequences of interactions observed over two years. The EPA notes that the proponent can request to review the MFIMP at any time if thought beneficial or gathered data or new information deems it necessary. Similarly, the CEO of the Office of the EPA can request a review at any time.

The EPA notes that there is likely to be some unavoidable residual impacts from the MWADZ proposal on seabirds due to their attraction to the physical structure of the sea cages, the additional food source and emissions of light and noise. The EPA, however, considers that the MFIMP contains effective management measures, based on industry best practice, which are likely to reduce the potential for seabird interactions.

The EPA also notes that the seabirds identified at highest risk of adverse interactions with the MWADZ are not considered threatened or protected and that the MFIMP includes an adaptive management strategy for marine fauna, including protected marine avifauna, with trigger and threshold criteria and contingency management actions.

In summary, the EPA does not consider that there would be a significant residual impact to seabirds provided best-practice management measures and procedures are correctly implemented.

To provide confidence in this the EPA has recommended a condition requiring proponents to provide a derived proposal MFIMP that includes requirements for:

- industry best-practice design;
- appropriate bird netting and anti-predator nets;
- maintenance programs for aquaculture gear to minimise potential for entanglement or entrapment;
- strategies to minimise the potential sources of attractants i.e. food waste, light and noise emissions; and
- monitoring program to record all observations and interactions.

Assessment of potential impacts to the Australian sea lion

The Australian sea lion is one of the world's rarest sea lion species and is currently listed as vulnerable under the EPBC Act (DSEWPaC 2013a) and as 'specially protected fauna', ranked vulnerable (Schedule 3) under the *Wildlife Conservation Act 1950*. Australian sea lions have a characteristically slow rate of maturation and low fecundity, with females having asynchronous breeding seasons between colonies and producing only one pup every 18 months. Female Australian sea lions have a high rate of natal site fidelity, thus supporting their restricted home range as well as limited gene flow with other regions (Campbell 2005).

As a result, some breeding colonies or clusters of breeding colonies are unique populations, and recolonisation of extinct breeding colonies is unlikely. In contrast, male Australian sea lions have foraging ranges that extend up to 60 km from their birth colonies, with some males ranging more than 180 km (Hamer et al. 2011).

There are 28 known breeding sites for Australian sea lions in WA including two at the Abrolhos Islands and 48 in South Australia (Goldsworthy et al. 2009, Shaughnessy et al. 2011, DSEWPaC 2013b). Their overall estimated abundance in WA is much lower (~2000 individuals) than in South Australia (~12,700 individuals) (Goldsworthy et al. 2009).

The Abrolhos Islands population is small and at the northern limit of the species range. Historical population abundances at the Abrolhos Islands ranged from 300–580 sea lions, while recent surveys described severely reduced population estimates (76–96 sea lions), most likely resulting from historical harvesting (Campbell 2005, DSEWPaC 2013a). Unlike other harvested pinniped species, Australian sea lion populations have not recovered, and there is evidence that some small populations are still in decline.

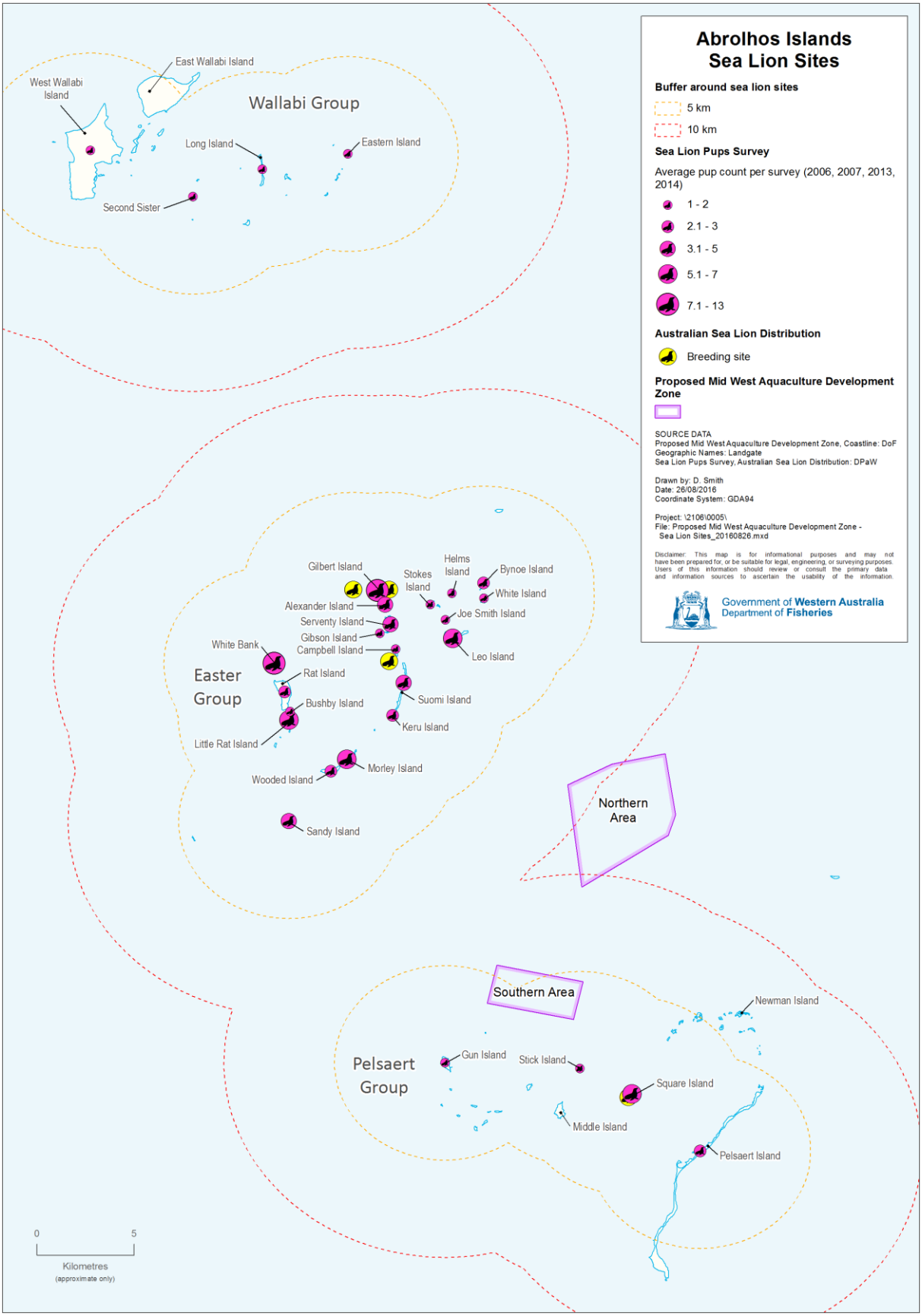

Figure 11: Abrolhos Islands sea lion sites

The Abrolhos Islands Australian sea lion sites in relation to the MWADZ are shown in Figure 11. Breeding occurs on at least 16 islands in the Abrolhos and the closest breeding island is located three kilometres from the southern area of the proposed aquaculture development zone. Additional islands are used as haulouts. This figure also illustrates sea lion buffer zones currently applied in South Australia with larger buffer exclusion zones applied to larger sea lion colonies. These buffer zones were developed by the Marine Protected Areas Aquaculture Working Group 2004 in consideration of known Australian sea lion foraging areas.

Potential impacts

The proponent notes in the PER that the Abrolhos Islands population of Australian sea lions, which is a small and closed population, is highly vulnerable, especially to increased mortality from anthropogenic causes (Campbell 2008).

The PER contained a desktop risk assessment of potential impacts from the MWADZ proposal on marine mammals, including Australian sea lions. It described the high vulnerability of Australian sea lions at the Abrolhos from sea-cage aquaculture and determined that any threat of incidental mortality may significantly affect the population in the proposal area.

The same assessment was provided by the Department of Parks and Wildlife (DPaW) in its submission to the PER and is supported by research which indicates that one mortality per breeding cycle at the Abrolhos Islands was sufficient to cause decline of the colony, and three mortalities would be likely to lead to extirpation of the colony. If the colony was lost there is little or no capacity to re-establish and there would be a significant reduction in the species range (Campbell 2008; DSEWPaC 2013b).

The PER assigned a high level of risk to Australian sea lions interacting with the MWADZ sea cages and that, based on experience from other jurisdictions, Australian sea lions are likely to be the most problematic predator attracted to marine finfish aquaculture. This is based on the following findings:

- In Australia, seals and sea lions are the most vulnerable marine mammal to potential impacts from sea-cage aquaculture.
- Sea-cage finfish aquaculture and associated potential food source is likely to attract Australian sea lions, which may develop complex predation techniques ranging from damaging nets and cages to entering enclosed structures and feeding on stock.
- By altering their natural foraging behaviours, attempts to predate on fish within marine aquaculture cages may occur all year round with seasonal or daily patterns and result in serious injury and mortality.
- Seals and sea lions have historically been entangled in cage nets, anchor lines and ineffective anti-predator nets, often with fatal consequences.
- Entanglements generally result from large mesh sizes (>15 cm), unrepaired holes, open bottom nets and loose or baggy nets.

- Pinniped interactions are estimated to increase up to 10 times when fish farms are located within 30 km of significant haul-out sites.
- At Port Lincoln, South Australia, tuna feedlots were located within 25 km of the second largest Australian sea lion breeding colony at Dangerous Reef, resulting in a high level of Australian sea lion interaction and predation (Kemper et al. 2003).

