



5 October 2016

SEYCHELLES FISHING AUTHORITY

**Noise Impact Assessment for  
the Proposed Implementation  
of the Seychelles Mariculture  
Masterplan (MMP)**

**Submitted to:**

Ministry of Environment, Energy and Climate Change  
Environment Department  
P.O. Box 445  
Victoria, Mahé  
Republic of Seychelles

**DRAFT FOR COMMENT**

REPORT

**Report Number:** 1543656-308158-5

**Distribution:**

1 x Seychelles Fishing Authority  
1 x Golder





## Executive Summary

Golder Associates Africa (Pty) Ltd have been appointed by the Seychelles Fishing Authority (SFA) as independent environmental assessment practitioners (EAPs) for the purpose of conducting an Environmental and Social Impact Assessment (ESIA) for the proposed implementation of the Seychelles Mariculture Master Plan (MMP).

The Mariculture Master Plan (MMP), which would guide the development of an aquaculture sector in the Seychelles, comprises four main zones, namely:

- Land-Based Zone Aquaculture;
- Inshore Zone Aquaculture;
- Aquaculture Development Zones (ADZs); and
- Offshore Zone Aquaculture.

The Noise Impact Assessment as part of the ESIA has assessed the land based components, comprising the BQAF, the R&D facility and the water based sites of the ADZs as well as the Pilot Project cage site located near the BQAF.

The BQAF will be located adjacent to the Seychelles Fishing Authority buildings at Providence harbour, surrounded by existing light industrial, commercial and harbour related activities. The closest residential receptor is located approximately 550 m south west of the proposed site. No institutional and culturally-important sites are noted in the vicinity (< 1 km) of the proposed site.

The proposed Pilot Project cage site is located approximately 400 m offshore of the light industrial/ commercial area of Providence harbour. Potential noise sensitive receptors are therefore likely to be limited to marine life and tourists, divers and recreational boat users entering vicinity of the Pilot Project cage site on occasion.

The Aquaculture R&D Facility is located within the UNISEY premises in close proximity (< 50 m) to the institution’s education facilities (including laboratories, lecture rooms, etc.). Residential areas surround the University and proposed beach site.

The ADZs of the MMP occur at a distance greater than 2 km from land on average, with some ADZs located closer in areas which are uninhabited. Potential noise sensitive receptors are therefore likely to be limited to marine life and tourists, divers and recreational boat users entering the vicinity of the ADZ on occasion.

Significant existing noise sources identified in the vicinity of the proposed MMP components are summarised in Table I. These sources will characterise the baseline noise environment in which the MMP components will operate. It should be noted that this study excludes any underwater noise or acoustic impacts to marine life.

**Table I: Existing noise sources in the vicinity of the proposed MMP components**

MMP Component	Significant existing noise sources
BQAF and Pilot Project	Vehicle traffic: <ul style="list-style-type: none"> <li>■ Two main roads (Providence Highway and East Coast Road) running parallel to the coastline, between the proposed BQAF and residential areas; and</li> <li>■ Vehicles travelling to and from the various industries/ companies within the Providence Industrial Estate.</li> </ul>
	Providence Industrial Estate includes a variety of industrial, commercial and harbour related activities including (but not limited to):



