



AQUACULTURE MANAGEMENT AND ENVIRONMENTAL MONITORING PLAN (MEMP)

Ocean Grown Abalone Pty. Ltd.

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Contents

1	INTRODUCTION	4
	Background	4
	Purpose.....	4
2	OVERVIEW	5
	Species and Quantity of Fish.....	5
	Location of Land and Waters.....	5
	Farming Methods and Aquaculture Gear	8
3	ENVIRONMENTAL MANAGEMENT AND MONITORING.....	8
	Baseline Information	8
	3.1.1 Overview of Flinders Bay	8
	3.1.2 Nutrient Budget.....	11
	Environmental Monitoring Program.....	11
	3.1.3 Water Quality.....	11
	3.1.4 Seagrass Monitoring.....	11
	3.1.5 Sediment Quality Monitoring Program	11
	Management of Specific Environmental Issues.....	16
	3.1.6 Genetics	16
	3.1.7 Maximum Stock Density	16
	3.1.8 Removal of Predators.....	16
	3.1.9 Fabrication and Location of Grow-Out Structures	16
	Risks and Response Protocols	18
4	IMPACT ON PROTECTED SPECIES AND OTHER AQUATIC FAUNA	21
	Marine Fauna.....	21
5	BIOSECURITY.....	22
	General Facility Information	22
	5.1.1 Introduction	22
	5.1.2 Layout of the Facility	22
	Administrative Biosecurity Procedures.....	23
	5.1.3 Record Keeping.....	23
	5.1.4 Aquaculture Gear and Vehicles (Equipment)	23
	5.1.5 Staff, Contractors and Visitors	24
	5.1.6 Access to and Movement in the Facility	24
	Operational Biosecurity Procedures	24
	5.1.7 Health Management and Certification.....	24
	5.1.8 Feeds	26
	5.1.9 Waste Management	26
	5.1.10 Disposal of Waste.....	26
	5.1.11 Quarantine and Testing Areas.....	26
	5.1.12 Prevention of Escapes.....	26
	Incident and Emergency Procedures.....	26
	Dealing with Suspected Diseased Abalone	27
6	AUDITING.....	29
	Internal Auditing Process.....	29
	External Auditing	29
7	REPORTING	29
	Sediment Monitoring	29
	Annual MEMP Report.....	29
8	MEMP REVIEW	29
	Amendments.....	29
9	References.....	30
	APPENDICES	31
	APPENDIX 1: Nutrient Budget.....	32
	APPENDIX 2: Disease Contacts and Reporting	37
	APPENDIX 3: Standard Operating Protocols for Unusual Mortalities	38
	APPENDIX 4: Bio-Security Induction Forms.....	44
	APPENDIX 5: Disinfection and Cleaning Procedures	44

APPENDIX 6: OGA Aquaculture Licence.....48

Figures

Figure 1. A) Greenlip abalone attached to habitat module and B) recently harvested greenlip abalone (<i>Haliotis laevigata</i>).	5
Figure 2. Map of the OGA aquaculture lease and the historic lease areas A-C	7
Figure 3. Example of typical habitat modules, ABITATs, showing typical A) layouts and B) stocking density....	8
Figure 4. Indicative location of sample sites and at A) a habitat module and B) reference sites.	14

Tables

Table 1. Common marine fauna found in and around Flinders Bay	10
Table 2. Environmental Factors Relevant to OGA Abalone Ranching Operation.....	18

List of Abbreviations

Abbreviation	Meaning
ACWA	Aquaculture Council of Western Australia
ANZECC/ARMCANZ	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
CEO	Chief Executive Officer
DoF	Department of Fisheries Western Australia
DPaW	Department of Parks and Wildlife
EBFM	Ecosystem Fisheries Based Management
EPBC	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
LAT	Lowest Astronomical Tide
LoR	Limit of Reporting
MEMP	Management and Environmental Monitoring Plan
NATA	National Association of Testing Authorities
OGA	Ocean Grown Abalone Pty Ltd
SOP	Standard Operating Procedure
t	Tonnes
TN	Total Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorous
UNEP	United Nations Environment Program
WA	Western Australia

1 INTRODUCTION

Background

Ocean Grown Abalone Pty Ltd (OGA) operates commercial ocean ranching of abalone in Australia. Low densities of greenlip abalone (*Haliotis laevis*) produced in hatcheries are released onto habitat modules for grow out to market size. No supplementary feeding is conducted and the abalone rely upon natural feeds from the surrounding environment. The abalone graze on drift algae dislodged from the seabed during swell and storm events which are caught by the habitat modules.

Broodstock abalone are captured in Flinders Bay, Augusta by abalone divers using commercial fishery quota as issued by the Department of Fisheries (DoF).¹ Broodstock are re-located to a land-based hatchery in Bremer Bay where they are induced to spawn. The resulting spat are grown to a length of 40-50mm at the land based facility. Juveniles are then transferred, after obtaining health certifications from DoF, to the OGA grow out site at Flinders Bay. Divers place the juvenile abalone onto the aquaculture habitat structures. Divers are also used throughout the growout period in maintaining the structures, removing predators and monitoring the animals as they grow. The abalone are grown until ready for harvesting, processing and sale.

Following proof of concept of this ocean ranching method in research trials conducted between 2008 and 2012, OGA has moved to full commercial operation. In the ensuing period of 2014-2019, 10,000 Abalone aquaculture production modules, herein termed ABITATs, were positioned on the seabed, within the 413 hectare lease. It is expected that the 10,000 ABITATs will have an annual abalone production of 150T per annum.

Abalone have been produced successfully for harvest using the above methods since 2014. OGA aims to supply high quality abalone that is indistinguishable from wild-catch product year round and is capable of providing abalone at different sizes, quantities and processing specifications (live, canned, IQF, fresh) to the market.

Purpose

As a committed long-term operator of a major aquaculture facility, OGA operates under strict procedures aimed at ensuring the health of the operation and the surrounding environment. OGA is aware of its environmental responsibilities which align with Ngari Cape Marine Park's ecological and social values and OGA aims to minimise and/or eliminate any potential environmental impacts. OGA operates within aquaculture guidelines set out by the Western Australian Department of Fisheries and complies with the Aquaculture Council of Western Australia's Code of Practice for the Abalone Aquaculture Industry.

This document sets out the monitoring and management undertaken by OGA to meet the above goals and the conditions of OGA's aquaculture licence.

¹ Should commercial divers not be available, OGA holds an exemption from DoF to collect abalone.

2 OVERVIEW

Species and Quantity of Fish

The primary focus of OGA's business is the commercial aquaculture of Greenlip Abalone (*Haliotis laevis*) in Flinders Bay, near Augusta, Western Australia, by the sea ranching of abalone on man-made structures (Figure 1).

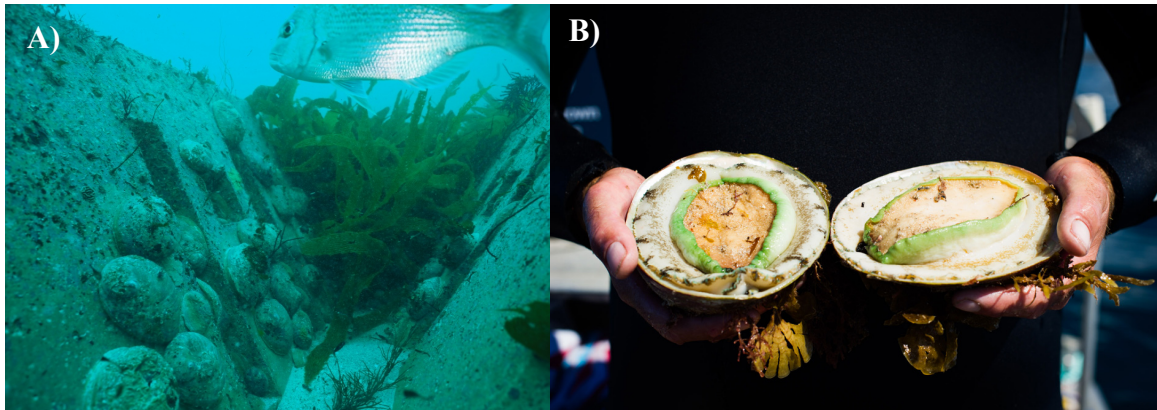


Figure 1. A) Greenlip abalone attached to habitat module and B) recently harvested greenlip abalone (*Haliotis laevis*).

Production capacity of the extended lease will allow for an initial maximum annual harvest of 150t per year. The annual harvest of the revised lease area may be increased after 5 years, to 300 t per year provided no exceedances of environmental monitoring criteria attributed to the increased abalone biomass occur in the lease area.

Each ABITAT has a base footprint of 1.4 m², with each unit having an available surface area of abalone habitat of 9.34 m². It is estimated that each ABITAT will supply up to a 15 kg live weight harvest over the course of 12 months. The deployment of 10,000 ABITATs over 413 hectares will account for less than 1% of the seafloor contained within the lease area and potentially produce up to 150t of abalone per annum. An additional 5,000 ABITATs may be added to target a 225t yield after 5 years (up to 1% of seafloor).

Stocking densities must be kept low to ensure enough feed (algal wrack drifting in water column) is available to the abalone to promote vigorous growth, low mortality and good health. OGA have allowed for an estimated stocking density of between 1.5 and 2 kg/m² on each ABITAT.

Location of Land and Waters

The lease area is located in Flinders Bay, near Augusta, Western Australia (Figure 2). The lease encompasses 413.3 ha of the sea floor, being 1.4 km from the nearest coast and 4.7 km at its most distant point. The water depth within the lease area ranges from approximately 15 m (LAT) at the northern end of the lease to 19 m (LAT) towards the lease's most southern extent.

The MEMP lease includes most of the area from Sites A and B of the historic leases held by OGA. Areas of Site A or B falling outside the new lease have been forfeited under the revised lease awarded to OGA. Site C, which is wholly enclosed by the proposed lease, is presently held by Two Oceans Abalone, a subsidiary of OGA (Figure 2). This area has been excluded

from the proposed revised OGA lease, but this MEMP applies equally to operations on the OGA lease and Site C. For MEMP purposes, the term “lease area” refers to the combination of the OGA and Two Oceans Abalone leases as shown in Figure 2.

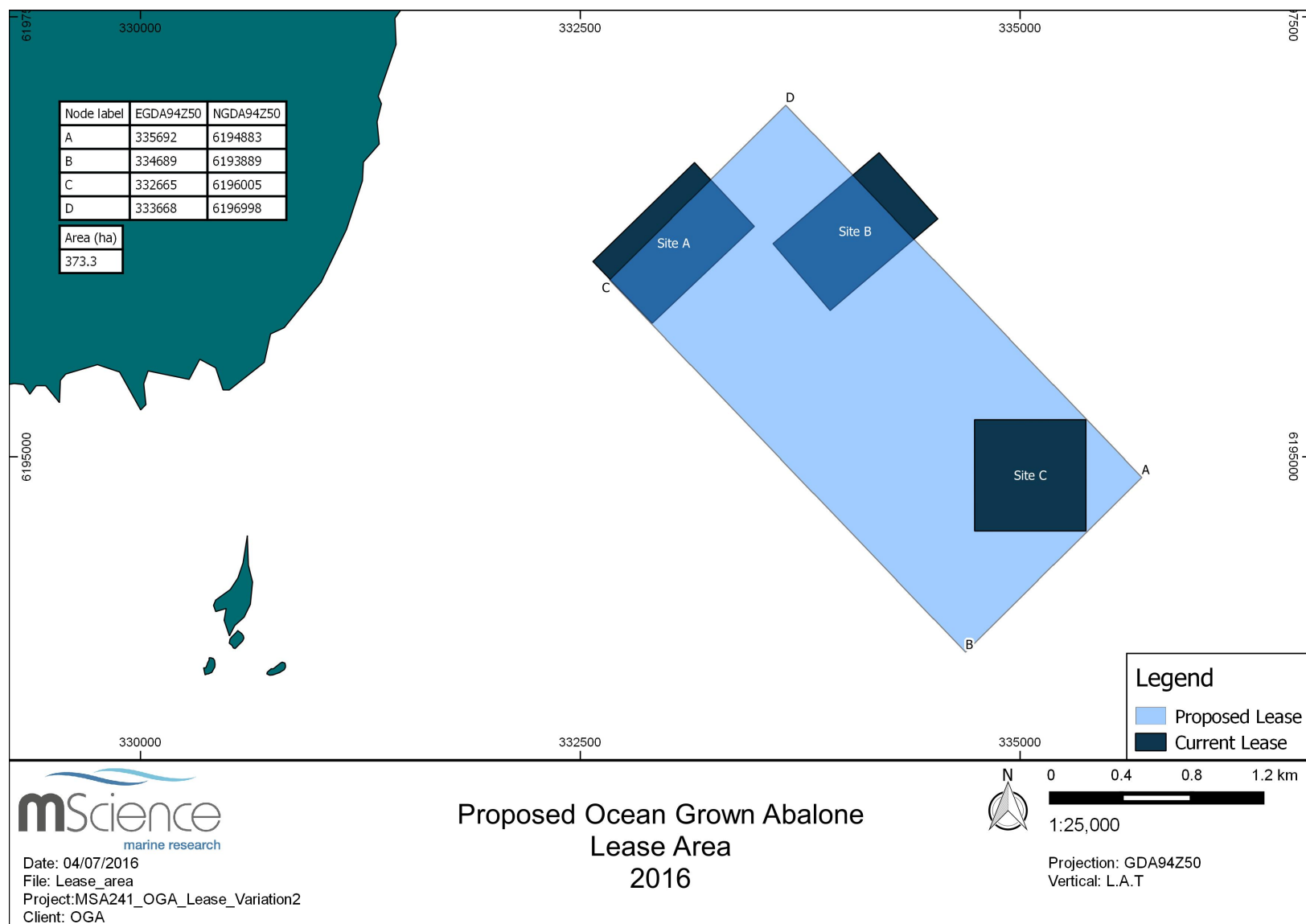


Figure 2. Map of the OGA aquaculture lease and the historic lease areas A-C

Farming Methods and Aquaculture Gear

The aquaculture method is ‘ranching’. This method uses purpose built habitat modules constructed from concrete (termed ABITAT – see Figure 3). The ABITATs are located in an area of Flinders Bay where there are large sandy areas interspersed with seagrass beds.