Buffer Zones

The EPA notes that other jurisdictions such as South Australia currently apply buffer zones around Australian sea lion colony/breeding sites, which are used to regulate where aquaculture can occur for individual aquaculture site assessment and aquaculture zone policy development. These buffer zones are based on the foraging locations of Australian sea lion colonies that are close to proposed aquaculture sites, to ensure that critical habitats and movement corridors are not occupied. Farms that are most vulnerable to Australian sea lion interactions are those located within, or adjacent to, major foraging areas.

The location of the MWADZ zone areas is already established and is located in close proximity to the Abrolhos Island Australian sea lion breeding islands (Figure 11). As the figure shows, the zone areas overlap with the PIRSA recommended buffer zones. From an EIA perspective, therefore, buffer zones are not a potential mitigation option. However, the EPA notes that more recent studies in South Australia indicate that this strategy may not be particularly effective in protecting sea lions given the extreme variability in foraging behavior and distances between individuals and cohorts within and between colonies (Goldsworthy et al, 2009).

Foraging areas

The EPA considers that the key area of uncertainty when assessing the level of risk to Australian sea lions is the likelihood of interactions with the proposed MWADZ sea-cage operations. It seems reasonable to assume that adverse interactions are more likely if the foraging areas of sea lions at the Abrolhos Islands overlap with the sea-cage leases within MWADZ. There are, however, significant challenges in determining the foraging areas of Australian sea lions due to the large degree of variability between individuals and colonies as well as significant knowledge gaps for the Abrolhos Islands population.

Adult female Australian sea lions show a high degree of foraging habitat fidelity; (i.e. individual animals appear to use geographically fixed foraging areas) (DSEWPC 2013a). However, at many colonies studies have identified partitioning among adult females between those foraging in shallow coastal waters, and those in offshore waters up to 120 m deep (Lowther et al. 2013). Adult males are known to forage over the entire continental shelf, where they overlap with adult females, but adult males also forage in deeper waters further out to sea (Goldsworthy & Page, 2009).

The EPA notes there is limited site-specific information for the Abrolhos Islands, though the tracked foraging excursion of one of just three tagged

adult females confirms that the range extends between island groups (Campbell 2008). The strength of the Leeuwin current is likely to influence the availability of food on the west coast, which could influence the foraging range of west coast Australian sea lions from year to year (Lowther et al. 2013).

The EPA notes that one study at the Abrolhos Islands, which tracked three adult females and three pups, indicated that most adult females show foraging ranges of less than 10 kms and were restricted to very shallow waters within the island group (Easter Group), where they were tagged in waters less than 10 m deep. The study also indicated juveniles (pups) showed similar ranges and site specificity to the adult females (Campbell 2008).

The EPA notes, however, that these results were based on a very small sample size over a single season and it also did not account for the expanding foraging ranges of juveniles as they mature. It also notes that no males were represented in the sample. Based on examples of interactions elsewhere in Australia, the EPA understands that sub-adult male sea lions from nearby colonies appear to be most likely to interact with aquaculture infrastructure (MISA, 2009).

In consideration of these issues the EPA has taken a cautious approach in its assessment of potential interactions between Australian sea lions and the MWADZ proposal. From an EIA perspective it has assumed the proposal is within the foraging areas of Australian sea lions and, therefore, based on experience from other jurisdictions, there is a reasonable chance that there will be interactions between aquaculture activities and Australian sea lions due to the attractant nature of sea-cage operations and Australian sea lions' capacity to learn and habituate to new food sources.

However, the EPA also notes from available literature and documentation, that Australian sea lion entanglements and deaths in modern aquaculture facilities are extremely rare where appropriate best-practice management measures are in place. The EPA, therefore, considers that best practice design and operation are critical to ensuring potential impacts to Australian sea lions are managed to an acceptable level.

Proposed management measures

The EPA notes that since the PER was released the proponent has reconsidered its assessment of the level of risk to Australian sea lions in its MWADZ proposal. The main reason given for this is that aquaculture activities are likely to commence in stages with incremental increases in production, starting with a few individual cages rather than large clusters of cages.

As such, the proponent has made changes to the proposed sea-cage design and management measures for Australian sea lions from those described in the PER as it considered some were excessive and not commensurate with the risk.

The EPA acknowledges the proponent's view that the MWADZ may take time to reach substantial production. However, although this may initially limit the potential source of attraction to the sea cages, the EPA considers that it does not significantly reduce the level of risk to Australian sea lions given the known vulnerability of the Abrolhos Islands population.

The EPA also acknowledges the industry's strong incentives to reduce adverse interactions with Australian sea lions due to both the significant potential loss of stock and financial cost as well as the impacts on the social license for aquaculture operations to become established at the Abrolhos Islands should the population of this iconic species be threatened.

The DoF has prepared a Mid-West Aquaculture Development Zone Marine MFIMP, on behalf of the proponent, which contains objectives, principles and strategies to minimise impacts to Australian sea lions. These include:

- operators are required to use durable fish nets (heavy duty) to exclude predators and to avoid predation on farmed stock by sea lions, sharks and dolphins;
- sea lion jump fences of an appropriate height;
- monitoring of Australian sea lion activity within 50 m of the sea cages;
- sea-cage netting to be inspected regularly (weather permitting) to ensure its integrity is intact, free from debris and maintained to a standard that will minimise entanglement or entrapment;
- rigorous maintenance programs for all aquaculture infrastructure, particularly nets, ropes and cages, to be implemented to ensure there is limited capacity for wildlife entanglement or entrapment;
- all practicable measures taken to prevent Australian sea lions from gaining access to or reward from the aquaculture operation;
- feeding protocols to be observed to minimise the amount of uneaten feed entering the surrounding water;
- to discourage predation by marine fauna, dead or moribund fish are to be removed regularly; and
- reducing light and noise emissions from aquaculture infrastructure and operations.

The proponent believes that these are commensurate with the perceived level of risk to the species.

The EPA acknowledges that these measures are consistent with most contemporary industry best practice for managing interactions with seals and Australian sea lions. The EPA notes, however, that there is a lack of detail in relation to some key cage-design and predator-exclusion measures to be implemented by proponents of future derived proposals for managing interactions with Australian sea lions.

The DoF has advised that the MFIMP is deliberately non-prescriptive as it requires that aquaculture operators adhere to best-practice measures based on other jurisdictions (particularly South Australia, where the efficacy of sea-cage design and farm maintenance have been tested and proven).

The EPA notes that other jurisdictions (South Australia and Tasmania) have more detailed requirements in relation to predator-exclusion devices which were prescribed in the proponent's PER but not in the latest MFIMP. For example, sea cages should have sub-surface external anti-predator nets (double barrier) made of durable high tensile material to avoid predation on farmed stock and seal jump fences should encircle the cage at a minimum height of 2.4 m and be rated at 300kg/bar breaking strength.

In its assessment of the risk of adverse interactions between the MWADZ aquaculture operations and Australian sea lions, the EPA has given particular regard to:

- the limited information available regarding Australian sea lions and their likely foraging areas at the Abrolhos Islands;
- the documented high level of variability in foraging areas between individuals and cohorts within and between colonies;
- the predictions in the PER that the sea-cage operations are likely to act as an attractant to Australian sea lions and interactions are highly likely;
- information from the DPaW that indicates that breeding occurs on at least 16 islands at the Abrolhos and the closest breeding island is located 3 km from the southern area of the proposed aquaculture development zone;
- both the northern and southern areas of the MWADZ are within the documented 10 km foraging radius of Australian sea lion colonies at the Abrolhos Islands;
- evidence of a high level of interaction between Australian sea lions and sea-cage finfish aquaculture in other Australian jurisdictions; and
- the high vulnerability of the Abrolhos Islands population to any loss of individuals.

The EPA notes that breeding female Australian sea lions are critical to population sustainability. Research from South Australia indicates breeding females do not appear to interact significantly with fish farms and that it appears sub-adult males are the main source of aquaculture interactions (MISA, 2009).

However, the EPA also notes that any additional mortality of an individual Australian sea lion, male or female, would represent a threat to the continued survival of the Abrolhos Islands colony and, if the colony was lost, a significant reduction in the species range.

The EPA considers the potential contribution of aquaculture at the MWADZ to mortality rates of Australian sea lions in the absence of targeted management and mitigation measures could be significant when added to the other natural and anthropogenic pressures on the species at the Abrolhos islands. However, while it is not possible to completely eliminate aspects that could attract marine fauna to the sea cages, the likelihood of entanglement, and potential death, can be substantially reduced.

The EPA acknowledges the proponent in its proposed mitigation measures to reduce the risk of interactions has addressed key strategies to reduce levels of attractant signals, opportunities for provisioning and preventing access and entanglement of Australian sea lions with the sea cages. A high level of uncertainty remains, however, in relation to predicting the level of interaction and significance of likely impacts to Australian sea lions from the proposed sea-cage operations due to the limited available evidence at the Abrolhos islands.

The EPA notes that in recent years best-practice mitigation measures have been deployed in other Australian jurisdictions with much larger numbers of Australian sea lions nearby, which have greatly reduced the number of entanglements and deaths.

This gives the EPA confidence that residual impacts to Australian sea lions from the MWADZ proposal will be acceptable as long as industry best-practice standards that reduce risks to acceptable levels, are implemented. The Abrolhos Islands Australian sea lion population is important and all risks associated with the proposal need to be eliminated or reduced to very low levels.