MMP Component	Significant existing noise sources
	<ul style="list-style-type: none"> <li>■ Paint manufacturers &amp; products retail;</li> <li>■ Auto parts and repair industries;</li> <li>■ Mattress, foam and roofing manufacturers;</li> <li>■ Logistics companies;</li> <li>■ Food and beverage distributors;</li> <li>■ Timber suppliers;</li> <li>■ Vehicle hire; and</li> <li>■ Trading/ financial/ service based companies</li> </ul> <p>Boat traffic:</p> <ul style="list-style-type: none"> <li>■ The Providence Industrial Estate hosts small crafts harbours. It is assumed boats come and go from these harbours frequently.</li> <li>■ Recreational boat traffic from the surrounding residential areas and hotels are also anticipated to come and go frequently.</li> </ul> <p>A quarry is located approximately 900 m south west of the proposed site, adjacent the Providence residential area (&lt; 150 m to the closest resident). It is assumed the quarry is operational with noise sources including land excavation and heavy vehicles.</p> <p>Seychelles International Airport is located approximately 2.8 km from the proposed site. Aircraft are a significant, although short lived, source of noise.</p>
Aquaculture R&D Facility	<p>Vehicle traffic:</p> <ul style="list-style-type: none"> <li>■ Two main roads, Les Canelles and East Coast Road, run perpendicular and parallel to the coastline respectively; and</li> <li>■ Vehicles travelling in and around the University.</li> </ul> <p>Boat traffic volumes are anticipated to be low and limited to recreational boat users and small artisanal fishing boats</p> <p>University related activities:</p> <ul style="list-style-type: none"> <li>■ Communication and interaction as students move between lectures or institutional facilities; and</li> <li>■ Infrequent sporting events, likely to be limited to weekends.</li> </ul>
ADZs	<p>Boat traffic including:</p> <ul style="list-style-type: none"> <li>■ Larger vessels/ work boats on shipping routes (in the vicinity of M1 and M5);</li> <li>■ Boats frequenting dive sites and general leisure activities;</li> <li>■ Passenger boats (ferry's) providing transport between islands; and</li> <li>■ Fishing boats.</li> </ul> <p>Sand extraction activities in the vicinity of M2, M3, M4, and M5</p>

## IMPACT ASSESSMENT

### Construction phase

It is anticipated that the construction of the BQAF and Aquaculture R&D Facility will generate noise in excess of the ambient noise standards and pose a significant annoyance to those in close proximity to the activity particularly with regards to impact noise which is considered more intrusive than continuous noise.

Receptors at the University (in the vicinity of the Aquaculture R&D Facility) are likely to be more sensitive to elevated noise levels compared to receptors at the Providence Industrial Estate (location for the BQAF). At both sites however, noise impacts will be short lived and limited to the duration of the construction phase.

The potential impact of construction noise at the proposed BQAF and Aquaculture R&D Facility sites was assessed as being of *moderate* ( $SP = 48$ ) significance. Following mitigation measures the impact may be reduced to *moderate* ( $SP = 40$ ) significance.



It is assumed that the cage components for the Pilot Project and fish farms within ADZs will be prefabricated and assembled on site. It is therefore anticipated that the noise sources will be limited to the work boats transporting the prefabricated components to the various sites.

The potential impact of the work boats was assessed as being of *low* ( $SP = 27$ ) significance. Following mitigation measures the impact may be reduced to a *lower* ( $SP = 24$ ) significance.

### Operational phase

The MMP will have a lifespan of 25 years at the least, possibly much longer. The following sources are likely to generate noise during the operation of the MMP:

- Work boats servicing the Pilot Project and ADZ; and
- Life support systems at the BQAF and Research & Development Facilities, including:
  - Water treatment units;
  - Air blowers;
  - Oxygen generators;
  - Seawater pumps; and
  - Diesel generators (it is assumed this will only be used when electrical supply is interrupted).

Noise emanating from the workboats transporting staff, feed, stock and harvested fish to and from the Pilot Project and ADZs are likely to be in similar frequency and intensity ranges as those of existing commercial and artisanal fishing, tourism and transport operations. For marine mammals, the effects of the sounds from these sources are usually transitory, or the animals can habituate to such sounds with regular exposure. However, the range of effects can be large, and cumulative effects cannot be ruled out for the louder vessels.

The potential impact of the work boats was assessed as being of *Moderate* ( $SP = 30$ ) significance. Following mitigation measures the impact may be reduced to *low* ( $SP = 24$ ) significance.

Noise levels generated by the life support systems at the BQAF and Research & Development Facilities are anticipated to be low and continuous and have little/no impact on the baseline noise levels beyond the site boundary. Elevated noise levels may however result from the use of the diesel generators, although it is assumed the generators will only be used when electrical supply is interrupted (i.e. infrequently).