No feed is provided to the abalone, as they are opportunistic feeders that rely on the algal wrack drifting past the modules on which they live. Adequate food sources are available in Flinders Bay which has many species of fast growing, ephemeral, epiphytic red algal species growing on the seagrass blades that break off during swell and tide and migrate across the lease.

The lease area is marked out with appropriate navigational markers as per license conditions. Markers are, and will continue to be, maintained in good working order.

Boats are used to transport divers to the site from Augusta boat harbour on a daily basis to monitor the progress of the abalone, as well as to remove predators and maintain the units. Harvesting is undertaken when the abalone have reached a size of approximately 110-130 mm. Harvesting involves divers removing abalone from the habitat modules and returning them to a land-based facility at the Augusta Marina for processing.

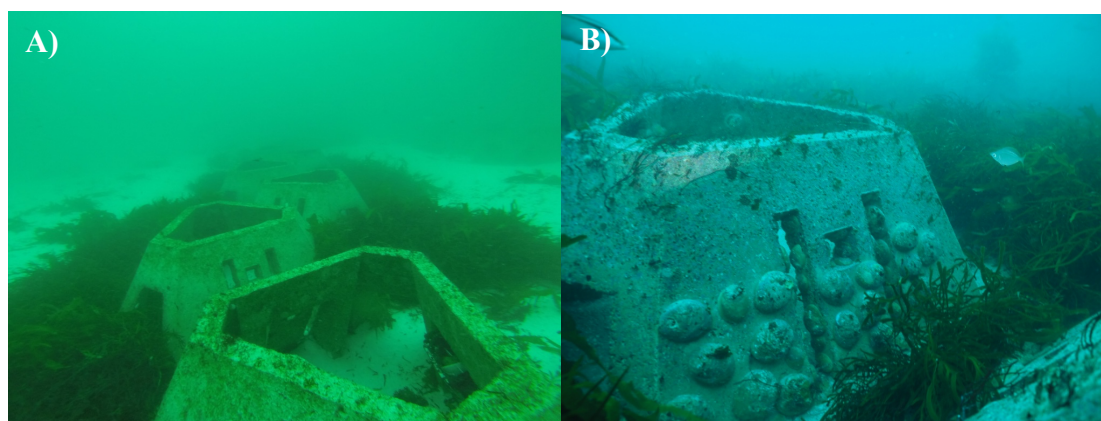


Figure 3. Example of typical habitat modules, ABITATs, showing typical A) layouts and B) stocking density.

3 ENVIRONMENTAL MANAGEMENT AND MONITORING

Baseline Information

3.1.1 Overview of Flinders Bay

A comprehensive summary of the physical, biological and social features of the Leeuwin-Naturaliste bioregion was documented by the Department of Environment and Conservation (now Department of Parks and Wildlife; DPaW) in the *Ngari Capes Marine Park Indicative Management Plan* (Department of Environment and Conservation, 2006). Much of the following has been taken from this report and in some cases appears “word for word”. The authors of this report acknowledge this and wish to clearly credit the original work and note this document has since been updated in 2013 (Department of Environment and Conservation, 2013).

Flinders Bay is located on the southern coast of Western Australia between Cape Leeuwin and Black Point and is approximately 19,600 ha. Hardy Inlet opens into Flinders Bay, drains

the Blackwood and Scott rivers, and is one of two permanently open estuaries on the south coast of Western Australia. The general substrate in the bay is of Quaternary sands overlying Cretaceous sediments, with sparse seagrass beds and macroalgae on low relief limestone or granite reefs (Western Australian Planning Commission, 2003; Department of Environment and Conservation, 2006).

The Blackwood and Scott Rivers form a component of the Blackwood Basin. This is the largest catchment in Western Australia's South-west (23,000 km²) and has been extensively cleared for various agricultural purposes. As a result of the intense anthropogenic uses of this area, the Blackwood and Scott Rivers, and thus the Hardy Inlet, experiences eutrophication issues.

A 2002 report (Kelsey, 2002) estimated that an annual nutrient load to the Hardy Inlet via the Blackwood and Scott Rivers consisted of 1,540 tonnes of total nitrogen, and 43 tonnes of total phosphorus. This study attributed much of this nutrient load to uses such as dairy, pigs, intensive animal production, seasonal horticulture, irrigated perennial horticulture, and grazing and improved pastures. However this study did not investigate nutrient input from landfill rubbish tips in the catchment (Kelsey, 2002). In addition, the town of Augusta has a secondary sewerage treatment system which is licensed to release up to 180 m³ day⁻¹, and released 40,624 m³ in 1999/2000, though not all properties in Augusta are connected to this system (Western Australian Planning Commission, 2003).

Sea surface temperatures range from approximately 23° C in summer to 16° C in winter. During autumn and winter the eastern region of Flinders Bay experiences the presence of the eastward flowing Leeuwin Current, the time of this current's strongest flow. The broad circulation of Flinders Bay is influenced by winds, but finer scale studies have not been performed in this region in any great detail. Although Flinders Bay is more sheltered than the west facing region between Cape Naturaliste and Cape Leeuwin, it is still subjected to the same heavy swells and the south facing expanses are exposed to the strong wave action. Under these swell conditions, littoral currents move sediments eastward in Flinders Bay (Department of Environment and Conservation, 2006).

Tides are typically mixed (diurnal and semi-diurnal) and less than 1 m, with a range of 0.7 m during spring tides and 0.5 m during neap tides. These tides are of importance in the Hardy Inlet with respect to the development and movement of strong haloclines. The seasonal freshwater discharge from the Hardy Inlet creates tidal currents in the nearshore area, ranging from 0.3 ms⁻¹ to 0.5 ms⁻¹ in summer to 1 ms⁻¹ in winter (Department of Environment and Conservation, 2006).

Currently, commercial fishing is economically important in the South-west, with a combined fisheries value of \$14.1 million in 2010/11. Over 75% of this value is attributable to the abalone and shark industries. The Hardy Inlet Estuarine Fishery is another economically important fishery in the south west. Species targeted in this region include Australian Salmon (*Arripis truttacea*), Herring (*Arripis georgianus*), Pilchards (*Sardinops neopilchardus*), Bronze Whaler Sharks (*Carcharhinus brachyurus*), Blue Sprat (*Spratelloides robustus*), and Whitebait (*Hyperlophus vittatus*) (Department of Environment and Conservation, 2006).

Table 1. Common marine fauna found in and around Flinders Bay

Taxonomic Group	Species
Sea birds	<ul style="list-style-type: none"> - Rock Parrots (<i>Neophemea petrophila</i>), - Little Penguins (<i>Eudyptula minor</i>), - Bridled Terns (<i>Sterna anethetus</i>) - Ospreys, Albatross' and Gulls
Cetaceans	<ul style="list-style-type: none"> - Humpback (<i>Megaptera novaeangliae</i>), - Southern Right (<i>Eubalaena australis</i>), - Blue Whale (<i>Balaenoptera musculus</i>), - Bottlenose Dolphins (<i>Tursiops truncatus</i>) - Common (<i>Delphinus delphis</i>) and Striped (<i>Stenella caeruleoalba</i>) dolphins have only been recorded as “stranded” within Flinders Bay.
Pinnipeds	<ul style="list-style-type: none"> - New Zealand Fur Seals (<i>Arctocephalus forsteri</i>) (most westerly breeding colony) - Australian Sea Lions (<i>Neophoca cinerea</i>) - Sub-Antarctic Fur Seal (<i>Arctocephalus tropicalis</i>) and the Leopard Seal (<i>Hydrurga leptonyx</i>) are occasionally reported as strandings.
Invertebrates	<ul style="list-style-type: none"> - Ascidians (<i>Pyura spp.</i>), - Calcareous sponges, octocorals and soft corals - Crustaceans, such as the commercially important Western Rock Lobster (<i>Panulirus cygnus</i>) - Various gastropods including abalone, sea stars, sea urchins, and sea cucumbers.
Fish	<ul style="list-style-type: none"> - WA Dhufish (<i>Glaucosoma hebraicum</i>) - Western Blue Groper (<i>Achoerodus viridis</i>) - Harlequin Fish (<i>Othos dentex</i>) - Australian Salmon (<i>Arripis truttacea</i>) - Tailor (<i>Pomatomus saltatrix</i>) - Australian Herring (<i>Arripis georgianus</i>) - Black bream (<i>Acanthopagrus butcheri</i>) - Great White Shark (<i>Carcharodon carcharius</i>) - Bronze Whalers (<i>Carcharhinus brachyurus</i>)
Macroalgae	<ul style="list-style-type: none"> - Macroalgae is more dominant than seagrasses in Flinders Bay. - Over 150 species of macroalgae exist there including <i>Ecklonia radiata</i>, <i>Cystophora spp.</i>, <i>Sargassum spp.</i>, and various species of turfing macroalgae. <i>Sargassum spp.</i> are predominant in the more sheltered areas
Seagrass	<p>Thirteen species of seagrasses are found in Flinders Bay including:</p> <ul style="list-style-type: none"> - <i>Amphibolis antactica</i> - <i>Amphibolis griffithi</i> - <i>Halophila ovalis</i> - <i>Heterozostera tasmianica</i> - <i>Posidonia ostenfeldi</i> - <i>Thalassodendron pachyrhizum</i> <p>These species are found near shore forming perennial dense to medium beds.</p> <ul style="list-style-type: none"> - Offshore the seagrass beds are dominated by <i>T. pachyrhizum</i> and are ephemeral or sparse

Sources: Thomson-Dans *et al.*, (2003); Western Australian Planning Commission (2003), Department of Environment and Conservation (2006).

3.1.2 Nutrient Budget

OGA has developed a Nutrient Budget (Appendix 1) to assess the significance of nutrients from the cultured abalone relative to other local nutrient sources to determine whether the modified habitat and use of the area is a significant nutrient-related risk to the health of the Flinders Bay marine environment, particularly seagrass meadows. As the operation does not add any feed to the lease area, the only change to normal nutrient flows is to process more of the algal wrack through abalone and then remove approximately part of the processed nutrient when abalone are harvested. The results of the modelled budget indicate that any changes are likely to be very small and neither seagrass monitoring nor water quality monitoring are required at this stage. As a precautionary response, a sediment monitoring plan has been established and if the sediment sampling indicates a significant shift in nutrient levels in response to the aquaculture operation, seagrass and water quality monitoring may become a requirement.

Environmental Monitoring Program

3.1.3 Water Quality

Based on the results of the Nutrient Budget (Appendix 1), monitoring of water quality is not required. Provision may be made for future water quality monitoring based on the results of the sediment monitoring program.

3.1.4 Seagrass Monitoring

Based on the results of the Nutrient Budget (Appendix 1), monitoring of seagrass is not required. Provision may be made for future seagrass monitoring according to the results of the sediment monitoring program.

3.1.5 Sediment Quality Monitoring Program

The nutrient budget study (Appendix 1) identified that nitrogen is likely to be a limiting nutrient in Flinders Bay and that the aquaculture operation has the potential to alter the flow of nitrogen through the operational area. However, the study demonstrated that the ranching of abalone, even with a production rate of up to 300 T yr⁻¹, is not expected to result in significantly altered nutrient levels compared to the background levels known from the area.

The study showed nitrogen flux across the sediment-water interface as the highest component of nutrient dynamics in the Bay. Organic enrichment and subsequent accumulation of organic matter in the sediments with resulting reduced oxygen levels is a potential stressor from aquaculture, although with a very low probability of causing detectable change in the current case.