As earlier mentioned, while the DoF has prepared a MFIMP, the EPA considers that there is a need for future aquaculture proponents to submit their own tailored MFIMP with sufficient detail demonstrating at the time of referral that best practice has been applied in their design. This is particularly important in relation to sea-cage design and predator-exclusion measures. With more detailed information at the referral stage, the EPA can determine with confidence that the agreed objective for the Australian sea lion – to ensure no adverse impact on the viability and persistence of the Abrolhos Islands populations of Australian sea lions – can and will be met.

The EPA therefore recommends a condition that requires proponents of future derived proposals to provide a derived proposal MFIMP that applies all aspects of the DoF's plan for the aquaculture zone. This would include:

- industry best practice sea-cage design;
- appropriate predator-exclusion devices for preventing access and entanglement of Australian sea lions;
- maintenance programs for aquaculture gear to minimise potential for entanglement or entrapment;
- strategies to minimise potential sources of attractants such as food waste, light and noise emissions; and
- monitoring program to record all Australian sea lion observations and interactions.

It is expected that the data generated from this monitoring program would be used to inform the future review of the DoF MFI MP (Version 1, February 2017) when the MWADZ reaches 7,200 tonnes or in five years from the commencement of aquaculture proposals, whichever occurs first.

Marine biosecurity

The proponent's assessment of potential impacts to marine biosecurity from the MWADZ proposal is described in Section 10 of the PER. The proposed biosecurity management measures are described in more detail in the proponent's EMMP.

The proponent has recognized through its risk assessment that marine biosecurity is one of the most significant threats to the MWADZ proposal. In an aquaculture context, biosecurity encompasses the protection of fish farming operations from pests, parasites, and pathogens as well as the prevention of aquaculture operations from impacting the surrounding marine environment as well as its social and economic values.

The DoF is the lead agency in WA in relation to aquaculture, marine biosecurity and fish health. The DoF, on behalf of the proponent, undertook a threat identification, hazard pathway analysis and assessment of the key biosecurity risks posed by the development of the MWADZ in WA.

The purpose of this was to determine whether current proposed management controls are adequate to bring associated risks to the wider ecosystem to an acceptable level. Three primary biosecurity risks were identified from this process in relation to the proposal to develop marine finfish aquaculture in the MWADZ, namely:

1. That a significant pathogen or disease is spread from an infected aquaculture facility leading to a significant impact on wild target fisheries based around the same or alternate species.
2. That escaped fish lead to a significant impact on the future sustainability of wild stocks through either competitive interaction or genetic mixing.
3. That the introduction and/or spread of marine pests in association with aquaculture activity have a significant impact on the sustainability of local ecosystems.

The proponent has described proposed translocation, biosecurity and management arrangements addressing these primary biosecurity risks. The purpose of the proposed measures is to minimise risks associated with disease, parasites, marine pests and the potential for adverse genetic effects. These proposed measures are described in the proponent's EMMP and are aimed at:

- preventing introduction and emergence of disease in a farm;
- ensuring effective early detection and containment of significant pathogens (including parasites);
- preventing the release of significant pathogens into the environment;
- maintenance of equipment to prevent fish escapes;
- reporting and investigation of fish escapes;

- implementing best practice design, management and anti-predator strategies to minimise fish escapes;
- training of staff in escape-critical operations and techniques; and
- developing protocols for monitoring and managing the threat of introduced marine pests consistent with national standards.

The proponent notes that a high level of biosecurity will be maintained using a combination of best-practice and proactive infrastructure management and that reactive management strategies will be employed to manage incidents as they arise. The proposed approaches to risk mitigation and incident management follow a comprehensive analysis of risks and a review of best practice mitigation strategies undertaken by the DoF.

The proponent considers that if the proposed biosecurity management and mitigation measures within the EMMP are implemented correctly across the MWADZ then the three primary biosecurity risks identified for the MWADZ can be managed to reduce residual risks to acceptable levels.

The EPA understands that biosecurity incursions present significant risks not only to the MWADZ proposal, but to the surrounding marine environment. The EPA notes, however, that the aquaculture industry has strong production and marketing incentives to minimise the risks to their operations and to the environment from biosecurity incursions. The presence of pests and diseases not only reduces profitability but also impacts on the social license for aquaculture operations to become established at the Abrolhos Islands.

The EPA considers that the DoF as zone manager has the policy, research, and stakeholder support as well as the on-water capacity and regulatory power necessary to prevent, control and emergency respond to the threat of marine pests and diseases that could potentially be introduced to the Abrolhos Islands as a result of this proposal. The EPA also notes the proponent's commitment to best-practice design and management to prevent fish escapes.

Whilst it is important that the proponent adheres to proposed biosecurity measures, the EPA considers that to minimise biosecurity risk, MWADZ biosecurity management should be implemented in concert with the biosecurity strategy proposed in the Houtman Abrolhos Islands Management Plan, which is also implemented by the DoF. This approach would effectively minimise the risks from all transport vectors that can introduce pests and pathogens to the MWADZ and the region.

The EPA has confidence that, given the role of the DoF as zone manager at the MWADZ, there would not be a significant residual impact to the environment from the proposal provided the biosecurity management and mitigation measures within the EMMP are correctly implemented.

Summary for Marine Fauna

The EPA has paid particular attention to the:

- considerations within the EPA Factor Guidelines for Marine Fauna (described in Appendix 3);
- EIA investigations undertaken by the proponent to predict impacts to marine fauna;
- proponent's commitment to industry best practice sea-cage design and operation to reduce the level of risk to marine fauna;
- identified principles and strategies for preventing access and entanglement of marine fauna;
- maintenance programs for aquaculture gear to minimise potential for entanglement and entrapment;
- strategies to minimise the potential sources of attractants such as food waste, light and noise emissions;
- monitoring program to record all observations and interactions; and
- MFIMP developed by the proponent for the MWADZ which includes an adaptive management strategy for marine fauna with trigger and threshold criteria and contingency management actions.

Accordingly the EPA considers, having regard to the environmental principles (see Appendix 3) and objective for Marine Fauna, that the impacts to this factor are acceptable, provided condition 7 is imposed requiring proponents of derived proposals to prepare a derived proposal MFIMP that contains provisions to ensure that the derived proposal will be implemented in a manner that:

- protects marine fauna so that biological diversity and ecological integrity are maintained; and
- ensures no adverse impacts on the viability and persistence of the Abrolhos Islands populations of Australian sea lions and seabirds.

The EPA considers that derived proposal MFIMPs should include sea-cage design and mitigation and management measures that address the principles and strategies in Section 4 of the overarching MFIMP. It also considers that derived proposal MFIMPs should demonstrate how the sea-cage design and anti-predator provisions are consistent with industry best practice measures for preventing adverse interactions with marine fauna.

Consistent with the requirements of Schedule 1 in Appendix 4, the EPA expects that a draft MFIMP be provided with the referral to inform the EPA's decision as to whether to declare the proposal to be a derived proposal. The plan will be reviewed in consultation with the Department of Parks and Wildlife.

4. Conclusion and recommended conditions

Having assessed the proposal against the EPA's objectives for the key environmental factors of Marine Environmental Quality, Benthic Communities and Habitats, and Marine Fauna, the EPA has also recognised there is a high degree of connectivity and interrelatedness of the processes and impacts under each factor, particularly in relation to Marine Environmental Quality and potential consequent impacts on Benthic Communities and Habitats.

The EPA also recognises that marine fauna are generally reliant on good marine environmental quality and are often supported by critical benthic communities and habitats. Understanding the environmental processes and their interactions was critical to assessing the significance of potential impacts from the proposal on the seabed and its associated habitat and flora and fauna communities.

In summary, the EPA has assessed the potential maximum residual cumulative environmental impacts and risks from future proposals based on the proponent's mitigation, the level of confidence in the predictions, and the degree of risk to the environmental values of the MWADZ proposal area and surrounding Abrolhos Islands and concluded that the proposal is environmentally acceptable.

Recommended conditions on derived proposals

As this is an assessment of a strategic proposal, the EPA has identified the key characteristics and elements that future derived proposals would require in order to meet the environmental objectives for the environmental factors it has assessed. This will ensure that the environmental consequences of the implementation of aquaculture proposals, individually and cumulatively, are consistent with the predicted residual environmental impacts set out in the PER document.

Proponents requesting to have a new project declared a derived proposal will need to demonstrate how the environmental objectives defined through the assessment of the strategic proposal will be met and how best practice will be applied, particularly in relation to marine fauna. The environmental objectives, limits and specifications that would apply to derived proposals are set out in Schedule 1 and Schedule 2 of the recommended conditions in Appendix 4.

Submitting sufficient information at the referral stage will enable the EPA to determine with confidence that the matters assessed and the environmental objectives defined through the assessment of the strategic proposal can and will be met.

The EPA recommends a set of conditions be imposed on the implementation of derived proposals if the proposal by the Minister for Fisheries to declare and establish an aquaculture development zone for large-scale sea-cage aquaculture of finfish at the Abrolhos Islands is approved (Appendix 4).