The potential impact was therefore assessed as being of *Moderate* ( $SP = 36$ ) significance. Following mitigation measures the impact may be reduced to *low* ( $SP = 27$ ) significance.

### Decommissioning phase

Noise impacts similar to those of the construction phase are likely to occur during the decommissioning of individual fish farms or components that comprise the aquaculture sector, but over a shorter period of time and restricted to the decommissioning and stripping of facilities. It is not anticipated that demolition of land based buildings will occur, however it may involve removal and transport of waste material to a waste management facility.

It is anticipated that the construction of the BQAF and R&D Facility will generate noise in excess of the ambient noise standards and pose a significant annoyance to those in close proximity to the activity particularly with regards to impact noise which is considered more intrusive than continuous noise.

It is assumed that the cage components for the Pilot Project and ADZ will be disassembled on site and transported. It is therefore anticipated that the noise sources will be limited to the work boats transporting the components back to the island.



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## NIA: SEYCHELLES MMP

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The potential impact of decommissioning noise at the proposed BQAF and R&D Facility sites was assessed as being of *moderate* ( $SP = 40$ ) significance. Following mitigation measures the impact may be reduced to *moderate* ( $SP = 32$ ) significance:

The potential impact of the work boats was assessed as being of *moderate* ( $SP = 30$ ) significance. Following mitigation measures the impact may be reduced to *low* ( $SP = 24$ ) significance:



## Table of Contents

<b>1.0 INTRODUCTION</b>	<b>1</b>
1.1 Project Description	1
1.1.1 Land-Based Zone Aquaculture	1
1.1.1.1 Research & Development Facility	1
1.1.1.2 Broodstock, Quarantine & Acclimation Facility	1
1.1.2 Inshore Zone Aquaculture	2
1.1.3 Aquaculture Development Zones (ADZs)	2
1.1.4 Offshore Zone Aquaculture	3
1.2 Study Area	3
<b>2.0 NOISE TERMINOLOGY</b>	<b>5</b>
<b>3.0 EFFECTS OF NOISE</b>	<b>5</b>
<b>4.0 BASELINE ENVIRONMENT</b>	<b>6</b>
4.1 Identification of Potential Noise Sensitive Receptors	6
4.2 Determination of the Baseline Noise Environment	9
<b>5.0 IMPACT ASSESSMENT</b>	<b>15</b>
5.1 Methodology	15
5.2 Legislation, Standards and Guidelines	16
5.3 Construction	17
5.4 Operation	20
5.5 Decommissioning	21
5.6 Summary of Environmental Impacts	23
5.6.1 Construction Phase	23
5.6.2 Operational Phase	23
5.6.3 Decommissioning Phase	24
<b>6.0 ENVIRONMENTAL MANAGEMENT PLAN FOR NOISE</b>	<b>24</b>
<b>7.0 RECOMMENDATIONS</b>	<b>29</b>
<b>8.0 REFERENCES</b>	<b>29</b>



**TABLES**

Table 1: Existing noise sources in the vicinity of the proposed MMP components..... 9

Table 2: Estimated baseline noise levels ..... 14

Table 3: Typical Rating Levels for Ambient Noise (SANS 10103)..... 14

Table 4: IFC Ambient noise level guidelines (2007) ..... 15

Table 5: Impact ranking matrix ..... 15

Table 6: Significance ratings ..... 16

Table 7: Seychelles noise standards..... 16

Table 8: Environmental Impact Assessment Matrix for the Construction Phase of the Proposed Seychelles MMP ..... 23

Table 9: Environmental Impact Assessment Matrix for Operational Phase of the Proposed Seychelles MMP ..... 23

Table 10: Environmental Impact Assessment Matrix for the Decommissioning Phase of the Proposed Seychelles MMP ..... 24