A monitoring program was established at the start of OGA operations on Sites A,B and C to determine whether the operation has caused any elevation of nutrients in sediments. The sediment monitoring program involves collecting sediment samples on each sampling occasion for the determination of:

- Total Phosphorus (TP)
- Total Nitrogen (TN)
- Total Organic Carbon (TOC)
- Sediment Redox Discontinuity (Redox)

Sediment nutrient surveys have been completed for Summer and Winter periods from 2015 to the current revision of this MEMP. Analysis of that data presented to DPIRD showed no indication of nutrient elevation observed within areas of final density of ABITATs or within the entire area at full ABITAT density. Based on that, the frequency of monitoring will be amended from seasonal to 5 yearly. The original monitoring design approved will be retained.

Each transect will examine nutrient concentration and redox depth at stations 1 m, 5 m, and 10 m down current of concentrations of ABITATs (Figure 4A). The presence or absence of a redox layer will be photographed and odour recorded as a qualitative assessment of the biological oxygen demand at the water-sediment interface. The development and depth of a redox layer at test sites relative to reference sites will be used as an indicator of increasing biological activity surrounding the ABITATs.

Sampling regime and sites

Sediments will be sampled at the end of Summer conditions every five years. The next sampling report is due Summer 2024.

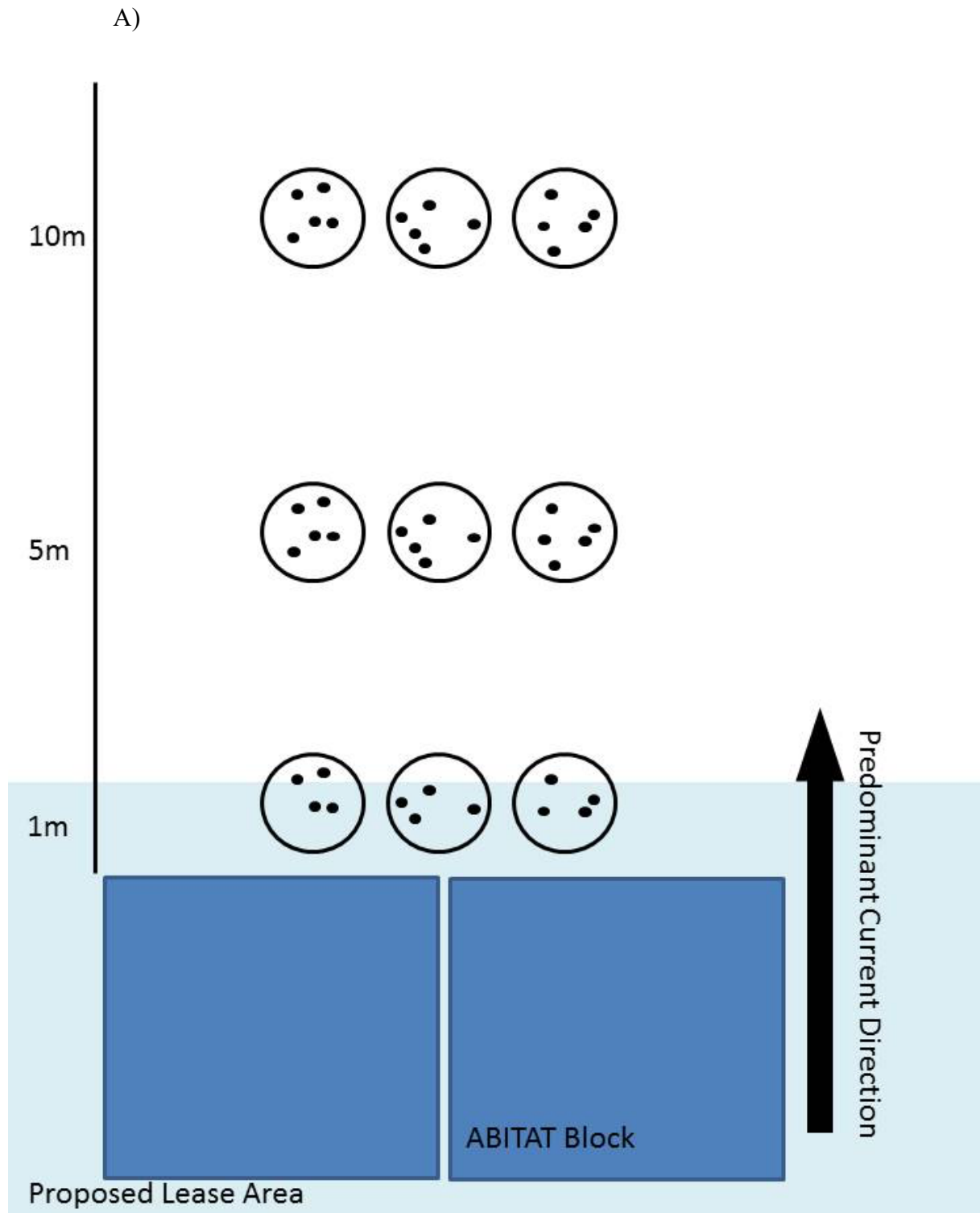
Sampling will be conducted along a down-current transect at 1, 5 and 10 m intervals from ABITATs. For each interval along the transect, three replicate samples will be obtained (Refer to Figure 4A). Samples will also be collected at Reference sites, which will be at least 50 m away from the boundary of the lease area (Figure 4B). The number of transects sampled will be approximately N. of ABITATs/2,000: i.e. 3 transects at present for 5,000 modules, raising to 5 transects at 10,000 modules and 7 transects at 15,000 modules. There will be an equivalent number of transects and reference sites.

Methodology for sampling nutrients

Sediment sampling will be undertaken by divers using an auger of at least 10 cm in diameter, which will enable a sample of 10 cm in sediment depth to be obtained.

Five core samples of the upper 10 cm of sediment will be taken at each site. Each of the five cores will be examined for visual or odour cues of redox layer discontinuity, then the upper 2 cm of sediment will be amalgamated and homogenised to form one sample. The collected sample will be stored in containers supplied by the nominated laboratory, and kept at a temperature of <4°C. Once all sites have been sampled, the chilled samples will be transported to the nominated laboratory for analysis. Care will be taken to ensure that sampling complies with holding times and any other specific sampling procedures outlined by the nominated analytical laboratory.

Analyses will be undertaken by a NATA-accredited laboratory and achieve LOR values equal to or less than the ANZECC/ARMCANZ (2000) sediment quality guidelines.



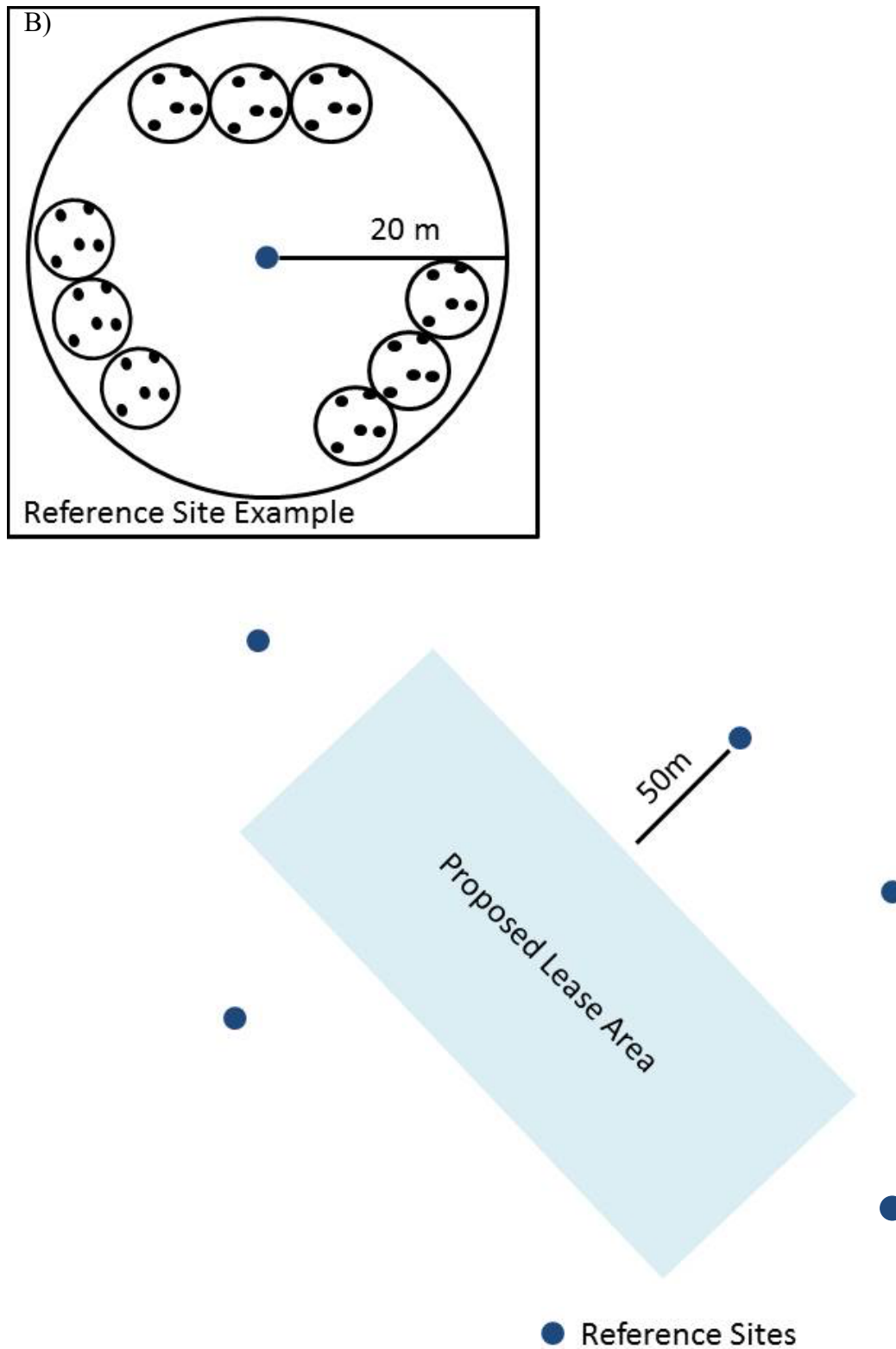


Figure 4. Indicative location of sample sites and at A) a habitat module and B) reference sites.

Methodology to assess redox discontinuity

All cores will be inspected for a redox discontinuity layer and the depth recorded. Photographs of the core structure (including the redox layer if present) will be taken and test and reference sites compared. Any sediment odour indicating the presence of hydrogen sulphide will be noted on the collection datasheet, to provide a “weight of evidence” for documenting the conditions of hydrogen sulphides in the sediments. Sediment redox discontinuity (fine black sediment and hydrogen sulphide in the upper 2 cm of sediment) can be considered an early indicator of the potential for organic enrichment linked to the aquaculture activity.

Data Analysis & Triggers

After each sampling event, median values for TP, TN and TOC levels calculated for individual sites (1, 5 and 10 m from each area within the site) should be less than the 80th percentile of the long term data from the five Reference Sites. Should any site return a median value above the reference 80thile, the pattern of nutrient concentration (1, 5, 10 m) will be investigated to determine whether that elevation is likely to be consistent with an origin from the aquaculture operation.

Note that with 18 sites (3 distances from each of 6 modules), 1 – 2 sites are likely to exceed the 80thile by chance alone.

Should redox discontinuity be noted, its depth and distance from the ABITATs will be noted and compared with results from reference sites.

Program review

The frequency and scope of the sediment quality monitoring program will be reviewed (by OGA in consultation with DoF and DPaW):

- Following the first 5 yearly monitoring, to be conducted in Summer 2024.

Any change in the program suggested by OGA would be subject to agreement by DoF prior to revision of the MEMP and implementation.

Management of Specific Environmental Issues

3.1.6 Genetics

In keeping with Western Australia's Abalone Aquaculture Policy (DOF 2013), OGA will grow greenlip abalone and selectively bred greenlip abalone (*Haliotis laevis*) produced from broodstock lines originating from the genetic zone in which the marine farm is located (Genetic Zone 3).

At the site authorised under its licence, OGA will not grow any abalone produced from broodstock lines originating from outside the genetic zone in which the marine farm is located. OGA will not grow hybrid or polyploid abalone at the site.

3.1.7 Maximum Stock Density

The OGA production system has been designed to operate at a stocking density of approximately 2 kg/m². Abalone are continually being harvested from the abalone modules year round as they reach a marketable size. Each year enough juvenile abalone from the 888 Abalone hatchery at an average size of 40mm are stocked onto the abalone modules at a density that after factoring in 50% natural mortality over the 3 year growing cycle allow for a maximum stocking density of no more than 2.5 kg/m² of a habitat module's surface area. Divers will be continually monitoring the habitat modules and will be adjusting the stocking density by harvesting or thinning as required.

OGA will work with the Department of Fisheries research staff to develop an effective means of measuring stocking density in-situ for compliance purposes. An initial audit of stocking density was conducted by DoF divers in November 2015. Follow up audits have been conducted in 2016, 2017, 2018 and 2019.

3.1.8 Removal of Predators

As for agriculture, a basic requirement for aquaculture is protection of cultured stocks through the control of predators.