Matters addressed in the conditions include the following:

- Condition 6, which requires the implementation of an Environmental Monitoring and Management Plan:
  - to protect the Environmental Values and achieve the Environmental Quality Objectives and Levels of Ecological Protection as described in the EMMP and Schedule 2 of the recommended conditions;
  - to ensure adequate monitoring and management responses within the aquaculture lease(s) are undertaken so that the moderate and high levels of ecological protection are not compromised;

- Condition 7, which requires the preparation, submission, and implementation of a derived proposal Marine Fauna Interaction Management Plan that contains measures and monitoring to meet the principles and strategies in the DoF's overarching Marine Fauna Interaction Management Plan, to ensure that the proposal will be implemented in a manner that:
  - protects marine fauna so that biological diversity and ecological integrity are maintained; and
  - ensures no adverse impacts on the viability and persistence of the Abrolhos Islands populations of Australian sea lions and seabirds.

5. Other advice

During the assessment of the strategic proposal, the EPA has had regard to the proposed governance of the MWADZ and the manner in which identified future aquaculture proposals will be approved, monitored, managed, and regulated inside the zone. The governance arrangements for the zone are set out in the draft MWADZ management policy and the environmental management framework is set out in the MWADZ EMMP (Version 1, 2017). Both these documents form part of the proponent's PER document and were subsequently revised and included in the proponent's Response to Submissions (Appendix 5).

The draft policy sets out the overarching framework for the MWADZ and outlines the broad principles for management. The policy sets out the codes of practice, the responsibilities of the DoF as zone manager, and the general principles that apply to the location and operation of aquaculture leases/licences within the MWADZ. These include specifying separation distances, the species of finfish to be farmed, details regarding what constitutes acceptable aquaculture infrastructure, disease and biosecurity arrangements, and linkages with the MWADZ EMMP. It also details the legislative framework applicable to aquaculture operations under the FRM Act and the EP Act. The policy recognises that the DoF, as zone manager, will work in conjunction with the Office of the EPA to ensure compliance with the authorisations provided under the EP Act.

This draft policy will be finalised when the MWADZ is declared and gazetted by the Minister for Fisheries.

The DoF has advised that the draft Policy and the MWADZ EMMP together aim to:

- establish an overarching, integrated structure for managing aquaculture;
- provide clear, efficient and effective processes for monitoring, evaluating and reporting;
- guide the development of finfish aquaculture; and
- ensure adaptive management for continual improvement.

In the context of the DoF's role set out in the draft Policy, the EPA considers there is merit in the DoF coordinating and collating the monitoring reports received under recommended conditions 6-5 (implementation of the EMMP) and 7-6 (implementation of the MFIMP). The DoF should interpret the monitoring data and consolidate the results in an Annual Zone Compliance Report to the Office of the EPA. This would enable appropriate measures to be implemented in response to the combined influence of aquaculture operations in the zone.

The reporting should cover whether:

- the plans have been properly implemented across the zone;
- aquaculture proposals have been managed to protect the Environmental Values and achieve the Environmental Quality Objectives and Levels of Ecological Protection as described in Schedule 2 of the draft Ministerial Statement;
- any mitigation measures applied within the MWADZ have been successful in restoring environmental quality to the specified level of ecological protection in the Environmental Quality Plan and Schedule 2 of the Ministerial Statement; and
- no more than 50% of each aquaculture lease and no more than 50% of both the northern or southern areas of the MWADZ are designated a MEPA and that the total area of MEPAs is <1,500 ha. This can be achieved by providing the geographic coordinates of the MEPAs within each area.

In addition to reporting on compliance against the agreed objectives and criteria in the agreed plans, the EPA considers that the collation and interpretation of monitoring data would enable the DoF to assess overall performance and trends in environmental quality and impacts on benthic communities and marine fauna (particularly for sea lions and seabirds).

The assessment of overall trends in environmental quality and marine fauna interactions would facilitate the DoF's commitment to review the MWADZ EMMP and MFIMP when the stocking biomass in the zone reaches 7,200 tonnes or five years, whichever occurs first, to ensure they are adaptive and in line with best practice.

The EPA notes that the DoF or the CEO of the Office of the EPA can request to review the MFIMP at any time if thought beneficial or if gathered data or new information identifies that it is necessary. The EPA would support changes to the monitoring and management framework based on the levels, types and consequences of interactions observed over two years. For example, if data clearly indicates there have been increases to certain seabird populations at the Abrolhos (e.g. gulls and cormorants), due to food subsidy from cages which may result in secondary impacts to populations of threatened seabirds.

6. Recommendations

That the Minister for Environment notes:

1. that the strategic proposal being assessed is to declare and establish an aquaculture development zone for large-scale sea-cage aquaculture of finfish at the Abrolhos Islands. Future proposals that have been identified in the assessment include aquaculture operations as set out in Appendix 4 of this Report;
2. the key environmental factors of Marine Environmental Quality, Benthic Communities and Habitat and Marine Fauna, as identified by the EPA in the course of its assessment set out in Section 3;
3. that the EPA has concluded that environmental impacts are acceptable and the identified future proposals may be implemented, provided the implementation of the future proposals are carried out in accordance with the recommended conditions and procedures set out in Appendix 4 and summarised in Section 4; and
4. the EPA's Other Advice in Section 6 of this report on the role of the DoF as the zone manager in coordinating annual zone compliance reports and reporting to the Office of the EPA.

Appendix 1

List of Submitters

Organisations:
Department of Aboriginal Affairs
Department of Parks and Wildlife
Department of Transport
Marine Fishfarmers Association of WA (Inc)

Individuals:
Dr Indre Kirsten Asmussen

Appendix 2

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Appendix 3

Relevant EPA Policies and Guidance and considerations for Environmental Impact Assessment

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Summary of Key Environmental Factors and Principles

The EPA reviewed its guideline and procedures documents for each environmental factor to determine their relevance to the assessment of the proposal. In this section the EPA outlines its relevant EIA considerations discussed in each document for the key environmental factors below.

The relevant considerations for environmental impact assessment from both the EPA's former policy suite and the EPA's new Environmental Factor Guidelines and Technical Guidance (released December 2016) have been included. The proponent prepared documentation in accordance with the relevant EIA considerations under the EPA's former guidance framework. However, the new Factor Guidelines and Technical Guidance documents address similar matters as those covered in the former EPA guidance documents, but adopt a more contemporary position to reflect the current practice of the EPA in undertaking EIA.

Marine Environmental Quality

The EPA considers that the following guidance is relevant to its assessment of the proposal in relation to this factor.

- Environmental Factor Guideline – Marine Environmental Quality (EPA, 2016b).
- Technical Guidance – Protecting the quality of Western Australia's marine environment (EPA, 2016).
- Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA, 2016).

Under the EPA's former guidance framework, the following documents were relevant to the assessment of this proposal:

- Environmental Assessment Guideline No.15 (EAG15), Protecting the Quality of Western Australia's Marine Environment, March 2015, Environmental Protection Authority Western Australia.
- Environmental Assessment Guideline No.7 (EAG7), Marine Dredging Proposals, September 2011, Environmental Protection Authority Western Australia.

Environmental Factor Guideline – Marine Environmental Quality

This Factor Guideline outlines considerations when undertaking environmental impact assessment for Marine Environmental Quality. For this proposal the relevant considerations include:

- application of the mitigation hierarchy to avoid or minimise impacts on marine environmental quality, where possible;
- the marine system that will potentially be affected and the significance of the environmental values that it supports;
- options for avoiding or reducing the potential effects on the environmental values (e.g. location, waste minimisation and/or waste treatment);

- predictive modelling of the extent, duration and intensity of impacts under normal and most likely worst-case scenarios, and in combination with any other changes in marine environmental quality caused by adjacent activities or natural events (cumulative effects);
- any additional mitigation strategies proposed to be implemented and the predicted residual impacts;
- whether proposed mitigation approaches are technically and practically feasible;
- potential impacts on the factor within the context of an environmental quality plan (EQP) as discussed in this guideline and environmental quality criteria developed consistent with current national and state guidance; and
- whether all analyses are undertaken to a standard consistent with recognised published guidance.

The relevant considerations have been addressed in the EPA's assessment.

Technical Guidance – Protecting the quality of Western Australia's marine environment (EPA, 2016).

The purpose of this Technical Guidance is to:

- assist proponents to develop a suitable environmental quality management framework for their proposal;
- assist proponents to design fit-for-purpose modelling and monitoring programs to spatially define, assess and manage potential impacts of their proposal on marine environmental quality; and
- ensure proposals that have the potential to significantly affect marine environmental quality are described and assessed in a sound and consistent manner that demonstrates how the EPA's objective for the Factor 'marine environmental quality' will be met.

Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA, 2016).

- This Technical Guidance describes the impact prediction and assessment framework that the EPA expects proponents and consultants to use so that predictions of the extent, severity and duration of impacts to benthic habitats associated with significant dredging activities are presented in a clear and consistent manner that incorporates the range of likely environmental outcomes (most likely best and worst-case scenarios). Although this Guidance is for dredging proposals, the approach is also recommended for other activities where there is a high level of uncertainty around potential impacts.

The surveys, modelling and technical studies for this proposal were undertaken in 2014 and have been presented in accordance with EAG7 and EAG15, which were the relevant EPA guidance documents at the time. These have been replaced by new factor guidelines and technical guidance documents released in December 2016. The standards and information required in the contemporary guidance documents have not changed and

therefore the EPA considers that the surveys, modelling and technical studies undertaken to inform the assessment are consistent with the EPA's contemporary expectations.

Benthic Communities and Habitat

The EPA's environmental objective for this factor is *to protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.*

Relevant EPA policy and guidance

The following guidance is relevant to the assessment of the proposal in relation to this factor.