Table 11: Noise EMP ..... 25

**FIGURES**

Figure 1: Proposed Mariculture Master Plan project components ..... 4

Figure 2: Typical sound levels (source: <https://sites.google.com/site/laurenmcnany脾n/sound?mobile=true>, July 2016)..... 6

Figure 3: Noise sensitive receptors in the vicinity of the BQAF and Pilot facility ..... 7

Figure 4: Noise sensitive receptors in the vicinity of the Aquaculture R&D Facility ..... 8

Figure 5: Significant noise sources in the vicinity of the BQAF and Pilot Project ..... 11

Figure 6: Significant noise sources in the vicinity of the Aquaculture R&D Facility ..... 12

Figure 7: Significant noise sources in the vicinity of the Aquaculture R&D Facility ..... 13

Figure 8: Typical noise levels associated with commonly used construction equipment (modified from Work Safe New Zealand, 2015) ..... 18

**APPENDICES**

**APPENDIX A**

Document Limitations



## 1.0 INTRODUCTION

Golder Associates Africa (Pty) Ltd have been appointed by the Seychelles Fishing Authority (SFA) as independent environmental assessment practitioners (EAPs) for the purpose of conducting an Environmental and Social Impact Assessment (ESIA) for the proposed implementation of the Seychelles Mariculture Master Plan (MMP). This reports presents the qualitative noise impact assessment undertaken in support of the ESIA.

### 1.1 Project Description

The Mariculture Master Plan (MMP), which would guide the development of an aquaculture sector in the Seychelles, comprises four main zones, namely:

- Land-Based Zone Aquaculture;
- Inshore Zone Aquaculture;
- Aquaculture Development Zones (ADZs); and
- Offshore Zone Aquaculture.

#### 1.1.1 Land-Based Zone Aquaculture

Seychelles Inner Islands offer a limited opportunity for the culture of various species in contained land-based systems. These production systems would typically involve pumping ocean water onshore for use in tanks in Recirculating Aquaculture Systems (RAS) and/or flow-through systems where land allows. These systems typically offer excellent biosecurity and husbandry controls, however they are often energy inefficient and currently expensive systems to operate and as such are limited to the culture of very high value species.

A Research & Development Facility (R&D Facility) and Broodstock Quarantine & Acclimation Facility (BQAF) will be built on Mahé as part of land-based aquaculture. Both facilities will be multipurpose buildings and will be important for sustainable growth and development of the Mariculture Master Plan (MMP).

##### 1.1.1.1 Research & Development Facility

The R&D Facility will be developed in parallel to the Pilot Project at Providence, Mahé. The Pilot Project cages provide a grow-out facility for the fingerlings of different species produced at the R&D Facility. Fingerlings will be stocked from the nursery tanks into containers which will be placed on the workboat and transferred to the Pilot Project grow-out cages at Providence.

The R&D Facility will comprise a services building, water storage reservoir and water abstraction and discharge pipe.

The services building will contain essential life support infrastructure including water treatment units, air blowers, oxygen generators, and electrical works. Seawater will be pumped ashore into a storage reservoir. It will then be pumped into a header tank before being gravity-fed through a drum filter into the aquaculture systems. Water supply to the tanks will be via suspended pipes (overhead) and drainage will be via an outlet into a central channel. Wastewater will be drum filtered and drained into a settling pond before being discharged into the canal. A new jetty is being planned for fisherman and it is likely that the pipeline will follow this structure out to sea. Electrical supply will be obtained from the public service as well as a diesel generator.

##### 1.1.1.2 Broodstock, Quarantine & Acclimation Facility

The BQAF will comprise a quarantine and an acclimation area. Six quarantine tanks (7.4 m<sup>3</sup>) will be installed. These tanks will be located adjacent to the entrance of the BQAF to facilitate the rapid transfer of broodstock from the transport vehicle/vessel to the quarantine tanks. They will also be used to house batches of imported fingerlings, which will undergo strict quarantine measures prior to transfer to the pilot project cages. The quarantine area will be isolated to allow for sanitation once the pilot project fingerlings have been transferred to the cages. Two acclimation tanks (40 m<sup>3</sup>) for grouper and other large species, and four



acclimation tanks (22 m<sup>3</sup>) for snapper and pompano will be installed. Water supply to the tanks will be on a flow-through basis.