Based on information provided by the Department of Fisheries, from an EBFM (ecosystem based fisheries management) perspective, the occurrence of predator and other species in this area conforms to a long-standing hypothesis that the productivity of benthic marine populations in WA is habitat-limited: that is, if the habitat is increased, so is carrying capacity of the environment. The creation of habitat in the aquaculture sites in Flinders Bay has led to an increase in carrying capacity for a suite of flora and fauna that require hard substrate or shelter through active colonization from surrounding natural habitats and local increased productivity.

In the Department's view, there is no sustainability issue and octopus populations in the natural abalone habitat will not be adversely affected by the aquaculture activity. Thus the current level of octopus removal by divers will continue without the need for monitoring.

3.1.9 Fabrication and Location of Grow-Out Structures

The fabrication of the abalone habitat units is from locally sourced materials. Concrete material used in the production of ABITATs will meet the following manufacturing standards with a minimum compressive strength at 30 days of 40Mpa. Standards for construction of the ABITATs include:

- AS 2758.1 Concrete Aggregates
- AS 3600 Concrete Structures
- AS 3972 Portland Blended Cements
- Moulds to cure for 3 days before lifting
- 7 days cure before load out on vessel
- >7 days before installation

These standards have proven successful in initial deployments and apply for a design life of greater than 30 yrs when submerged.

According to guidelines developed by the United Nations Environment Program (UNEP) concrete is the preferred material for the construction of marine aquaculture habitat modules for ranching because “concrete materials are compatible with the marine environment, is highly durable, stable and readily available” (IMO 2009)

The Abalone Modules will not be placed directly on seagrass but will be deployed on clear sand patches.

Risks and Response Protocols

Table 2. Environmental Factors Relevant to OGA Abalone Ranching Operation

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Response Protocols and Management
Marine Mammals – cetaceans & pinnipeds	Within the lease area	To avoid adverse impact on biological diversity, comprising the different plants and animals and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.	Cetacean or pinnipeds harmed.	No interaction anticipated: no potential for entanglement in structures. Any negative Cetacean interactions with aquaculture equipment to be reported immediately to DBCA
Disease	Flinders Bay.	To avoid adverse impact on biological diversity, comprising the different plants and animals and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.	Mass mortalities amongst local abalone stocks with potential for negative ecosystem effects	Operate under approved MEMP (which has a section on biosecurity) per WA Abalone Aquaculture policy 2013. - Abalone sourced locally - Hatchery spat subject to health checks - Continual monitoring for disease - Health and reporting protocols in place
Invertebrates	Flinders Bay.	To avoid adverse impact on biological diversity, comprising the different plants and animals and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity	Negative changes on invertebrate populations	To mitigate any impact on this stock, the grow-out apparatus is designed to minimize suitable habitat for octopus. In the Department's view, there is no sustainability issue and octopus populations in the natural abalone habitat will not be adversely affected by the aquaculture activity. Thus the current level of octopus removal by divers will continue without the need for monitoring
Water quality	Beneath and around habitat modules.	To maintain the integrity, ecological functions and environmental values of the seabed and coast.	Increased nutrient levels in adjacent waters	No supplementary feeding undertaken and nutrient budget suggests low potential for impacts. No pathway for impacts on water quality. Water quality monitoring may be implemented should sediment monitoring show impacts. Any program would be

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Response Protocols and Management
				approved by DoF in consultation with DBCA.
Health of Seagrass Community	Seagrass meadows in Flinders Bay.	To maintain the integrity, ecological functions and environmental values of the seabed and coast.	Adverse change in seagrass density, or species composition	Structures are placed on sand. A nutrient budget has determined it is unlikely that abalone ranching will have an impact on seagrass health. A seagrass monitoring plan may be required if the sediment sampling indicates a significant shift in nutrient levels. The plan, if required, would be approved by DoF in consultation with DBCA.
Sediments	Flinders Bay	To maintain the integrity, ecological functions and environmental values of the seabed and coast.	Elevation in nutrients in sediments and/or increased oxygen demand.	Bi-annual monitoring of sediments 2014-2019 has shown no impact of OGA aquaculture activities on surrounding sediments. MEMP requires OGA to undertake sediment samples every 5 years as of January 2020.
Macroalgal wrack	Flinders Bay	To maintain the integrity, ecological functions and environmental values of the seabed and coast.	Wrack processes altered by operation	Minimal potential for adverse impact. Structures unlikely to restrict the amount of wrack transiting the area. Holding effect of structures temporary and abalone do not consume a significant amount of total wrack biomass.
Changes to sea floor from apparatus	Flinders Bay	To maintain the integrity, ecological functions and environmental values of the seabed and coast.	Area of sand under ABITAT altered to be hard surface habitat.	Minimal potential for adverse impact. Sand habitat is abundant within the lease and wider Flinders Bay. At maximum production 15,000 structures cover only 1% of lease area.
Fish Abundance & distribution	Flinders Bay	To maintain the integrity, ecological functions and environmental values of the seabed and coast.	Abalone aquaculture equipment will increase fish abundance in lease area.	There will be no management response to increased local fish populations as this is seen as a positive outcome of the abalone ranching activity.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Response Protocols and Management
Waste Management	Flinders Bay	To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards	Increase in wastes leads to negative visual or environmental consequences	Waste management plan will avoid such emissions. Waste management protocol requires all waste and mortalities to be returned to land for appropriate disposal. All continuous loop plastics to be cut. All plastics with the potential to float to be cut.
Antibiotics & Genetically Engineered Material	Flinders Bay	To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards	Negative impacts on natural ecosystems.	Comply with the Abalone ECOP. No use of antibiotics, growth hormones or GE products is intended in this proposal.
Recreational Fishers	Lease site within Flinders Bay	To ensure that existing and planned recreational uses are not compromised	Large exclusion zones could alienate fishing grounds from recreational fishers.	OGA has no issue with recreational fishing from a vessel within the lease, as long as daily management practices (e.g. diving) are not impacted. Recreational diving would not be permitted.
Visual Amenity	Around the lease area	To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable	The intrusion of man-made objects into otherwise natural vistas.	Apparatus are all submerged and therefore invisible from the surface.

4 IMPACT ON PROTECTED SPECIES AND OTHER AQUATIC FAUNA

Marine Fauna

During assessment of the original OGA proposal in Flinders Bay, concerns were raised on the potential for negative interactions with marine fauna, especially cetaceans and pinnipeds. During the first years of operation, OGA has raised the issue of developing a monitoring plan in conjunction with the Department of Biodiversity, Conservation and Attractions (DBCA). However, to date there have been zero interactions recorded with the potential for harm to marine fauna and DBCA has not rated this issue as of sufficient risk to commit resources to the development of a monitoring program. Thus a full monitoring program is no longer proposed. Rather OGA will maintain a management and alert program as below.

Following observations during the first years of operation, the only apparent (but very low probability) risk to whales, seals or other wildlife would be entanglement in moorings of the lease markers. In that regard, OGA will follow the ACWA Environmental Code of Practice for the Sustainable Management of Western Australia's Abalone Aquaculture Industry, That outlines the procedures for entanglement of marine mammals. Below is an excerpt from the above mentioned from page 32:

“A “Marine Mammal Entanglement Plan” currently exists within the Department of Biodiversity, Conservation and Attractions (DBCA) - Nature Conservation Division, and MUST be invoked in the event of a mammal entanglement in aquaculture equipment. It contains the Standard Operating Procedure for all Cetacean entanglements. People who see an entangled or beached whale SHOULD keep a safe distance from the animals and contact DPW's Wildcare Helpline on (08) 9474 9055 or Marine Emergencies on (08) 9483 6462.”

OGA is aware of the following legislation relating to the conservation of Cetaceans and Pinnipeds in Australian waters:

- All cetaceans in Commonwealth waters are protected under the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act).
- The three whale species found in Flinders Bay are threatened species declared to be specially protected under the Wildlife Conservation Act 1950.
- The New Zealand Fur Seal and Australian Sea Lion are specially protected under the Wildlife Conservation Act 1950 and it is an offence to disturb these animals.
- Departmental licenses are needed for tourism operators and wildlife viewing is controlled by a code of conduct, which includes minimum approach distances, maximum boat speeds and use of lights in the vicinity of wildlife. These restrictions also apply to non-commercial activities. For example, boats must stay 100 m away from a whale or if a whale approaches a boat, it must be in neutral or move the vessel at less than five knots away from the whale (Department of Environment and Conservation, 2004)

OGA field staff are required to report any negative interaction with marine fauna. Should any entanglement or negative interaction with marine fauna occur, OGA will immediately notify the local DPaW office.

5 BIOSECURITY

General Facility Information

5.1.1 Introduction

OGA is committed to upholding world-class biosecurity standards to protect its own abalone farming interests and the natural abalone stocks in Australia, and to ensure its farming activities do not adversely impact on the Australian marine environment.

Within this MEMP, biosecurity is defined as the sum of all procedures in place to protect living organisms from contracting, carrying and spreading diseases and other non-desirable health conditions. This MEMP identifies biosecurity risks and includes protocols on how to maintain the health of stock including translocation procedures, sanitation procedures and procedures for excluding pathogens. This section of the MEMP addresses biosecurity matters for OGA's proposed site and lease in Flinders Bay, off Augusta.

The Biosecurity Plan is a requirement under s.92A of the *Fish Resources Management Act 1994*.

OGA is the holder of Aquaculture Licence No. 1630, which authorises the aquaculture of greenlip abalone at a site in Flinders Bay. Because the current licensed site is within 5 NM of a productive reef area, as defined in the 2013 *Abalone Aquaculture Policy*, the operation is subject to additional biosecurity measures. These measures have been determined in consultation with DoF and are set out in the relevant sections of this MEMP.

5.1.2 Layout of the Facility

Abalone juveniles arrive from the Bremer Bay hatchery by truck. Following examination of the health certificate for each batch abalone are assessed visually for signs of disease. Abalone are then transferred to vessels and taken to the lease where they are hand-placed on structures by divers.

The facility consists of ABITATs placed in lines on sandy seabed within the lease. Navigational markers are placed at each corner of the lease area and are maintained as per licence conditions.

Administrative Biosecurity Procedures

5.1.3 Record Keeping

- All completed records must be retained in the OGA office. Lot 331 UB Leeuwin Road Augusta.
- All translocation approvals and health certificates must be retained for a period of not less than 7 years.
- An accurate record of all translocations to, and harvest movements from the OGA/TOA sea ranching lease site must be maintained, including location and contact details of supplier, source, receiver, receiving site/facility, date of receipt or supply, and the numbers of abalone translocated for a period of not less than 7 years.
- Consignment notes must be forwarded to the Department of Fisheries, Albany District Office within 7 days as required under Aquaculture Licence condition.
- Record books must be kept by OGA for a period of not less than 7 years after the last date of entry.

5.1.4 Aquaculture Gear and Vehicles (Equipment)

- Equipment used to collect and transport stock from the hatchery in Bremer Bay to the grow out lease in Flinders Bay must be cleaned and disinfected prior to collection and following delivery (per Appendices 3 and 4)
- Dive Equipment, gear, vehicles and vessels used by divers on the OGA lease should be routinely cleaned and disinfected (per Appendices 3 and 4).

To have a biosecure site, best practice is to ensure no equipment is brought onto the site. All equipment worn or used (wetsuits, knives, boots, clothing etc) should be permanently located on site, and all personnel required to change into this gear upon entering the site.

OGA divers will change into wetsuits which are only used for OGA activities in this location. The same occurs for all gear used.

- No dive equipment and gear that has been used previously in any areas outside of the OGA lease is permitted to be used on the OGA lease (per Appendices 3 and 4).
- No diving equipment or other equipment that has been used on the OGA lease is permitted to be used for diving in other areas. Only equipment required for containment of stock during translocation will be moved between aquaculture sites, after appropriate disinfection per Appendices 3 and 4.
- Access to diving the lease is restricted to authorised staff only. All visitors must undergo an induction detailing biosecurity protocols. Employees must undergo induction and biosecurity protocol training.

- Aquaculture gear must not be moved between aquaculture sites unless the aquaculture gear is authorised and confirmed by the manager to be appropriately disinfected, per Appendices 3 and 4.

5.1.5 Staff, Contractors and Visitors

All staff are educated regarding their role in ensuring the biosecurity of the farm. This is done through an onsite induction, ongoing training and testing of the procedures. Inductions include information on the MEMP and the need to comply with its protocols. A copy of this MEMP is held in the OGA office. Visitors must complete and sign a bio-security induction form prior to being admitted on-site.

5.1.6 Access to and Movement in the Facility

Only authorised personnel are permitted to dive the OGA abalone leases. Visitors or contractors permitted by management to dive the leases must undergo an induction detailing bio-security protocols.

Operational Biosecurity Procedures

5.1.7 Health Management and Certification

Biosecurity Risks

Stock for the OGA marine farm will be sourced only from the hatchery facility operated by 888 Abalone Pty Ltd and located in Bremer Bay. 888 Abalone is operating according to an approved, Biosecurity Plan which is subject to audit by DoF.

The identified biosecurity risks are set out below.