- Environmental Factor Guideline – Benthic Communities and Habitat (EPA, 2016).
- Technical Guidance – Protection of Benthic Communities and Habitat (EPA, 2016).
- Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA, 2016).

Under the EPA's former guidance framework the following documents were relevant to the assessment of this proposal:

- Environmental Assessment Guideline No .3 (EAG3), Protection of Benthic Primary Producer Habitat in Western Australia's Marine Environment, December 2009, Environmental Protection Authority Western Australia.
- Environmental Assessment Guideline No. 7 (EAG7), Marine Dredging Proposals, September 2011, Environmental Protection Authority Western Australia.

Environmental Factor Guideline – Benthic Communities and Habitat

This Factor Guideline outlines considerations when undertaking environmental impact assessment for Benthic Communities and Habitat. For this proposal the relevant considerations include:

- application of the mitigation hierarchy to avoid and minimise impacts to benthic communities and habitats, where possible;
- the benthic communities and habitat types affected by the proposal and their significance;
- the alternative design options considered, and the management measures and approaches proposed, to avoid and minimise impacts to benthic communities and habitats;
- the spatial and temporal scale of the residual impacts to benthic communities and habitats from the proposal, in combination with historical and approved losses, and the flow-on implications for ecological integrity and biodiversity;
- the current state of knowledge of the affected benthic communities and habitats, including the services they provide, and the level of confidence underpinning the predicted residual impacts;

- the risk posed to benthic communities and habitats and their associated environmental values and ecological integrity should those predictions be incorrect; and
- whether proposed mitigation measures are technically and practically feasible.

The relevant considerations have been addressed in the EPA's assessment.

Technical Guidance – Protection of Benthic Communities and Habitat (EPA, 2016)

The purpose of this Technical Guidance is to explain how impacts on benthic communities and habitats are considered during Environmental Impact Assessment and to set out the type and form of the information that should be presented to facilitate the assessment of impacts on benthic communities and habitats in Western Australia's marine environment.

It 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 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.

Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA, 2016).

- This Technical Guidance describes the impact prediction and assessment framework that the EPA expects proponents and consultants to use so that predictions of the extent, severity and duration of impacts to benthic habitats associated with significant dredging activities are presented in a clear and consistent manner that incorporates the range of likely environmental outcomes (most likely best and worst-case scenarios). Although this Guidance is for dredging proposals, the approach is also recommended for other activities where there is a high level of uncertainty around potential impacts.

The surveys, modelling and technical studies for this proposal were undertaken in 2014 in accordance with EAG3 and EAG7, which were the relevant EPA guidance documents at the time. These have been replaced by new factor guidelines and technical guidance documents released in December 2016. The standards and information required in the contemporary guidance documents have not changed and therefore the EPA considers that

the surveys, modelling and technical studies undertaken to inform the assessment are consistent with the EPA's contemporary expectations.

Marine Fauna

The EPA's environmental objective for this factor is to *protect marine fauna so that biological diversity and ecological integrity are maintained*.

Relevant EPA policy and guidance

The EPA considers that the following policy and guidance is relevant to its assessment of the proposal in relation to this factor.

- Environmental Factor Guideline – Marine Fauna (EPA, 2016f).

Environmental Factor Guideline – Marine Fauna

This Factor Guideline outlines considerations when undertaking environmental impact assessment for Marine Fauna. For this proposal the relevant considerations include:

- application of the mitigation hierarchy, to avoid and minimise impacts to marine fauna, wherever possible;
- the marine fauna species affected by the proposal;
- the management measures and approaches proposed and whether they are technically and practically feasible;
- the spatial and temporal scale of the residual impacts to marine fauna and the flow-on implications for ecological integrity and/or biodiversity;
- the current state of knowledge of the affected species of marine fauna and the level of confidence underpinning the predicted residual impacts;
- the risk posed to marine fauna should those predictions be incorrect.

The relevant considerations have been addressed in the EPA's assessment.

Preliminary environmental factors	Description of the proposal's likely impacts on the environmental factor	Government agency and public comments	Evaluation of whether a factor *is* a key environmental factor
SEA			
Marine Environmental Quality	The proposal could result in: • degradation of marine water and sediment quality through the deposition of organic wastes and inorganic nutrients; • nutrient enrichment of the water column and increased turbidity; • release of trace metals, therapeutants and other contaminants into the marine environment; • direct and indirect impacts to key sensitive receptors; and • Impacts to marine environment and biota quality through release of pharmaceuticals, trace metals or	**Public Submission** • The submitter requested further clarification on accommodating staff at the site, including specifications of operational vessel's waste systems and how the appropriate standards would be regulated. • The submitter considers that the environmental pressures, including impacts relating to climate change, already facing the Abrolhos Islands may be considered to be significant, and the introduction of excessive nutrients and potential wastes would likely exacerbate these natural pressures. • The submitter queries the accuracy of the proponent's water quality modelling, and considers that the Precautionary Principle should be given more consideration given the high conservation value of the site. **Marine Fishfarmers Association of WA (Inc)** • The submitter contends that the proposed monitoring is prohibitive in terms of cost and resources. It is argued that in most cases no attributable difference between measurable indices and reference site would be recorded. Therefore, efforts and resources should be directed to measurable sediment and water quality indices that are likely to be affected by the activity.	**The EPA considers this to be a key environmental factor and is discussed in section 3.1**

Preliminary environmental factors	Description of the proposal's likely impacts on the environmental factor	Government agency and public comments	Evaluation of whether a factor *is* a key environmental factor
	metalloids and/or petroleum hydrocarbons.	• Contemporary methods for fauna monitoring have not been considered. Furthermore, consideration should be given to consolidate monitoring data already received by DOF to meet zone reporting requirements. • The submitter considers that alternative sampling and monitoring with elements consisting of lease/licence levels and regional/zone levels.	
Benthic Communities and Habitat	The proposal could result in: • direct and indirect disturbance or loss of benthic communities and habitat; • settling of organic waste can lead to direct smothering through burial; and • Secondary impacts to benthic communities and habitats may also result from organic loading and nutrient enrichment causing changes to water and sediment quality.	No submissions were received for this factor.	**The EPA considers this to be a key environmental factor and is discussed in section 3.2**

Preliminary environmental factors	Description of the proposal's likely impacts on the environmental factor	Government agency and public comments	Evaluation of whether a factor *is* a key environmental factor
Marine Fauna	Direct and indirect impacts on significant marine fauna from: • organic deposition and nutrient enrichment of the sediments; • additional food from aquaculture activities; • physical presence of aquaculture infrastructure; • artificial lighting; • changes in the abundance and distribution of fish and invertebrate species; • attraction to, altered feeding behaviour from, and possible entanglement in or entrapment within, sea cages and associated infrastructure; and • indirect impacts on other avifauna (particularly in relation to competition for	**Public Submissions** • The submitter notes that impacts to Australian sea lion, migrating whales and seabirds may occur. Logs for marine fauna interactions (including injury, entrapment, entanglement and death) should be required as part of the licence conditions. • The submitter considers that a management plan is required to regulate recreational activities that may be undertaken by the facilities staff on nearby islands. **Marine Fishfarmers Association of WA (Inc)** • The submitter considers the management requirements contained within the Marine Fauna Interaction Plan are unduly onerous, in particular the need to record all sightings and observations as opposed to interactions with the aquaculture activity. **Department of Parks and Wildlife** • The submitter notes that the threatened Australian sea lion, which is ranked vulnerable under the Wildlife Conservation Act, is known to occur in the vicinity of the proposal. Consideration of the national Recovery Plan for the Australian sea lion is required, including impacts to the breeding females of the Abrolhos Island's colony. • The submitter is of the view that to ensure the Abrolhos Islands Australian sea lion colony persists, the limit of acceptable impact (direct and indirect) on both	**The EPA considers this to be a key environmental factor and is discussed in section 3.3**

Preliminary environmental factors	Description of the proposal's likely impacts on the environmental factor	Government agency and public comments	Evaluation of whether a factor *is* a key environmental factor
	breeding sites) as a result of any expansion to 'increaser' seabird species (i.e. silver gull, Pacific gull or pied cormorant) due to aquaculture activities in the proposed MWADZ. • introduction of marine pests and pathogens; • competition or genetic mixing implications for wild stocks from escaped farm fish.	individuals and the population as a result of the implementation of the strategic assessment proposal, should be set at zero. • Species interactions with the facility are considered inevitable, therefore robust monitoring and management measures are recommended to address the risks to marine fauna, particularly Australian sea lions and threatened bird species. • The proponent should provide further information and clarity regarding the standards that will be applied to subsurface bird, and marine wildlife predator exclusion netting, and how fauna entanglement and entrapment will be avoided.	
PEOPLE			
Social surroundings	Direct and indirect impacts on social surroundings may include: • excessive presence of macroalgae, phytoplankton and encrusting invertebrates on and around the sea cages; • reductions in the natural visual clarity of	**The Department of Aboriginal Affairs** • The submitter recommends that the proponent consult with the Yamatji Marlpa Aboriginal Corporation who is the Native Title Representative body for the region. This would then ensure that any potential impact on significant Aboriginal heritage is minimised.	In view of no native title or native title claim over the Abrolhos Islands and the MWADZ Proposal area, the impacts to social surroundings are not considered likely to have a significant effect on the environment as they can be managed to meet the EPA's environmental objective.