The quarantine section will be isolated from the acclimation facility and will be a RAS, while the acclimation facility will be a flow-through system. Total biomass in the acclimation facility (167 m<sup>3</sup>) will be around 250 kg while the quarantine facility (44.5 m<sup>3</sup>) will hold a maximum of around 60 kg biomass.

The life support infrastructure will include: water treatment units, air blowers, and electrical works. Seawater will be pumped ashore into a header tank before being gravity-fed through a drum filter into the aquaculture systems. Water supply to the tanks will be via suspended pipes (overhead) and drainage will be via an outlet into a central channel. Wastewater will be drum filtered before being discharged into a canal or existing storm water drain. Wastewater from the quarantine section will flow through a chlorine contact tank before being discharged.

Air blowers and oxygen bottles will be housed within the services building. Air supply lines to the aquaculture systems will be suspended (overhead). Electrical supply will be obtained from the public service as well as a diesel generator.

### 1.1.2 Inshore Zone Aquaculture

The inshore zone comprises sea-based areas within 2 km from the islands of Mahé, Praslin, La Digue, and potentially Silhouette and Romainville, which have been identified as suitable for aquaculture development.

The development of this zone will depend on the carrying-capacity scenario which is realised. Inshore finfish aquaculture is viable in the Seychelles Inner Islands on a small scale under specific conditionality. The objective of establishing small-scale inshore projects is to accommodate an entry point into the aquaculture sector by local Seychellois investors who may not have access to the quantum of capital required to establish an ADZ or offshore farm. The inshore projects will be primarily grow-out units in application and as such they will be reliant on commercial operators and government facilities for the supply of suitable stocking material as well as access to quality pelleted feed at competitive pricing. Small-scale operations will have exclusive access to the domestic market and as such direct competition with products from the commercial operations will be avoided.

It should be noted that this zone has potentially the highest user conflict due to its proximity to the shore and sensitive receptors.

*Note: This ESIA will not be assessing the inshore zone for environmental and social suitability (ESIA) for aquaculture production. Each potential inshore project will require a specific ESIA to determine impacts.*

### 1.1.3 Aquaculture Development Zones (ADZs)

This zone refers to finfish cage culture within identified Aquaculture Development Zones (ADZs) of the MMP. These cages will be serviced daily from land and occur at a distance greater than 2 km from land (the 2 km distance from shore criterion was applied only where the shore (in direct line of sight) was inhabited. In-depth analysis and research has been undertaken in order to select each ADZ based on environmental and ecological criteria.

An assortment of technologies can be applied to feeding fish in offshore cages. In the simplest form feeding is done by hand using scoops that are used to manually distribute feed pellets over the cage surface. Various types of equipment are available as a means of mechanising feeding operations and ultimately even a fully automated system could be used.

One such fully automated system is the use of feed barges combining feed silos, feeding equipment, monitoring systems and living facilities are the commonly used approach to off-shore aquaculture. Barges are scalable with production requirements and it is possible that a 100 tonne unit would be used per 1 000 tpa site, however this is more likely to occur for offshore sites (not covered under this ESIA).

The transport of harvest size fish from the grow-out sites to the onshore processing facility is done by the use of a well-boat. In mature industries it is common that this service can be outsourced to a third party operator but based on the early stage nature of the industry in the Seychelles it is assumed that a well-boat



would not be purchased by individual operators, however they may choose to combine and purchase one that services multiple operators and sites.

A large workboat will typically be required for the delivery of feed to the cage sites and general operations. A second boat may be required for the transport of employees. It is anticipated that cage sites may have a workboat permanently moored to the cages for emergencies.