- Transfer of contaminated abalone, pests, or diseases from the 888 Abalone Farm to the OGA sea ranching lease, or from OGA sea ranching lease to the 888 Abalone Farm.
- Movement of contaminated water used in transportation of stock from the 888 Abalone Farm to the OGA sea ranching lease or from OGA sea ranching lease back to 888 Abalone Farm.
- Movement of contaminated equipment such as wetsuits, boats, dive equipment, stock containers (bags) from waters outside of the OGA sea ranching lease to the OGA sea ranching lease or to the 888 Abalone Farm.
- Movement of contaminated equipment such as wetsuits, boats, dive equipment, stock containers (bags) from waters of the OGA sea ranching lease to waters outside of the OGA lease or back to 888 Abalone Farm premises.

Biosecurity Protocols

- The 888 Bremer Bay Abalone Hatchery is a bio-secure facility. It is regularly inspected and monitored by DPIRD staff, trained in bio-security protocols, practices and procedures.
- OGA have a copy of the 888 MEMP and bio-security policy at its Augusta office.
- Abalone held in the 888 abalone farm must undergo disease testing as specified by the Department.
- Before being transported to the Ocean Grown Abalone Ranch in Augusta, juvenile abalone must undergo testing and a health certificate must be obtained from the Department's Principal Health Pathologist.
- All sampling and testing protocols will be specified by the Department as specified in the Abalone Aquaculture Policy. They are not specified in this MEMP because the regime may change from time to time, for example as new tests become available.
- Abalone stocked in marine-based grow-out farms must be visually inspected according to an agreed inspection schedule specified in the MEMP; a record must be maintained of all inspection times.
- All unusual mortalities and the associated circumstances must be recorded and records maintained and made available to the Department upon request. An unusual mortality is defined as more than 5% of unexplained mortality on a growout module (ABITAT).
- Prior to release of stock from transport vessel into the lease the stock will be examined thoroughly by trained employees for signs of disease (such as weak adhesion; retraction of mantle; excessive mucous production) and marine pests.
- All abalone stock must be inspected by employees who have undertaken OGA inductions when servicing the lease for the presence of disease, other pests, morbidity or any unusual behaviour which may indicate the presence of disease (such as weak adhesion; retraction of the mantle; or excessive mucous production).
- Any unusual deaths or behaviour must be reported immediately to the OGA Manager and if it can't be explained, then the Department of Fisheries' Chief Executive Officer must be notified (via the Principal Fish Pathologist or the Translocation Officer) within 24 hours (see Appendix 2).
- Any mortalities (shells) collected on the lease must be kept and records of mortality must be maintained on the OGA central database.
- OGA divers will inspect the abalone regularly. It is expected on at least a weekly basis, weather permitting, as part of routine husbandry management procedures.

5.1.8 Feeds

No feeds are to be used.

5.1.9 Waste Management

The facility generates only minimal waste. Wastes are associated with vessel operations, and normal activities.

- All waste plastics, ropes and other waste materials to be taken ashore disposed of in an approved landfill.
- Plastic wastes with entanglement risk are cut in case any are lost prior to return to land.

5.1.10 Disposal of Waste

Any waste materials from the operation will be correctly disposed of in landfill. Shells removed from the site are also disposed to landfill. Records are to be kept of the number of abalone shells from mortality collected by divers (see Section 5.2.1).

5.1.11 Quarantine and Testing Areas

No quarantine or testing areas exist. Abalone on the OGA lease have been through extensive quarantine and testing protocols prior to release on the ranch to ensure only abalone of certified disease free status are released.

5.1.12 Prevention of Escapes

The OGA ranch is surrounded by sand and abalone moving on sand are highly vulnerable to predation. Abalone are a highly sedentary species and once placed on the abalone habitats they rarely move. No specific management measures are proposed to avoid off-lease migration.

Incident and Emergency Procedures

- OGA will notify the Department of Fisheries in writing within 24 hours of becoming aware, or suspecting, that any fish (abalone) at the lease is or may be affected by:
 1. any disease specified in Fish Resources Management Regulations 1995 and Biosecurity and Agriculture Management Act 2007.
 2. any disease or condition that cannot be identified (unexplained moribund stock or stock mortality).
- Management of, and response to a disease occurrence or outbreak, (including eradication or containment) will occur under advice and direction from the Department of Fisheries and the Department's Principal Fish Pathologist.
- OGA will take all reasonable precautions to prevent the spread of any disease or condition in fish at the place where aquaculture is carried out.
- All samples will be sent to the Department of Fisheries Fish Health Unit as directed by the Department of Fisheries' Principal Fish Pathologist (see Appendix 2 for contact details). Note: Contact the Department of Fisheries for approval and direction on the timing and protocol for transport of samples as required.

- The standard record sheet (Appendix 3) detailing the event must be completed and a copy sent to the Department of Fisheries Principal Fish Pathologist within 24 hours. The original report must be filed in the site office in a secure cabinet.

Dealing with Suspected Diseased Abalone

This document is designed to ensure a quick response in the case of unexplained mortality or disease with the aim of achieving the following outcomes:

- Control the spread of an infectious disease within the farm
- Control the spread of disease beyond the farm boundaries into the wider marine environment or coastal bioregion.

All abalone are checked regularly by staff divers who are trained to identify signs of disease. If high, unexplained mortality, abalone showing clinical signs of disease or mortality above 2% is noted then the supervisor will be notified. If the supervisor cannot explain the mortality or there are clinical signs of disease then the Standard Operating Protocols in case of Unexplained Mortality (below) are implemented. All employees will be trained to recognise the various symptoms that sick and dead abalone exhibit and the trigger points that require them to notify the supervisor.

Any rates of mortality greater than 5% or signs of disease shall be reported to the Department of Fisheries' Senior Fish Pathologist and the Translocation Officer, within 24 hours.

Legislative requirements: Regulation 69 of Western Australia's Fish Resources Management Regulations 1995 stipulates that:

- (d) the holder of the licence must notify the CEO in writing within 24 hours of becoming aware, or suspecting, that any fish at the place where aquaculture is carried on under the licence is or may be affected by —
 - (i) any scheduled fish disease; or
 - (ii) any disease or condition that the person cannot identify; and
- (e) the holder of the licence must notify the CEO in writing within 14 days of becoming aware, or suspecting, that any fish at the place where aquaculture is carried on under the licence is or may be affected by any disease or condition other than one referred to in paragraph (d) if, within those 14 days, the holder of the licence has not eradicated the disease or condition by taking all reasonable steps to do so; and
- (f) the holder of the licence must take all reasonable precautions to prevent the spread of any disease or condition in fish at the place where aquaculture is carried on under the licence; and
- (g) where the holder of the licence is aware or suspects that fish at the place where aquaculture is carried on under the licence are affected by any disease or condition, that person must ensure that no water is discharged from the place to a natural waterway without the prior written approval of the CEO; and
- (h) the holder of the licence must ensure that fish at the place where aquaculture is carried on under the licence which the holder of the licence is aware, or suspects, is diseased or contaminated is not removed from the place without the prior written permission of the CEO.

[Regulation 69 amended in Gazette 13 Aug 1999 p. 3826; 6 Jul 2007 p. 3389; 24 Sep 2013 p. 4438.]

6 AUDITING

Internal Auditing Process

ACWA will develop and implement a process for internal audits. To align with best practice for abalone ranching, audits will be conducted against the ACWA Environmental Code of Practice for the Sustainable Management of Western Australia's Abalone Aquaculture Industry and this MEMP.

External Auditing

An independent audit of compliance with the MEMP will be undertaken at the expense of the licence holder within 4 months of any written directive by the DoF CEO.

The DoF will undertake inspections annually, or more frequently if required, to confirm compliance with the MEMP. The level of compliance will be commensurate with risk and may need to include a contribution from the beneficiary.

OGA is also participating in a 3rd party certification project for Aquaculture Stewardship Council accreditation, ensuring compliance with best environmental practice and sustainability.

7 REPORTING

Sediment Monitoring

OGA will submit a report to DoF within three months of each sediment monitoring occasion. OGA to undertake sediment monitoring every 5 years as of January 2020. Results of the sediment monitoring are made available on the OGA website.

Annual MEMP Report

OGA will submit its annual MEMP report one month prior to licence renewal date in each calendar year.

8 MEMP REVIEW

Amendments

Should the lease or operating procedures of OGA change significantly from those of this document, or should OGA identify a problem with biosecurity or environmental management, the MEMP will be updated to reflect necessary changes.

In addition, OGA may review and update the MEMP for DoF approval if deemed necessary.

9 References

- ANZECC & ARMCANZ (2000) Australian Guidelines for Water Quality Monitoring and Reporting, National Water Quality Management Strategy. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT
- Department of Environment and Conservation (2006) Ngari Capes Marine Park Indicative Management Plan.
- Department of Environment and Conservation (2013) Ngari Capes Marine Park Management Plan 2013– 2023. Department of Environment and Conservation, Perth WA
- DOF (2013) Abalone Aquaculture Policy in Western Australia. Western Australian Department of Fisheries, Perth, WA
- IMO (2009) Guidelines for the placement of artificial reefs London Convention and protocol / UNEP. International Maritime Organization, London
- Kelsey P (2002) Aggregated emissions of total nitrogen and total phosphorus to the Blackwood and Scott River catchments. A submission to the National Pollutant Inventory Western Australia.
- Thomson-Dans C, Ryan K, Hill A (2003) The capes coast : a diverse coastal and marine environment. Dept. of Conservation and Land Management, Perth, W.A
- Western Australian Planning Commission (2003) The Augusta-Walpole Coastal Strategy - Background Information.

APPENDICES

- 1- Nutrient budget
- 2- Disease Contacts and Reporting
- 3- Standard Operating Protocols for Unusual Mortality
- 4- Disinfection and Cleaning Procedures
- 5- OGA Aquaculture Licence

APPENDIX 1: Nutrient Budget

Nutrient budget below as prepared by BMT Oceanica, 9th May 2014 on behalf of Ocean Grown Abalone Pty Ltd



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MEMORANDUM

ATTN:	Brad Adams	CC:	Mark Bailey
ORGANISATION:	Ocean Grown Abalone	FROM:	Martin Lourey
PROJECT NO:	1123	DATE:	9 May 2014
SUBJECT:	A nutrient budget for abalone aquaculture in Flinders Bay		

1. Introduction

Ocean Grown Abalone Pty Ltd (Ocean Grown Abalone) proposes to ranch greenlip abalone on artificial reefs constructed in Flinders Bay, south of Augusta, in south-western Australia. Juvenile hatchery reared greenlip abalone will be introduced to the reefs at ~40 mm shell length and grown out for a period of 2–3 years. Ocean Grown Abalone aims to achieve a harvest rate of 100,000 kg/year from approximately 50,000 m² of reef surface area.

Ocean Grown Abalone has three leases in Flinders Bay, each 400,000 m² in size for a total of 1,200,000 m² (1.2 km²). Once construction is complete, the artificial reef footprint will occupy less than 1% of the total area of these leases. The reefs will be constructed on open areas of bare sand with areas of seagrass nearby. The Department of Parks and Wildlife requires an assessment of the potential impact of nutrients arising from a greenlip abalone culture of 100,000 kg/year on seagrass meadows in Flinders Bay.

The cultured abalone will utilise naturally occurring feeds (drift and attached macroalgae and benthic microalgae) for nutrition and will not be fed supplemental feeds. As a result, any nutrient-related stress must result from the introduction of reef substrate and grazers to areas of bare sand near seagrass meadows rather than an increase in overall nutrient load. Abalone produce ammonia directly via respiration and indirectly as organic waste, so localised nutrient enrichment could occur with the change in habitat and increased grazer biomass.

This memorandum uses a simple but conservative nutrient budget to determine the significance of nutrients from the cultured abalone relative to other local nutrient sources to determine whether the modified habitat and use of the area is a significant nutrient-related risk to the health of seagrass meadows. In keeping with the simple and conservative nature of this approach, hydrodynamics and dilution effects will not be calculated but the abalone are in deep (15–20 m) water and Flinders Bay is oceanic, with strong tides, swell and surge so the nature of the dynamic environment will be generally considered.

2. Nitrogen sources and budget assumptions

Western Australian coastal waters are nitrogen limited (Lourey et al. 2006) so this budget models nitrogen dynamics as the nutrient species likely to drive community change. Flinders Bay is rarely studied and as such estimates have mostly been derived from available data compiled for nearby systems (Oceanica 2013). It is assumed that these best available estimates are broadly representative. The intention of the budget is to provide a contextual reference to evaluate the relative contribution of total nitrogen (TN) from naturally occurring nutrient sources available to

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abalone compared to other potential nitrogen inputs. The primary nitrogen sources and sinks considered were:

- surface water (rivers and drains)
- groundwater
- atmosphere
- sediments
- recycled beach wrack.

2.1 Surface water sources (rivers and drains)

Annual surface water TN loads calculated by DAL et al. (1995) were incorporated into the budget and are likely lower (more conservative) than discharge into the study area (Water and Rivers Commission 2002).