Preliminary environmental factors	Description of the proposal's likely impacts on the environmental factor	Government agency and public comments	Evaluation of whether a factor *is* a key environmental factor
	the water; • visible film the water from petrochemical origins; • floating debris, dust or other objectionable matter; and presence of objectionable odours. • The physical presence of marine finfish sea-cage aquaculture infrastructure within the MWADZ Proposal area is the only possible potential impact on environmental heritage values. However, there do not appear to be any such values applicable to that particular area.		**The EPA does not consider this to be a key environmental factor.** **The factor does not require further evaluation by the EPA.**

PRINCIPLES		
Principle	**Relevant Yes/No**	**If yes, Consideration**
Environmental principles of the EP Act		
1. The precautionary principle *Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.* *In application of this precautionary principle, decisions should be guided by –* *a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and* *b) an assessment of the risk-weighted consequences of various options.*	Yes	In considering this principle, the EPA notes that Marine Environmental Quality, Benthic Communities and Habitat and Marine Fauna could be significantly impacted by this proposal. The assessment of these impacts is provided in this report. Investigations on the biological and physical environment undertaken by the proponent have provided sufficient certainty to assess risks and identify measures to avoid or minimise impacts. The EPA has recommended conditions to ensure relevant measures are undertaken by the proponent. From its assessment of this proposal, the EPA has concluded that there is not a threat of serious or irreversible harm.
2. The principle of intergenerational equity *The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.*	Yes	In considering this principle, the EPA notes that the proponent has taken measures to avoid and minimise impacts. In assessing this proposal the EPA has recommended adaptive management mechanisms (through conditions requiring environmental management plans) be implemented to maintain ecological processes. From its assessment of this proposal, the EPA has concluded that the health, diversity and productivity of the environment can be maintained and enhanced for the benefit of future generations.

3. The principle of the conservation of biological diversity and ecological integrity *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*	Yes	In considering this principle, the EPA notes that the proposal would result in impacts to Benthic Communities and Habitat and Marine Fauna. In assessing the proposal the EPA has considered these impacts and has taken into account measures proposed by the proponent to minimise impacts to the affected communities and species. The EPA has concluded that the proposal would not compromise the biological diversity or ecological integrity of the MWADZ proposal area and surrounds if the proposed and recommended management measures are implemented. Through this assessment, the EPA has demonstrated that the conservation of biological diversity and ecological integrity was a fundamental consideration.
4. Principles relating to improved valuation, pricing and incentive mechanisms *(1) Environmental factors should be included in the valuation of assets and services.* *(2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.* *(3) The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.* *(4) Environmental goals, having been established, should be pursued in the most cost effective*	Yes	In considering this principle, the EPA notes that the proponent and derived proponents would bear the cost relating to waste and pollution, including avoidance and containment. The EPA also notes the incentive mechanisms to the aquaculture industry in maintaining a healthy marine environment and reducing the amount of expensive uneaten feed. The management imposed by the EPA allows for innovative solutions to environmental problems and investigation of new aquaculture technologies. The EPA has demonstrated due regard to this principle during the assessment of the proposal.

way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimize costs to develop their own solution and responses to environmental problems.		
5. The principle of waste minimisation *All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.*	Yes	In considering this principle, the EPA notes that a key management measure for the MWADZ proposal is reducing the amount of organic waste released to the environment from uneaten feed. The EPA notes that dead fish stock would be disposed of according to relevant regulations and legislation. The EPA has demonstrated due regard to this principle during the assessment of this proposal.

Appendix 4

Identified Decision-making Authorities and Recommended Environmental Conditions

Identified Decision-making Authorities

Section 44(2) of EP Act specifies that the EPA's report must set out (if it recommends that implementation be allowed) the conditions and procedures, if any, to which implementation should be subject. This Appendix contains the EPA's recommended conditions and procedures.

Section 45(1) requires the Minister for Environment to consult with decision-making authorities, and if possible, agree on whether or not the proposal may be implemented, and if so, to what conditions and procedures, if any, that implementation should be subject.

The following decision-making authorities have been identified for this consultation:

Decision-making Authority	Approval
1. Minister for Land	Concurrence is required from the Minister administering the *Land Administration Act 1997* regarding the declaration of an aquaculture development zone
2. Minister for Fisheries	• Declaration of aquaculture zone; and • granting of aquaculture leases, under the *Fish Resources Management Act 1994*
3. CEO of the Department of Fisheries	Granting of aquaculture licenses under the *Fish Resources Management Act 1994*

Note: In this instance, agreement is only required with DMA #1 and #2 since these DMAs are Ministers.

Statement No. xxx

RECOMMENDED ENVIRONMENTAL CONDITIONS

STATEMENT THAT A FUTURE PROPOSAL(S) IDENTIFIED IN A STRATEGIC PROPOSAL MAY BE IMPLEMENTED
(Sections 40B and 45 of the *Environmental Protection Act 1986*)

MID WEST AQUACULTURE DEVELOPMENT ZONE

Strategic Proposal:	Designation of areas of Western Australian coastal waters as an aquaculture development zone under the *Fish Resources Management Act 1994*, described in Table 1 of Schedule 1, and identification of the future finfish aquaculture proposals described in Table 2 of Schedule 1 which may be developed in the aquaculture development zone.
Proponent:	Minister for Fisheries
Proponent Address:	Locked Bag 39 Cloisters Square WA 6850
Assessment Number:	1972

Report of the Environmental Protection Authority: 1593

It has been agreed that:

1. The Minister for Fisheries may declare that areas of the coastal waters of Western Australia, described in Table 1 of Schedule 1, are an aquaculture development zone (Mid West Aquaculture Development Zone) for carrying out of marine finfish aquaculture (aquaculture proposal(s));

2. The Department administering the *Fish Resources Management Act 1994,* on behalf of the Minister for Fisheries, will manage and regulate the development of the Mid West Aquaculture Development Zone in accordance with the Mid West Aquaculture Development Zone Management Policy (2017) having regard to the Mid West Aquaculture Development Zone Marine Fauna Interaction Management Plan (MFIMP) and Environmental Monitoring and

Management Plan (EMMP) dated February 2017 or any revisions made to these plans as approved by the CEO;

3. Pursuant to sections 40B and 45 of the *Environmental Protection Act 1986* (the Act), and subject to the Environmental Protection Authority declaring it a derived proposal pursuant to section 39B of the Act, a proposal to undertake an aquaculture proposal listed in Column 1, within the location described in Column 2 and meeting the specifications defined in Column 3 of Table 2 of Schedule 1 of this Statement, may be implemented. Upon declaration that an aquaculture proposal is a derived proposal, subject to the Minister for Environment's identification of relevant conditions under section 45A(3) of the Act, the implementation of the aquaculture proposal shall be subject to the following implementation conditions and procedures:

Note: Words and expressions used in these conditions shall have the same respective meanings as in the Act or as provided for in Table 3 of Schedule 1.

1 Derived Proposals

1-1 The implementation of the derived proposal shall not exceed **environmental objectives and specifications** provided for in Column 3 Table 2 of Schedule 1.

2 Contact Details

2-1 The proponent shall notify the CEO of any change of its name, physical address or postal address for the serving of notices or other correspondence within twenty eight (28) days of such change. Where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State.

3 Time Limit for Proposal Implementation

3-1 The proponent shall not commence implementation of the aquaculture proposal after the expiration of five (5) years from the date of the Section 45A Notice, and any commencement, within this five (5) year period, must be substantial.

3-2 Any commencement of implementation of the aquaculture proposal, within five (5) years from the date of issue of the Section 45A Notice, must be demonstrated as substantial by providing the CEO with written evidence, on or before the expiration of five (5) years from the date of the Section 45A Notice.

4 Compliance Reporting

4-1 The proponent shall prepare, and maintain a Compliance Assessment Plan which is submitted to the CEO at least six (6) months prior to the first

Compliance Assessment Report required by condition 4-6, or prior to implementation of the aquaculture proposal, whichever is sooner.

4-2 The Compliance Assessment Plan shall indicate:

(1) the frequency of compliance reporting;

(2) the approach and timing of compliance assessments;

(3) the retention of compliance assessments;

(4) the method of reporting of potential non-compliances and corrective actions taken;

(5) the table of contents of Compliance Assessment Reports; and

(6) public availability of Compliance Assessment Reports.

4-3 After receiving notice in writing from the CEO that the Compliance Assessment Plan satisfies the requirements of condition 4-2 the proponent shall assess compliance with conditions in accordance with the Compliance Assessment Plan required by condition 4-1.

4-4 The proponent shall retain reports of all compliance assessments described in the Compliance Assessment Plan required by condition 4-1 and shall make those reports available when requested by the CEO.

4-5 The proponent shall advise the CEO of any potential non-compliance within seven (7) days of that non-compliance being known.

4-6 The proponent shall submit to the CEO and the Department of Fisheries a Compliance Assessment Report annually from the date of issue of the Section 45A Notice addressing the previous twelve (12) month period, or as otherwise agreed in writing by the CEO. The Compliance Assessment Report shall:

(1) be endorsed by the proponent's CEO or a person delegated to sign on the CEO's behalf;

(2) include a statement as to whether the proponent has complied with the conditions;

(3) identify all potential non-compliances and describe corrective and preventative actions taken;

(4) be made publicly available in accordance with the approved Compliance Assessment Plan; and

(5) indicate any proposed changes to the Compliance Assessment Plan required by condition 4-1.