### 1.1.4 Offshore Zone Aquaculture

Aquaculture extending greater than 5 km from land is termed Offshore Zone Aquaculture. This form of production is characterised by a fully industrial approach to aquaculture within the Seychelles EEZ but beyond 5 km from any of the islands. To accommodate the environmental and logistical requirements of this approach, leading technologies (as utilised in Norway) are applied at an industrial scale.

Products that could be successfully cultivated in the offshore zone using cage culture are high-value finfish.

*Note: This ESIA will not be assessing the offshore zone (> 5 km offshore cage aquaculture) for environmental and social suitability (ESIA) for aquaculture production. Each potential offshore project will require a specific ESIA to determine impacts.*

## 1.2 Study Area

The BQAF is located in Providence, Mahé (Figure 1). The site is located at the Providence Harbour adjacent to the shoreline providing convenient access to water supply and cost-effective pumping with minimal head (water pressure). Bulk infrastructure including port infrastructure, unused existing warehousing, electricity and fresh water is available at this site which also has existing road access. Facilities including ablutions and offices are also available on site. This site also has the benefit of being located adjacent to the SFA Providence Office.

The planned Pilot Project cage site will be located at Providence, Mahé (Figure 1).

The Seychelles Aquaculture R&D Facility will be located on the southern grounds of the University of Seychelles (UNISEY) and is easily accessible and well serviced by road networks. The area has a very gentle slope and is situated next to an artificial canal. The canal leads under the East Coast Road, into the sea, offering good access for water supply and waste discharge pipes from the facility into the sea with minimal environmental or aesthetic impacts (Figure 1).

The Aquaculture Development Zones (ADZs) of the MMP occur at a distance greater than 2 km from land on average, except where sections of coastline were deemed uninhabited or sufficiently screened by other smaller islands near to the coast, and thereby occur closer than 2km to land (Figure 1).