2.2 Groundwater

Annual TN loads from groundwater sources (DAL et al. 1995) were incorporated into the budget. Groundwater flow from a superficial aquifer, the Leederville aquifer and the older, larger Yarragadee aquifer flow towards the coast (DoW 2010) and we assume the DAL et al. (1995) estimate broadly represents discharge further south.

2.3 Atmospheric Sources

Atmospheric sources of nitrogen were extrapolated from Martinick and Associates (1993), who estimated atmospheric deposition rates from ambient nitrogen dioxide levels in Warnbro Sound (0.15–0.2 tonnes/km² yr⁻¹).

2.4 Sediments

The release rate of TN from sediments was estimated from values collected near Perth (Rosich et al. 1994).

2.5 Wrack

The release of TN from seagrass wrack was determined from the average TN flux rate from wrack as determined by modelled simulations (Cunningham 2010).

3. Nitrogen budget

For the purposes of this investigation, we make the comparison between nutrient sources on a per square kilometre basis. Although the influence of the various nutrients sources varies spatially, consistent scaling of each estimate allows direct comparison of the relative proportion of each nutrient source without having to model of culture and habitat distribution. The flux of nutrients resulting from abalone culture is calculated in two ways: a) derived from the available food stocks and b) derived from typical wastage patterns associated with creating biomass.

The proposed culture of abalone in Flinders Bay utilises a naturally occurring diet and because it does not incorporate supplemental feeding cannot be considered a nutrient source. The proportion of the available standing stock of nitrogen available to be redistributed by abalone (assumed to be equivalent to wrack + phytoplankton) is 0.9% of the total available nitrogen (most (89%) being stored in the sediments) (Table 3.1). Only a small proportion of this available standing stock is accessible by the abalone because the artificial reefs occupy just 1% of the substrate.

Table 3.1 Standing stocks of nitrogen

Stores	Low TN (t/km ²)	High TN (t/km ²)	Typical TN (t/km ²)	Proportion (%)
Ambient seawater	2	8	4	9.3
Sediments	19	263	39	89.3
Seagrass	0.04	0.45	0.19	0.45
Wrack	0.19	0.53	0.35	0.82
Phytoplankton	0.02	0.12	0.03	0.08

Notes

1. TN = total nitrogen, t = tonnes, km = kilometre

If all of the 1% of standing stock accessible by the abalone was turned over each day (unlikely and therefore conservative) and waste nitrogen released amounted to 60% of that consumed (Neori et al. 2000) an annual nitrogen flux of 0.85 t/km²/year would result. This is an order of magnitude lower than the typical flux from the existing sediments (7 t/km²/yr) (Table 3.2).

Table 3.2 Sources of nitrogen

Sources	Low TN (t/km ² /yr)	High TN (t/km ² /yr)	Typical TN (t/km ² /yr)	Proportion (%)
Atmosphere	0.15	0.2	0.17	2.1
Surface water	n/a	n/a	1.3	15.4
Groundwater	n/a	n/a	0.09	1.1
Sediment flux	3	11	7	81.5
wrack flux	n/a	n/a	7 x 10 ⁻¹⁵	<0.001

Notes

1. TN = total nitrogen, t = tonnes, km = kilometre, yr = year.

A more conservative estimate of nitrogen waste can be estimated from the proposed yield with the added benefit of also yielding an estimate of annual nitrogen removal arising from harvesting the product. Assuming the nitrogen content in shellfish is around 1.4% (Shumway et al. 2003) and 40% of the available nitrogen is assimilated (Neori et al. 2000) around 1.2 t/km²/year is expected to be removed as product (Table 3.3). If waste nitrogen amounts to 60% of the total amount assimilated (Neori et al. 2000), mass balance dictates that 1.75 t/km²/year will be released as waste (Table 3.3). This is twice the estimate derived from the standing stocks of available food but is likely a substantial overestimate (and therefore conservative) because it is based on 100 t/year (the annual harvest) and not necessarily the stock being carried at any one time. Increasing the harvest three-fold (to 300 t/year) increases the annual nitrogen removal to 3.5 t/km²/year and the projected waste release to 5.3 t/km²/yr (Table 3.3). The projected waste discharge at 300 t/year harvest is still lower than the typical nitrogen flux from the sediments already expected in the area (7 t/km²/yr) (Table 3.2).

Table 3.3 Nitrogen harvested and waste nitrogen released based on mass balance

Annual harvest		Nitrogen harvested (t/km ² /yr)	Nitrogen waste (t/km ² /yr)
t/yr	t/km ² /yr		
100	83	1.2	1.8
200	167	2.3	3.5
300	250	3.5	5.3

Notes

1. t = tonnes, km = kilometre, yr = year.

4. Discussion

The aim of this investigation was to use a simple nutrient budget to determine whether abalone aquaculture represents a nutrient related risk to seagrasses in Flinders Bay. The abalone culture does not incorporate supplemental feeding and relies on a naturally occurring diet only. There would be no increase to the anthropogenic nutrient load in Flinders Bay arising from this proposal. Indeed, the proposal effectively acts as a nutrient sink with the removal of 100 t of product ($\sim 1.2 \text{ t/km}^2/\text{year}$ of nitrogen) annually.

Although there would be no increase in nitrogen loads, there is the potential for localised changes in nutrient patterns caused by the introduction of artificial reef and abalone as grazers onto areas of bare sand. Conservative estimates of nitrogen release based on mass balance calculations involving a) standing stock of available food sources and b) the nitrogen requirements and wastage patterns associated with seafood production suggest that the nitrogen flux arising from directing organic matter into abalone culture at each site is small compared to existing fluxes from sediments expected at those sites. The worst case estimates for 100 t/year abalone culture suggest they would release less than one-fifth of the TN presently expected to be released from the sediments. This worst case nitrogen flux is within the natural variation in the expected sediment nitrogen flux arising from differences in sediment characteristics, background organic material loads and environmental conditions (e.g. temperature).

The relatively low localised nitrogen flux expected from the introduction of abalone culture relative to existing sources suggests that background nutrient concentrations near seagrass meadows of Flinders Bay is unlikely to be significantly elevated above those already present and there would be a low risk to seagrass health. This result is independent of uptake by phytoplankton and has not considered mixing processes. In a nutrient limited and dynamic environment such as Flinders Bay it is likely nitrogen released from the culture system will be consumed and/or diluted to near background levels and within natural variation within a short distance of release.

The proposed abalone culture would make no additional contribution to the annual nutrient budget in Flinders Bay and localised changes are expected to be small relative to existing anthropogenic and natural sources, and below levels expected to be measurable. This simple budgeting approach cannot capture the full complexity inherent in nutrient processes (i.e. hydrodynamics, cycling processes and uptake) but it is conservative and the results suggest that the impacts from nutrients on seagrasses should be immaterial.

5. References

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APPENDIX 2: Disease Contacts and Reporting

Disease/stock kill hotline: (08) 9368 3286 / 1800 815 507 / 0438 102 307

Responsible department: Fish Health Unit, Department of Fisheries

If you see any evidence of any fish diseases, or unexplained deaths in cultured or wild fish, report it to the Fish Health Unit as soon as possible.

Dr Jo Bannister | Aquatic Animal Pathologist
DPIRD Diagnostic and Laboratory Services
Sustainability and Biosecurity
Department of Primary Industries and Regional Development
3 Baron-Hay Court South Perth WA 6151
t +61 (0)8 9368 3286 | f +61 (0)8 9474 1881 | w dpiird.wa.gov.au

Website for reporting diseases:

<http://www.fish.wa.gov.au/Sustainability-and-Environment/Aquatic-Biosecurity/Identifying-Pests-And-Diseases/Pages/Report-A-Pest-Disease-Or-Fish-Kill.aspx>

Instructions for sample collection:

<http://www.fish.wa.gov.au/Sustainability-and-Environment/Fisheries-Science/Aquatic-Animal-Health/Pages/Disease-Diagnostic-Service.aspx>

APPENDIX 3: Standard Operating Protocols for Unusual Mortalities

Standard Operating Protocols in the case of unexplained mortality (SOP):

1. Ensure that you and your staff are not in any immediate danger.
 - Any mortalities are to be placed in a sealed leak proof container to be disposed of.
 - Ensure adequate OH&S precautions are taken to protect those handling any infected abalone or any fixative chemicals involved.
2. Identify the size of the stock mortality and record a detailed description.
 - Accurate record keeping is essential in the epidemiology and controlling a disease in the early stages. Fill out “Stock Mortality Record” (see below) accurately and ASAP.
 - Keep an eye out for any other tanks exhibiting similar symptoms or high mortality.
3. Identify the potential cause of the stock mortality, fill out Stock Mortality Record (below).
4. Contact aquatic animal health expert or fish pathologist (Appendix 2). Any rates of mortality greater than 5% or signs of disease shall be reported to the Department of Fisheries’ Principal Fish Pathologist and the Translocation Officer, within 24 hours (contact information at the start of this document).
5. Act on the Principal Fish Pathologist’s (Department of Fisheries) or aquatic animal health expert’s advice.
6. If the cause of the mortality still has not been identified, take samples of live sick abalone, water and feed. Directions on how to do this are found in appendix 5.
7. Contact the Principal Fish Pathologist (Department of Fisheries) to obtain approval for, and directions regarding transport the samples.
8. Pack and transport samples to the laboratory (see below)
9. Continue to liaise with Department of Fisheries fish pathologist and aquatic animal health expert as required or directed.

Stock Mortality Record

Item	Response
Date	_____
Time	_____
Reported by	_____
Management notified	<input type="checkbox"/> Yes <input type="checkbox"/> Not yet
Department of Fisheries notified	<input type="checkbox"/> Yes <input type="checkbox"/> Not yet
Manager responsible	_____
Origin/source of stock and transfer date / /
Biomass of stock	_____ (kg)
Approximate number of stock	_____
Average size of stock	_____ (g)
Average age of stock	_____ (months)
Recent growth rate	<input type="checkbox"/> Normal <input type="checkbox"/> Abnormal
Time in culture or holding structure	_____ (months)
Time since last handling, grading, or other stressful event (type of stress: _____)	_____ (days, months)
Time before scheduled harvest	_____ (months)
Average daily mortality in past 3 months	_____
Average daily mortality in past week	_____
Is the current daily mortality 20% or higher than the average daily mortality over the previous 3 months?	<input type="checkbox"/> Yes* <input type="checkbox"/> No

* Initiate emergency SOP

Behavioural changes (from Herfort 2004) — All species of aquatic animals have characteristic protection, food-gathering and breeding behaviours. Abnormal behaviour, such as a decrease in feeding, could indicate stress from disease. Some behavioural changes can occur across groups of species, or even across different phyla.

In abalone, decreased feeding, increased activity or piggy backing can indicate that they are under stress.

In case of abalone affected by the disease Abalone Viral Ganglioneuritis (AVG) look for the following signs:

The most likely sign is, abalone that are weak and/or dead.

In some abalone you may see:

- Protrusion of the mouth part; and/or
- Edges of the foot curling inwards, leading to exposure of clean shiny shells; and/or
- Abalone showing signs of stiffness and or rigour, commonly referred to as 'hardfoot' or 'hardfish'. In such cases the abalone remain alive but are easily removed from the habitat module, remain rigid and fail to right themselves if inverted.

Note any unusual behaviour of any other organisms that may have been in contact with water from the affected habitat module.

Stock behaviour — ☐ Normal ☐ Abnormal (explain below)

Potential Cause of Stock Mortality

A kill or mortality involving a range of aquatic species will normally indicate an environmental problem (such as toxicity or oxygen depletion). Deaths limited to one species only are more likely to be caused by an infectious agent (Herfort 2004).

Potential factors that could have caused the deaths include: (*tick ✓ the ones which may have caused the abnormal mortality*)

- ☐ rapid change in temperature
- ☐ rapid change in salinity (eg from flooding of river)
- ☐ contaminates (eg toxin, chemical)
- ☐ incoming water polluted or contaminated (eg toxin, chemical)
- ☐ pathogen (disease, parasite) outbreak
- ☐ toxic microalgae
- ☐ other: _____.

Environmental changes — These could include storms, full moon, large swell, temperature fluctuations, unusual weather events and so on. Please consider/observe all aspects of the culture environment.

Immediate environmental conditions — ☐ Normal ☐ Abnormal (explain below)

Taking abalone samples and preparing them for testing.

Only staff trained in the handling of diseased abalone are to be in contact with suspect or diseased stock.

Cleaning and disinfection protocols must be observed when preparing samples for testing.

NOTE: Some fixatives are carcinogenic. All samples should be taken by an adequately trained and qualified person. Ensure all appropriate personnel protective equipment is used when dealing with fixatives (eg formalin) or other chemicals.

Abalone samples:

It is important that the freshest samples are provided, so live sick abalone are the best samples for the experts to determine the cause of the mortality. Therefore, as a precaution, immediately take some near-dead (moribund) stock and place them into a holding container for later transport.

For adult stock, take 15–30 live, sick stock and the same number of normal stock for comparison (if possible) – keep the live sick and normal (healthy) stock separate. For larvae, spat, seed or small juveniles, take 25–50 specimens of each (sick and normal).