5 Public Availability of Data

5-1 Subject to condition 5-2, within a reasonable time period approved by the CEO after the issue of the S45A Notice and for the remainder of the life of the proposal the proponent shall make publicly available, in a manner approved by the CEO, all validated environmental data (including sampling design, sampling methodologies, empirical data and derived information products (e.g. maps)) relevant to the assessment of and implementation of the aquaculture proposal(s).

5-2 If any data referred to in condition 5-1 contains particulars of:

- a secret formula or process; or
- confidential commercially sensitive information;

the proponent may submit a request for approval from the CEO to not make these data publicly available. In making such a request the proponent shall provide the CEO with an explanation and reasons why the data should not be made publicly available.

6 Marine Environmental Quality

6-1 The proponent shall ensure that implementation of the aquaculture proposal protects the environmental values and achieves the levels of ecological protection for each of the ecological protection areas as specified in Table 2 of Schedule 2 and referred to in the Mid West Aquaculture Development Zone Environmental Monitoring and Management Plan (Version 1, February 2017), or its revisions as approved by the CEO.

6-2 The proponent shall implement the Mid West Aquaculture Development Zone Environmental Monitoring and Management Plan (Version 1, February 2017), or its revisions as approved by the CEO.

6-3 The proponent shall not implement any aquaculture proposal prior to:

(1) submitting proposed sea-cage layout and location and details of the number and co-ordinates of the sediment quality and infauna monitoring sites that will be used to implement the Mid West Aquaculture Development Zone Environmental Monitoring and Management Plan (Version 1, February 2017); and

(2) receiving written notice from the CEO that the number and co-ordinates of the sediment quality and infauna monitoring sites are satisfactory for the purposes of the monitoring required by the Mid West Aquaculture Development Zone Environmental Monitoring and Management Plan (Version 1, February 2017).

6-4 In the event that monitoring required by the Mid West Aquaculture Development Zone Environmental Monitoring and Management Plan (Version 1, February 2017), or its revisions as approved by the CEO, indicates the levels of ecological protection as specified in Table 2 of Schedule 2 or environmental quality standards as specified in the Mid West Aquaculture Development Zone Environmental Monitoring and Management Plan (Version 1, February 2017), or its revisions as approved by the CEO, are not being met, the proponent shall:

(1) report such findings to the CEO within seven days of the exceedance(s) being identified;

(2) investigate to determine the likely cause(s) of the exceedance(s) of the criteria defined in the Mid West Aquaculture Development Zone Environmental Monitoring and Management Plan (Version 1, February 2017), or its revisions as approved by the CEO;

(3) provide a report to the CEO within 30 days of first detecting the exceedance(s) detailing the findings of the investigation required by condition 6-4(2);

(4) if the exceedance(s) is determined by the CEO to be a result of implementation of the aquaculture proposal, the proponent shall immediately implement the mitigation measures identified in the Mid West Aquaculture Development Zone Environmental Monitoring and Management Plan (Version 1, February 2017), or its revisions as approved by the CEO; and

(5) continue implementing the mitigation measures until the criteria defined in the Mid West Aquaculture Development Zone Environmental Monitoring and Management Plan (Version 1, February 2017), or its revisions as approved by the CEO, are no longer being exceeded.

6-5 The proponent shall submit to the CEO and the Department of Fisheries annual compliance assessment reports in accordance with Condition 4-6 and which includes:

(1) the monitoring results required by the Mid West Aquaculture Development Zone Environmental Monitoring and Management Plan (Version 1, February 2017), or subsequent approved revisions, under Condition 6-1;

(2) evidence that the sediment quality and infauna monitoring sites are located along a transect from the cage(s) with the highest standing biomass over the annual monitoring period;

(3) an assessment of the effectiveness of the management and contingency measures implemented to ensure compliance with the requirements of Conditions 6-1 and 6-2; and

(4) evidence that the Moderate Ecological Protection Area defined in Table 2 of Schedule 2 comprises no more than 50 per cent of the proponent's Aquaculture Lease Area.

7 Marine fauna

7-1 The proponent shall manage operations associated with the implementation of the aquaculture proposal in a manner that:

- protects marine fauna so that biological diversity and ecological integrity are maintained; and
- ensures no adverse impacts on the viability and persistence of the Abrolhos Islands populations of Australian sea lions and seabirds.

7-2 The proponent shall not implement any aquaculture proposal prior to:

(1) submitting a Marine Fauna Interaction Management Plan (Plan) which shall include provisions to ensure the environmental objectives required by condition 7-1 are met, and

(2) receiving written notice from the CEO in consultation with the Department of Parks and Wildlife that the Plan meets the objectives of condition 7-1 and the requirements of conditions 7-3.

7-3 The Plan shall include detailed specification of the sea cages and predator exclusion devices (including specifications described in Table 1 of Schedule 2), incorporate all aspects of the Mid West Aquaculture Development Zone Marine Fauna Interaction and Management Plan (Version 1, February 2017), and include the following requirements:

(1) avoidance, mitigation and management measures;

(2) an adaptive management framework, including trigger criteria, monitoring design and methodologies, data analysis and interpretation and trigger management actions;

(3) incident reporting;

(4) review periods; and

(5) implementation reporting and auditing.

7-4 After receiving notice in writing from the CEO in consultation with the Department of Parks and Wildlife that the Plan satisfies the requirements of condition 7-3 and addresses the objectives outlined in condition 7-1, the proponent shall implement the requirements of the Plan.

7-5 In the event that the monitoring specified in the Plan, indicates that the trigger criteria specified in the Plan have been exceeded, the proponent shall:

(1) immediately implement the trigger management actions specified in the Plan and continue implementation of those actions until the trigger criteria are not exceeded, or until the CEO has confirmed by notice in writing that it has been demonstrated that the outcome in condition 7-1 is being and will continue to be met and implementation of the trigger management actions is no longer required;

(2) investigate to determine the likely cause of the trigger criteria being exceeded and to identify any additional management measures required to prevent the trigger criteria being exceeded in the future; and

(3) provide a report to the CEO within 30 days of an event occurring. The report shall include:

a) details of trigger management actions implemented; and

b) the findings of the investigation required by condition 7-5(2).

7-6 The proponent shall submit to the CEO and the Department of Fisheries annual compliance assessment reports in accordance with Condition 4-6 and which includes:

1) all monitoring data, recorded observations and reportable incidents required by the Plan or subsequent approved revisions, under Condition 7-3; and

2) an assessment of the effectiveness of monitoring, management and contingency measures implemented to ensure compliance with the requirements of Conditions 7-1.

7-6 The proponent may review and revise the Plan.

7-7 The proponent shall review and revise the Plan, as and when directed by the CEO.

7-8 The proponent shall implement the latest revision of the Plan, which the CEO has confirmed by notice in writing, satisfies the requirements of conditions 7-1 and 7-3.

Notes

1. The Minister for Fisheries has agreed that the Department administering the *Fish Resources Management Act 1994,* on behalf of the Minister for Fisheries, will manage and regulate the development of, and the activities within, the Mid West Aquaculture Development Zone and will be responsible for coordinating and interpreting monitoring reports from proponents required by conditions 6-4 and 7-6 and providing advice to the CEO on the satisfactory implementation of the Mid West Aquaculture Development Zone Environmental Monitoring and Management Plan (Version 1, February 2017), or subsequent approved revisions, and the Marine Fauna Interaction Management Plan, and overall achievement of the environmental objectives and specifications in column 3 of Table 2 of Schedule 1 across the Zone.

2. To facilitate continuous improvement in achieving the environmental objectives for the Mid West Aquaculture Development Zone, the Department of Fisheries has agreed to undertake a review of the Environmental Monitoring and Management Plan and the Marine Fauna Interaction Management Plan when the total stocking of finfish in the Mid West Aquaculture Development Zone reaches 7,200 tonnes, or five (5) years after the issuing of the first Section 45A Notice, whichever occurs first.

Schedule 1 – Description of the Strategic Proposal and future proposals

Table 1: Strategic Proposal

Strategic Proposal Title	Mid West Aquaculture Development Zone
Short Description	This proposal is to designate areas of waters, located approximately 75 kilometres west of Geraldton within the Fish Habitat Protection Area of the Abrolhos Islands, as described below, as an aquaculture development zone under the *Fish Resources Management Act 1994* for the purpose of carrying out marine finfish aquaculture (Mid West Aquaculture Development Zone).
Detailed Description	**Zone boundaries** As delineated in Figure 1 and defined by spatial co-ordinates listed in the Legend in Figure 1. **Area** Northern Area: 2,200 ha Southern Area: 800 ha **Zone Manager** Department of Fisheries, on behalf of the Minister for Fisheries. **Aquaculture Lease minimal spatial separation distance** Separation distance between aquaculture leases owned by different entities is to be ≥1 km. **Aquaculture Species** Marine **finfish** of a species that occur naturally within the West Coast region of Western Australia **Stocking limits** Maximum cumulative total standing stock biomass in the Zone is not to exceed 24,000 tonnes of marine finfish at any time. Maximum stocking density in the Zone is not to exceed eight tonnes of marine finfish per hectare in any aquaculture lease.

Spatial coordinates for the boundaries of the Mid West Aquaculture Development Zone (MGA Zone 50)

Coordinates defining the boundaries of the Mid West Aquaculture Development Zone in Figure 1 are held by the Office of the Environmental Protection Authority, Document Reference Number 2017-1483595350527.