# NIA: SEYCHELLES MMP

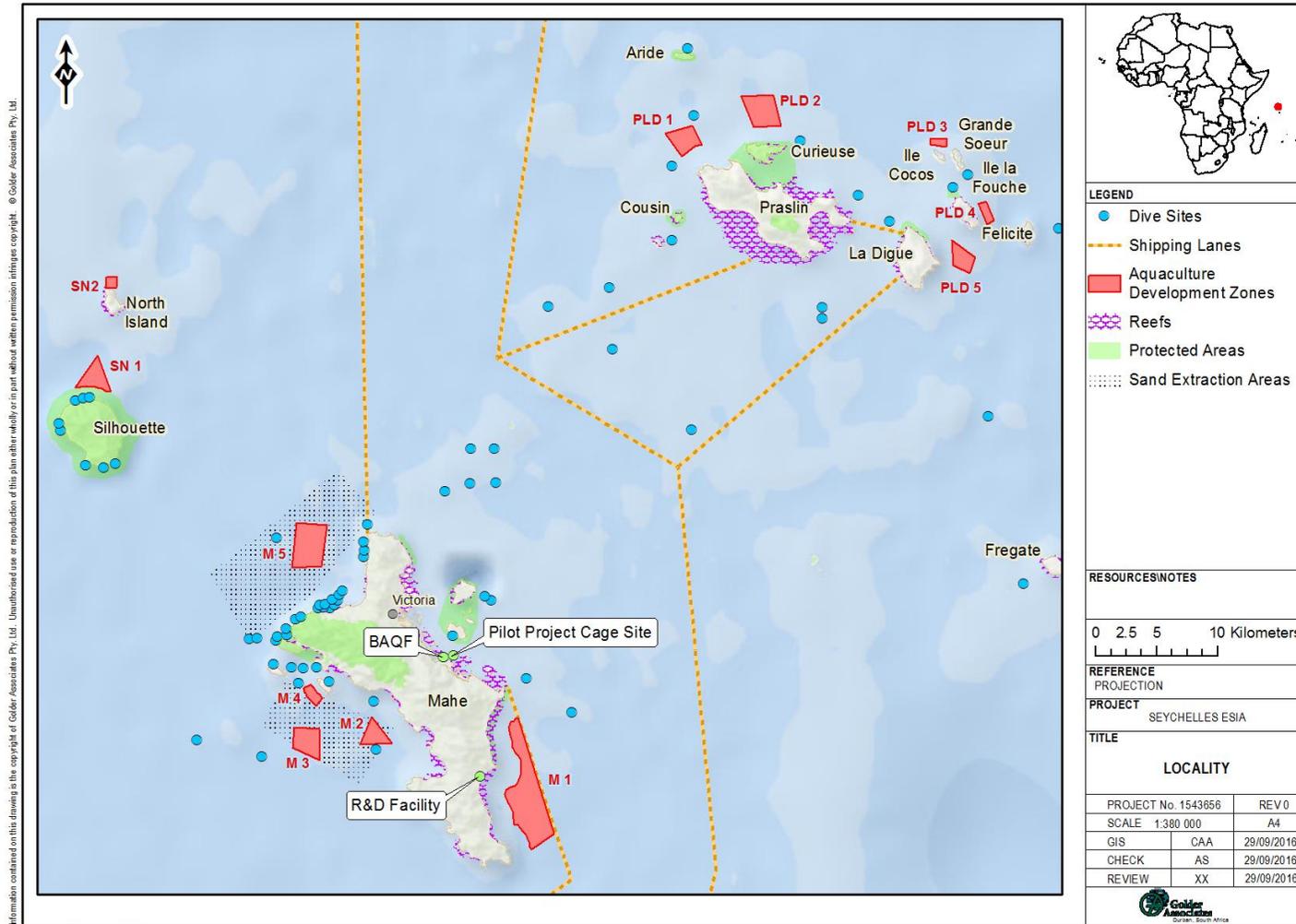


Figure 1: Proposed Mariculture Master Plan project components



## 2.0 NOISE TERMINOLOGY

Noise is defined as unwanted sound. The range of sound audible to humans is from 0 dB to 140 dB, from the threshold of audibility to the threshold of pain, respectively. The frequency response of the human ear is usually taken to cover the range from 20 Hz to 20,000 Hz. The human ear's response to sound is not equal across all frequencies; it is more sensitive in the mid-frequency range than in the low and high frequencies. In order to compensate for this in sound measurement equipment, a weighting (filter) is applied. The weighting which is most widely used and which correlates best with the human response to noise is the A-weighting. This is an internationally accepted standard for noise measurements to represent the human subjective response to sound.

For steady-state noise levels an increase or decrease of 1 dB(A) is not perceptible to most people under normal conditions, although this may be perceptible under laboratory conditions. An increase of 3 dB(A) is normally just perceptible under normal conditions. The 'loudness' of a noise is a purely subjective parameter, but it is generally accepted that an increase/decrease of 10 dB(A) corresponds to a doubling or halving in the perceived loudness.

External noise levels are rarely steady, but rise and fall according to surrounding activities. In an attempt to produce a figure that relates to this variable noise level to the subjective response a number of noise metrics may be used. The relevant noise parameter to this assessment is the  $L_{Aeq}$  level.

The  $L_{Aeq}$  level is the 'equivalent continuous A-weighted sound pressure level, expressed in decibels'. The  $L_{Aeq}$  is defined as:

*"The value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval,  $T$ , has the same mean square sound pressure as a sound under consideration whose level varies with time".*

It is a unit commonly used to describe construction noise, noise from industrial premises and is the most suitable unit for the description of many other forms of environmental noise.

## 3.0 EFFECTS OF NOISE

Noise generated as a result of project activities during the construction and operation stage of the development will result in an increase in ambient noise levels across the study area. The effects of this increase in noise will depend on the level of increase.