Once you have collected the live sick abalone it is important to fix them in a few different ways to ensure that accurate tests can be completed. Before starting any of the bottom fixing take what photos you can and mark down any observations. (eg length, weight, colour etc)

1. Consult with the Fish Health Unit of the Department of Fisheries for approval and directions to transport samples.
2. Take 5 to 10 of the samples and pack on ice to be sent fresh to the lab.
3. Take 5 to 10 of the samples and put in the freezer for later testing if required.
4. Take 5 to 10 of the samples and swab either a pustule or blister or withdraw some blood and squirt onto the swab. Then shuck the abalone and dissect laterally across the foot. Finally place a small incision in the gut before storing in a 10% buffered solution of formalin.

Then pack all samples in preparation for sending to a laboratory. Any samples fixed for bacteriology need to be sent for analysis straight away as they become unviable in a short period of time.

Taking Water Samples - Water quality

Check current water quality. Is it within the preferred ranges for:

Temperature	<input type="checkbox"/> Yes <input type="checkbox"/> No
Salinity	<input type="checkbox"/> Yes <input type="checkbox"/> No
Turbidity	<input type="checkbox"/> Yes <input type="checkbox"/> No
pH	<input type="checkbox"/> Yes <input type="checkbox"/> No
Dissolved oxygen	<input type="checkbox"/> Yes <input type="checkbox"/> No
Ammonia and nitrate	<input type="checkbox"/> Yes <input type="checkbox"/> No

Check for water discolouration, films, bubbles, smells or other evidence of a chemical or poison spillage, or toxin input.

For all samples, consult with the Fish Health Unit of the Department of Fisheries for approval and directions to transport samples.

Water sampling protocol:

Take a water sample (>250 mL) from at the surface of the habitat unit for potential further analysis.

- Rinse all sample containers several times in the water to be sampled before the sample is taken to ensure accurate test results.
- Keep the water samples cool and out of direct sunlight. Fill the container to the brim and exclude bubbles of air.
- Treat samples for algal testing with iodine killing solution (acidified Lugol's iodine solution). Add enough killing solution (1–5 mL) to achieve a strong tea colour.
- Seal samples securely to prevent spillage and preferably double-pack them in a Styrofoam box that is contained within a cardboard carton.

It is very important to accurately label any water or stock samples taken for analysis. Make a note as to when and where the samples were collected at the mortality site and ensure the samples are sent as quickly as possible to the laboratory. As your sample may be one of a dozen arriving in the lab, the absence of a label slows down the processing of the package.

Transport details for samples

All samples should be packed into sealed leak proof (watertight) bags and placed with ice packs inside a sealed foam box. Foam boxes must be of a type that has walls at least 2cm thick. As required, check with the transport company or the post office for advice on what chemicals are able to be sent, and enquire about any other Australia Post requirements. All external surfaces of packaging must be disinfected prior to transporting.

Abalone Samples:

Once the abalone samples have been prepared for testing and transport they should be sent to the address below or as directed by the Fish Health Unit of the Department of Fisheries. Contacts details found in Appendix 2.

Water Samples:

Once the water samples have been prepared for testing and transport they should be sent to the below address or as directed by the Fish Health Unit of the Department of Fisheries.

APPENDIX 4 : Bio-Security Induction Forms



Staff Bio-Security Induction

All new staff must complete this induction before leaving the induction area.

Bio-Security Policy.

Ocean Grown Abalone Ltd is committed to upholding world-class bio-security standards to prevent the introduction of diseases and pests to its marine aquaculture lease in Augusta and the local surrounding marine environment.

By ticking the below boxes, you accept and understand the information that has been explained to you by either the Managing Director, Dive Manager or Processing Manager

Boxes must be ticked:

- ☐ I UNDERSTAND AND ACCEPT THE BIO SECURITY GUIDELINES EXPLAINED TO ME REGARDING ENTRY INTO, AND WORKING AT THE FLINDERS BAY ABALONE RANCH IN AUGUSTA

- ☐ I HAVE BEEN TOLD WHERE THE MEMP IS KEPT AND ACKNOWLEDGE THAT IT IS EXPECTED THAT I WILL BE FAMILIAR WITH THIS DOCUMENT BEFORE MY TRIAL PERIOD ENDS.

- ☐ I UNDERSTAND THAT THERE ARE A NUMBER OF BIOSECURITY RISKS TO THIS BUSINESS AND THAT THESE HAVE BEEN EXPLAINED TO ME (INCLUDING SIGNS AND SYMPTOMS OF SICK ABALONE).

- ☐ I UNDERSTAND NOT TO BRING CONTAMINATED CLOTHING/ ANIMALS/ EQUIPMENT ONTO THE RANCH OR PROCESSING FACILITY THAT HAVE BEEN IN CONTACT WITH THE OUTSIDE MARINE ENVIRONMENT, ABALONE, OR OTHER ABALONE FARMS.

IF YOU HAVE ANY FURTHER QUESTIONS, CONCERNS OR CANNOT ADHERE TO THE ABOVE INSTRUCTIONS THEN PLEASE NOTIFY ONE OF OUR OGA MANAGERS.

NAME OF STAFF CONTACT PH.:

SIGNATURE OF STAFF DATE:



Visitor Bio-Security Induction

All visitors must complete this induction before leaving the induction area.

Bio-Security Policy.

Ocean Grown Abalone Ltd is committed to upholding world-class bio-security standards to prevent the introduction of diseases and pests to its OCEAN RANCH in FLINDERS BAY, AUGUSTA and the local surrounding marine environment.

By ticking the below boxes you acknowledge and accept that you are entering an aquaculture system where bio-security is paramount and that you will adhere to our simple quarantine guidelines.

Boxes must be ticked:

- ☐ ALL VISITORS MUST BE ACCOMPANIED BY AN OGA REPRESENTATIVE AT ALL TIMES AND ADHERE TO ANY BIOSECURITY PROTOCOLS.
- ☐ I HAVE BROUGHT NO AQUATIC ORGANISMS OR PLANTS ONTO THIS BIOSECURE SITE.
- ☐ I WILL WASH MY HANDS BEFORE LEAVING THE INDUCTION AREA.
- ☐ VISITING DIVERS MUST PRESENT EVIDENCE OF RECREATIONAL DIVE QUALIFICATION.
- ☐ VISITING DIVERS TO UNDERGO DIVE PLAN INDUCTION FROM OGA DIVE MANAGER.
- ☐ I HAVE BEEN PROVIDED OGA APPROVED DIVE SUIT AND EQUIPMENT.
- ☐ I HAVE NO UNDISINFECTED CLOTHING OR EQUIPMENT THAT HAS BEEN IN CONTACT WITH THE OUTSIDE MARINE ENVIRONMENT, ABALONE OR OTHER ABALONE FARMS.

**** IF YOU HAVE ANY FURTHER QUESTIONS, CONCERNS OR CANNOT ADHERE TO THE ABOVE INSTRUCTIONS THEN PLEASE NOTIFY ONE OF OUR OCEAN GROWN ABALONE LTD REPRESENTATIVES.**

PURPOSE OF VISIT.....

NAME OF VISITOR

CONTACT PH.:

SIGNATURE OF VISITOR

DATE:

THANK-YOU FOR YOUR PATIENCE AND CO-OPERATION

APPENDIX 5: Disinfection and Cleaning Procedures

Cleaning and Disinfection Requirements

The key to any of the procedures described in this document is the **regular** routine cleaning of boats and equipment. Ensure that all organic material including shell, weed and mucus is cleaned from surfaces as these may inactivate disinfectant agents.

Cleaning and disinfection are required to prevent introduction of pests, known diseases, such as Abalone Ganglioneuritis, as well as unknown diseases. The majority of disease incursions are from previously unknown/ unidentified diseases.

Areas and equipment requiring cleaning and disinfection include:

- Divers and diving equipment including wetsuits, fins, masks, weight/ buoyancy vests, regulators, hookah gear, shark pods and other abalone harvesting equipment
- Fish bins, catch bags, baskets, nets, knives
- Equipment used to collect and transport juvenile stock
- Boats including hulls, decks, deck equipment, anchors, anchors/ mooring lines
- Abalone holding tanks
- Pumps and pipe-work associated with holding tanks
- Vessel deck areas
- Protective clothing including gumboots and wet weather pants etc
- Transport vehicles, boxes and associated equipment
- Personnel and clothing

Principles of cleaning and disinfection include:

- After cleaning and disinfection has occurred, aquaculture gear must be completely dry before it is reused.
- Concentrations of disinfection agents may be diluted when applied to a wet surface, and thus concentrations must be modified accordingly.
- Wastewater is to be contained on land and should not re-enter the marine environment.
- Any cleaning using chemicals must take into consideration and meet relevant legislative requirements regarding chemicals, such as detergent agents, discharged or released into the environment.

OGA vessels should keep on board all equipment required for cleaning and disinfection, such as brushes, brooms and scrapers. In addition pressure sprayers/ cleaners are useful but those used on-water should be low volume, in order to manage biosecurity risks of water runoff into the marine environment.

Misters & low pressure sprayer are useful for applying detergents and disinfectants to surfaces. High pressure water cleaners are useful for all stages of cleaning and disinfection and highly efficient at dislodging most types of environmental debris and biological matter.

Cleaning and Disinfection Methods

Procedures to Minimise the Risk of Transferring Aquatic Diseases through Diving & Fishing (*adapted from Fisheries Biosecurity: Abalone Wild Harvest Protocol 1, Dept of Primary Industries and Water Tasmanian Abalone Biosecurity Framework, Victorian Abalone Harvesting Code of Practice, AQUAVETPLAN Operational Procedures Manual Decontamination 2008*))

ROUTINE CLEANING is good biosecurity practice. The cleaning process involves a combination of physical and chemical procedures to remove soiling and inactivate any potential pathogenic organisms.

Appropriate Cleaning Agents

The following detergents are suitable for general cleaning purposes:

- Boats and vehicles: Specialised truck wash or boat cleaning detergents. These compounds are classified not hazardous and are available from a number of suppliers. Note: detergents contain compounds that can pollute coastal environments.
- Wetsuits and other diving equipment: Specialised wetsuit wash preparations or a liquid soap or shampoo.
- Fish bins, harvest bags, shark pods and nets: Heavily soiled equipment should be washed clean of soiling with fresh water at high-pressure, then soaked using a detergent suitable for soaking.
- People: Hands should be washed using soap, prior to and after handling equipment or animals. Clothing should be cleaned with laundry detergent.

Cleaning of Boats

- Routine cleaning can take place before the vessel leaves the area in which diving has taken place. Do not clean in transit. On water vessel cleaning must take into consideration and meet relevant legislative requirements regarding chemicals, such as detergent agents, discharged or introduced into the environment.
- Decks, diving equipment and other equipment should be hosed down with freshwater, washed with cleaning agent, rinsed with freshwater and left to dry in the sunlight after each trip. The use of high-pressure sprayers will aid the cleaning process.
- Operators should ensure that organic matter accumulated under carpets and other difficult to reach places is removed and the area rinsed with freshwater.
- Back bungs and scuppers (if present) should be undone to allow any water to drain out of the boat (preferably so that the water will drain to land rather than back into the sea) and any bilge areas should be rinsed thoroughly with freshwater.

Cleaning of Divers and Equipment

- At the end of diving, rinse all equipment in freshwater to remove salt.
- All equipment must be washed or sprayed with a wetsuit cleaning agent to remove traces of organic matter. Dive suits must be washed inside and out, and diving equipment can be immersed in large plastic bins with disinfectant. Immersion times are a minimum of 2 minute soak in warm water and detergent.
- All dive equipment can be rinsed in freshwater and sun dried or dried in a well ventilated area. All gear must be completely dry before it is reused.

Cleaning of people

- Ensure that all people who have come into contact with abalone or equipment, thoroughly wash their hands with soap/ detergent and freshwater.
- All clothing should be thoroughly cleaned with a laundry detergent.
- Wastewater should be managed to ensure it will not return to the marine environment.

Cleaning of vehicles

All vehicles and holding containers used to transport abalone from the hatchery to the marine farm will require cleaning and disinfection (see below).

Disinfection

Disinfection involves the use of appropriate disinfection agents, as per Appendix 3.

Disinfection is mandatory when moving from one location to another place (eg Augusta to Windy Harbour).

Disinfection is critical when sick, dead or abalone of suspect health are encountered. See Appendix 5 – “Dealing with Suspected Diseased Abalone” for additional information for dealing with suspected diseased abalone.

Routine cleaning protocols must be applied PRIOR to disinfection procedures. Detergent agents should be used for the removal of gross fouling or organic matter. Detergents will assist with removing the virus but may not kill or inactivate the virus. Product directions for disinfection agents should be followed and recommended personal protective gear be used, as recommended by product descriptions.