Table 2: Future finfish aquaculture proposals within the Mid West Aquaculture Development Zone

Future proposals identified in the strategic proposal		
Future proposals	**Location**	**Description of environmental objectives and specifications**
Aquaculture proposals including: • installation and maintenance of floating sea cages secured to the seabed with mooring anchors and high tensile lines and cables; • stocking of marine finfish; and • finfish feeding, husbandry and harvesting.	Within the boundaries of the Northern Area and the Southern Area of the Mid West Aquaculture Development Zone as shown in Figure 1.	Planned, designed and managed (demonstrated by future proposal details; a draft marine fauna interaction management plan, and sediment quality and infauna monitoring sites and coordinates and the spatial extent of the Moderate Ecological Protection Area, being submitted at the time of the referral of the future proposal(s)) to meet the following: **1. Environmental Objectives** 1.1. <u>Marine Environmental Quality</u> Aquaculture operations be designed and managed to maintain the quality of water, sediment and biota so that environmental values are protected and ensure the environmental quality objectives detailed in Table 2 of Schedule 2 are achieved and levels of ecological protection are no lower than the ecological protection levels for the Moderate Ecological Protection Area (MEPA). 1.2. <u>Marine fauna</u> Aquaculture infrastructure and operations be designed and managed during all phases of development (construction, operation and decommissioning) to ensure no adverse impacts on the viability and persistence of the Abrolhos Islands populations of Australian sea lions and seabirds. **2. Specifications** In accordance with the design and operational specifications detailed in Table 1 of Schedule 2.

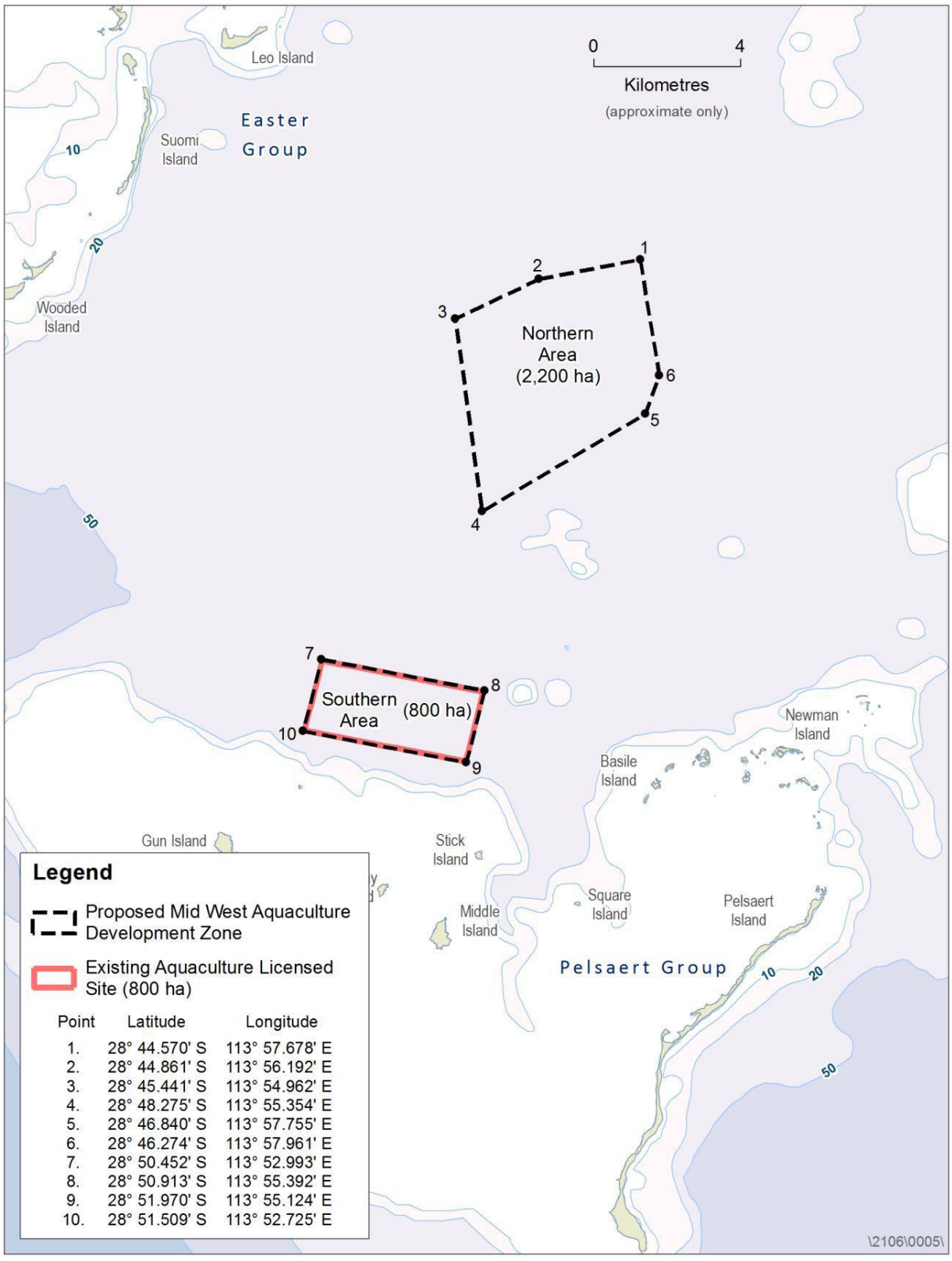

Figure 1 Location and extent of the Mid West Aquaculture Development Zone showing the Northern and Southern Areas

Schedule 2 - Specification and Description of Future Proposals and the Environmental Values and Levels of Ecological Protection to be achieved in marine water for the future proposals

Table 1: Specifications and description of future operations identified in the Strategic Proposal

Element	Specification / Description
Floating sea cage provisions	Deployment of industry best practice sea-cage design and predator exclusion devices and features including: • durable, high tensile sea-cage netting (single barrier) or durable, high tensile external anti-predator nets (double barrier) capable of withstanding attempted breach or access to fish stock by marine predators including seabirds and Australian sea lions; • above water perimeter fencing capable of withstanding attempted breach or access to sea cages by Australian sea lions; • high-visibility seabird exclusion netting; and • all sea-cage gear designed and maintained to avoid and/or minimise mortality and/or injury of marine fauna by minimising potential for entanglement, entrapment and collision.
Maximum stocking density	Not to exceed eight tonnes of marine finfish per hectare in any aquaculture lease.
Species to be cultured	Marine finfish species that naturally occur within the West Coast bio-region of Western Australia.
Seed stock	From a facility certified by the Supervising Scientist Biodiversity and Biosecurity, Department of Fisheries or with a health certificate issued or approved by the Department of Fisheries.
Feed inputs	Only commercial pellet feeds manufactured within Australia to the standard specified in the Mid West Aquaculture Development Zone Management Policy or if imported fish feed or ingredients to be used then only with the approval of the Australian Quarantine Inspection Service.
Decommissioning	Permanent removal of all sea cage and associated infrastructure.

Table 2: Description and spatial extent of the Environmental Values and levels of Ecological Protection to be achieved in the marine waters of the Mid West Aquaculture Development Zone

Environmental Value*	Environmental Quality Objective*	Area Description	Spatial Extent
Ecosystem Health	*Maintain ecosystem integrity at a high level of ecological protection*	Within the Mid West Aquaculture Development Zone (Northern Area and Southern Area)	At least 50 per cent of the Northern Area and the Southern Area of the zone must be designated and maintained as a High Ecological Protection Area. A high level of ecological protection will apply at the outer boundary of both the Northern Area and the Southern Area.
	Maintain ecosystem integrity at a moderate level of ecological protection	Within the Mid West Aquaculture Development Zone (Northern Area and Southern Area)	No more than 50 per cent of the Northern Area and the Southern Area may be designated as a Moderate Ecological Protection Area.
Fishing and Aquaculture	*Seafood (caught or grown) is of a quality safe for eating*	Within the Mid West Aquaculture Development Zone (Northern Area and Southern Area)	The entire Northern Area and Southern Area
	Water quality is suitable for aquaculture Purposes		
Recreation and Aesthetics	*Water quality is safe for primary contact recreation (e.g. swimming and diving)*	Within the Mid West Aquaculture Development Zone (Northern Area and Southern Area)	The entire Northern Area and Southern Area
	Water quality is safe for secondary contact recreation (e.g. fishing and boating)		
	Aesthetic values of the marine environment are protected		

* Environmental Values and Environmental Quality Objectives are defined in the EPA's Technical Guidance Protecting the Quality of Western Australia's Marine Environment (EPA 2016).

Table 3: Abbreviations and Definitions

Acronym or Abbreviation	Definition or Term
ANZECC Guidelines	The Australian and New Zealand Guidelines for fresh and marine water quality (ANZECC & ARMCANZ 2000) updated from time to time.
Best Practice	When designing proposals and implementing environmental mitigation and management actions, the contemporary best practice measures available at the time of implementation should be applied.
CEO	The Chief Executive Officer of the Department of the Public Service of the State responsible for the administration of section 48 of the *Environmental Protection Act 1986*, or his delegate.
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
Finfish	Means fish of the Class Elasmobranchii (Chondrichthyes) or Osteichthyes
OEPA	Office of the Environmental Protection Authority
ha	Hectare
ISQG-low	Interim sediment quality guideline - low

Appendix 5

Summary of Submissions and
Proponent's Response to Submissions

Provided on CD in hardcopies of this report and on the EPA's website at
http://www.epa.wa.gov.au/proposals/mid-west-aquaculture-zone