For all situations, OGA should have available, appropriate disinfection agents for use on-shore at the designated site, where wastewater will not return to the marine environment. The waste water may be discharged on to land subject to any municipal or other licence requirements to de-chlorinate the water before discharge. Be advised that chlorine may not be suitable for cleaning all equipment, therefore consider alternative disinfectants as per AQUAVETPLAN Operation Procedures Manual Decontamination).

On board vessel disinfection must take into consideration and meet relevant legislative requirements regarding chemicals, such as detergent agents, discharged or introduced into the environment.

Appropriate Disinfection Agents

(from the AQUAVETPLAN, Operational Procedures Manual Decontamination, 2008)

Common disinfection agents are:

1. Hypochlorite solutions (calcium hypochlorite $\text{Ca}(\text{OCl})_2$ or sodium hypochlorite), as chlorine. The active chlorine level needs to nominally exceed 100 parts per million (milligram per litre or gram per cubic metre of water). This should be let stand for at least one hour.

- As a guide: one milligram per litre or one grams per cubic metre of water will yield an active chlorine level nominally exceeding 100 parts per million.
- Adding one millilitre of a common commercial 120 gram per litre solution of "available chlorine" to each litre of waste water will yield 120 parts per million.
- Following disinfection, waste water may be discharged to a drain which flows to a municipal wastewater treatment facility, subject to any municipal or other licence requirements to dechlorinate or further treat the waste water before discharge.

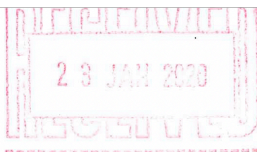
2. Virkon™ is an alternative to Hypochlorite and can be used in accordance with the *AQUAVETPLAN, Operational Procedures Manual Decontamination, 2008*. When using Hypochlorite or Virkon™ as immersion, the exposure contact time is to saturation plus a further two minutes.

Disinfectant of equipment using commercially available cleaning products, such as Truckwash™, Napisan™ or equivalent requires longer contact periods and product descriptions must be followed.

Full information regarding disinfection agents is located in the Aquavetplan. Disinfection must take into consideration and meet relevant legislative requirements regarding chemicals, such as disinfection agents, in regard to disposal / discharge.

APPENDIX 6 : OGA Aquaculture Licence

Department of
Primary Industries and
Regional Development

**Head Office**

140 William Street, PERTH WA 6000

(by appointment only)

Locked Bag 4, Bentley Delivery Centre, WA, 6983

Telephone: (08) 6551 4444

Email: enquiries@dpird.wa.gov.au

www.dpird.wa.gov.au

ABN: 18 951 343 745

Western Australia Fish Resources Management Act 1994 Regulations 127-128

Licence No: **1630**
Fee: **\$363.00**

AQUACULTURE LICENCE**Name and Business Address of Licence Holder**

OCEAN GROWN ABALONE LIMITED
PO BOX 86
FREMANTLE WA 6959

Pursuant to section 92 of the Fish Resources Management Act 1994, the licensee named above is hereby authorised to engage in the aquaculture of the fish specified in Schedule 1 on the land and/or waters specified in Schedule 2 to the extent of the activities specified in Schedule 3 and subject to the conditions specified in Schedule 4.

Schedule 1 - Species:

GREENLIP ABALONE (*Haliotis laevis*)

Schedule 2 - Location:

All that portion of territorial water located in Flinders Bay, Augusta within the boundary described and coloured green on Site Plan AL-0009

Schedule 3 - Method:

HATCHERY CULTURE/GROWOUT CULTURE IN THE MARINE ENVIRONMENT

Schedule 4 - Conditions and Restrictions:

Page Number 1 of 5 Pages

Receipt Details: IDCA1630 08/01/2020 2020 - 151 EFTPOS \$455.00 FISHVrc



Department of
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www.dpird.wa.gov.au

ABN: 18 951 343 745

Western Australia Fish Resources Management Act 1994 Regulations 127-128

Licence No: **1630**

Condition No 1,630 - Ocean Grown Abalone Pty Ltd

1. Interpretation

(1) In the conditions on this licence -

Fish Health Pathologist means an employee of a laboratory facility that is accredited by the National Association of Testing Authorities, Australia;

Principal Research Scientist Fish Health means the person holding or acting in the office of that name;

site means the area specified in Schedule 2 of this Licence.

(2) The following terms used in the conditions on this licence have the same meaning as in the Fish Resources Management Act 1994 -

- CEO;
- Department;
- record.

2. Requirement for aquaculture lease

No abalone are to be stocked or cultured at any area of the site, unless the licence holder is authorised under an aquaculture lease to occupy or use that area for aquaculture.

3. Method

Abalone are only to be cultured on grow-out structures situated on the ocean floor.

4. Aquaculture gear

(1) No more than 15,000 grow-out structures are to be used at any one time.

(2) Any grow-out structure used must have a total surface area, not including the base that rests on the sea bed, of less than 10 square metres.

(3) Any grow-out structure must be constructed of concrete from materials sourced from a supplier in Australia.

(4) The licence holder must on demand from a Fisheries Officer remove a sample from a grow-out structure for testing

5. Source of stock

Abalone must not be stocked at the site unless they have been sourced from a hatchery authorised for abalone aquaculture.

6. Health management and certification

(1) A health certificate, issued by a Fish Health Pathologist is required for all abalone being moved from a land-based facility to the marine environment. Abalone must not be moved from a land-based facility or onto any part of the site unless the licence holder has first obtained confirmation from the Principal Research Scientist Fish Health that a copy of a health certificate for those abalone is in the possession of the Principal Research Scientist Fish Health.

(2) Any abalone being moved from a land-based facility to the site must be accompanied at all times by a copy of the health certificate issued for the purpose of this condition.

7. Stocking density and biomass

(1) Abalone must not be cultured at a density that exceeds a biomass of three kilograms whole weight per square metre of grow-out surface, calculated from a scientific sampling protocol designed to provide a mean biomass estimate that has a 97.5% probability of being less than the 3 kg target.

(2) The licence holder must comply with an R&D plan to be agreed between the licence holder and the Department's

Page Number 2 of 5 Pages



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ABN: 18 951 343 745

Western Australia Fish Resources Management Act 1994 Regulations 127-128

Licence No: **1630**

Fisheries Science and Resource Assessment team.

8. Feeds and other substances

No growth hormones, antibiotics, feed or any genetically engineered substance of any kind is to be used at the site, or transported on any boat used for or in connection with the aquaculture activity, unless otherwise authorized in writing by the Principal Research Scientist Fish Health.

9. Sediment quality monitoring program

(1) The licence holder must comply with the sediment monitoring program outlined in the associated MEMP.

(2) A written report, including data and an analysis of those data, must be provided to the CEO within three months of each sampling period.

(3) The licence holder must make sediment monitoring results publicly available if requested.

10. Marking and lighting and moorings

(1) Subject to paragraph (2), marking of the site must be installed and maintained in accordance with Category 2 as set out in the document "Guidance Statement for Evaluating and Determining Categories of Marking and Lighting for Aquaculture and Pearling Leases/Licences (2010)".

(2) No marking is required if the site is only used for bottom culture and all aquaculture gear is at a depth greater than five metres below the lowest tide.

(3) All surface lines that form part of the aquaculture gear must have a minimum diameter of 24 millimetres and a maximum length of 1.5 times the water depth.

11. Inspection

The abalone on each of the grow-out structures in each area are to be visually inspected for any sign of clinical disease or any material, significant or unusually high levels of mortalities, starting from [the date the variation is given effect]. An inspection must be undertaken not more than 15 days after the previous inspection.

12. Disease testing

(1) Dead or moribund abalone must be collected whenever possible and preserved. At the end of each month, and at any time when the total number of preserved abalone reaches 30, the samples must be provided in preserved condition to the Principal Research Scientist Fish Health for testing. The transport and any testing will be at the cost of the licence holder. "Preserved" means frozen unless otherwise directed by the Principal Research Scientist Fish Health.

(2) Additional disease testing of abalone, whether during transport to or from the site or situated at the site, must be carried out as required by notice in writing by the Principal Research Scientist Fish Health. The additional testing will be at the cost of the licence holder.

(3) All testing undertaken for the purposes of this condition must be in accordance with the document Assessment and management of the health risks associated with abalone (*Haliotis* spp.) in Western Australia [date] or as otherwise specified by the Principal Research Scientist Fish Health.

13. Biosecurity

(1) In addition to the requirements under regulation 69 of the Fish Resources Management Regulations 1995, the licence holder must undertake the actions required at paragraph (2) where the licence holder -

- (a) suspects that any fish at the site are affected by disease; or
- (b) becomes aware of any material, significant or unusually high levels of mortalities of fish or of any mortalities caused by, or potentially caused by, disease at the site; or
- (c) becomes aware of any signs of disease in fish at any part of the site.

(2) Where any of the circumstances in paragraph (1) arise, the licence holder must -

Page Number 3 of 5 Pages



Department of
Primary Industries and
Regional Development

Head Office

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(by appointment only)

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Telephone: (08) 6551 4444

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ABN: 18 951 343 745

Western Australia Fish Resources Management Act 1994 Regulations 127-128

Licence No: **1630**

- (a) immediately notify an officer of the Fish Health Section of the Department by telephone of the level of mortality or signs of disease; and
- (b) follow the directions of the Principal Research Scientist Fish Health in relation to providing reports, samples of fish and other things at such times as the Principal Research Scientist Fish Health requires.

14. Use of a boat

(1) Any boat being used for, or in connection with, transporting any abalone, gear or person to or from the site must not be used during the voyage for any purpose that is not related to the activity being conducted under the authority of this licence.

(2) Any boat that is used during any voyage for any purpose that is not related to the activity being conducted under the authority of this licence must not, during any subsequent part of the voyage be used for, or in connection with, transporting any abalone, gear or person to or from the site.

(3) Any voyage undertaken using a boat for any purpose relating to the activity being conducted under the authority of this licence must be the shortest practicable and most direct route between the site and the marina or other boat launching facility at Augusta.

(4) No boat may be used for any purpose relating to the activity being conducted under the authority of this licence other than:

- i. Kon Dios, [ID: 79397];
- ii. Chelby-Anne, [HIN: AU-TWAO19477AX3, Reg. No. DU298];
- iii. Tin Thing, [ID: 28560];
- iv. Barge, [HIN: AU-TWA050839CP0, Reg. No. C1492];
- v. Abalone Endeavour, [ID: 6284]; and
- vi. such other boat as authorised in writing by the CEO.

15. Removal from site

Abalone being moved from the site must remain 'in-shell' until delivered to a licensed processing facility or to a Fish Health Pathologist.

16. Processing

Abalone must not be processed on the site or at sea.

17. Consignment Notes

Prior to any abalone being moved from the site, a consignment note must be prepared in triplicate in a form approved by the CEO, and:

- a) the number of individual abalone must be recorded on the consignment note;
- b) the original of the consignment note must be securely attached to the receptacle, container or package containing the abalone to the place where the abalone are being transported;
- c) the duplicate copy of the consignment note must be sent to the Busselton Office of the Department of Fisheries within seven days of the abalone being moved from the site; and
- d) the triplicate copy referred to in (a) must at all times be maintained in a secure place within the premises of Lot 615, Light Industrial Area, Augusta WA 6290, for a period of seven years.

18. Record Keeping

- (1) The licence holder must make and keep in a safe place accurate and timely records of:
 - i. the date of moving any grow-out structure to, or removing any grow-out structure from, the site and the number of grow-out structures moved;
 - ii. the total number of grow-out structures at each area of the site at any time;
 - iii. the number and size of abalone moved onto or from each area of the site, including the time and date of movement; and any mortalities during movement
 - iv. the estimated number of abalone being kept each month at each area of the site;
 - v. the number and size of abalone harvested and removed from each area of the site;
 - vi. the time, date and details of observation of any inspection of the abalone on the growout structures;

Page Number 4 of 5 Pages



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- vii. all mortalities, both in total and as a percentage of total stock; and
- viii. all health certificates issued to it whether by a Fish Health Pathologist or otherwise.


(2) The licence holder must upon request from time to time provide the data on mortalities to the Principal Research Scientist Fish Health in a form approved by the Principal Research Scientist Fish Health.

(3) At all times the written records made and kept must be maintained in a secure place within the premises of Lot 615, Light Industrial Area, Augusta WA 6290, for a period of seven years.

***** END OF CONDITIONS *****

Term of Authorization: Monday, 6 January 2020 to Tuesday, 5 January 2021

File No: L643/12-4


as delegate for the

Chief Executive Officer

This licence must be produced to a Fisheries Officer on demand.

WARNING: This licence will have no effect until the imprint of the cash register or other authority is hereon.

Renewal - 08/01/2020

Attention

Fisheries legislation changes from time to time. To assist fishers, aquaculturists and members of the public to access fisheries legislation, the Chief Executive Officer has arranged for up to date fisheries legislation to be made available on the internet. Fisheries legislation may be viewed by logging on to the Department of Fisheries website (www.fish.wa.gov.au) and clicking on the Legislation link on the top of the home page. The Chief Executive Officer recommends that the licence holders and persons acting on their behalf (eg. employees), regularly access this legislation service and make themselves aware of the fisheries legislation that relates to their activities.