An increase in ambient noise levels of over 3 dB(A) will be noticeable to most people, although such an increase is unlikely to cause disturbance to leisure activities or sleep. An increase of 10 dB(A), however, is likely to cause disturbance or require people to modify their behaviour to avoid that disturbance, depending on the absolute level of noise.

Typical sound levels (dB(A)) are shown in Figure 2 for reference.

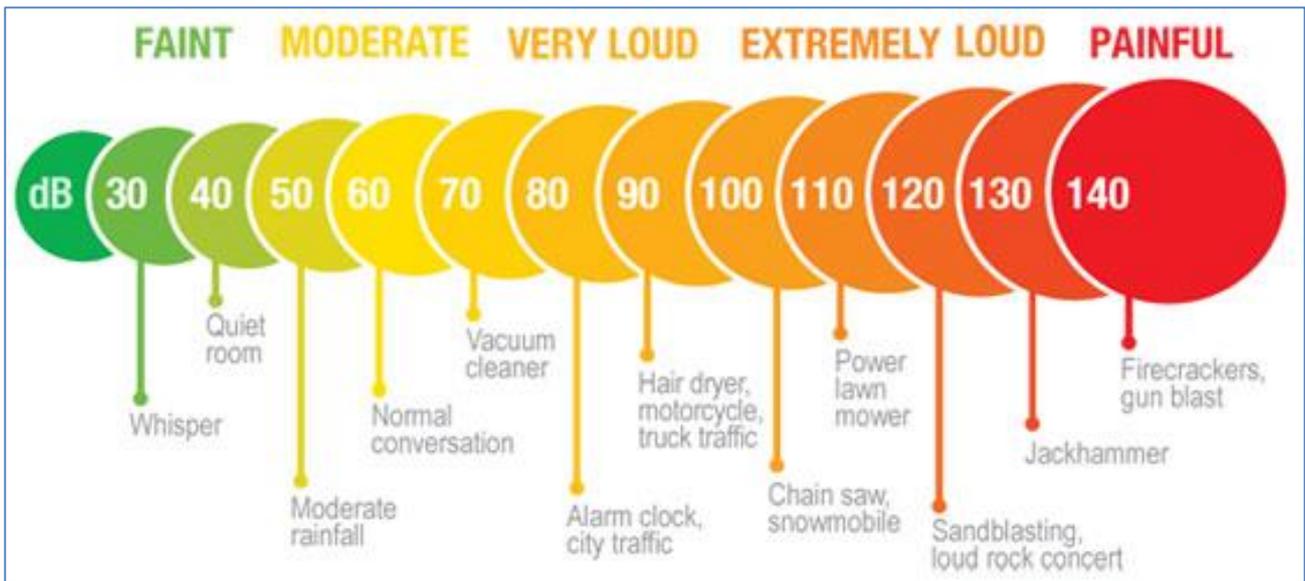


Figure 2: Typical sound levels (source: <https://sites.google.com/site/laurenmcnany脾n/sound?mobile=true>, July 2016)

## 4.0 BASELINE ENVIRONMENT

### 4.1 Identification of Potential Noise Sensitive Receptors

Noise impacts are typically experienced at relatively close proximity to the emitting source. The noise sensitive receptors are considered by SANS 10328:2008 to include residential dwellings, institutional and culturally-important sites, such as schools, hospitals and places of worship.

The BQAF will be located adjacent to the Seychelles Fishing Authority offices and small craft harbour at Providence, which is surrounded by existing light industrial, commercial and harbour related activities. The closest residential receptor is located approximately 550 m south west of the proposed site. No institutional and culturally-important sites are noted in the vicinity (< 1 km) of the proposed site (Figure 3).

The proposed Pilot Project cage site is located approximately 400 m offshore of the light industrial/commercial area (Figure 3). Potential noise sensitive receptors are therefore likely to be limited to marine life and tourists, and recreational boat users entering the vicinity of the Pilot Project on occasion as they pass by.

The R&D Facility is located within the UNISEY premises in close proximity (< 50 m) to the institution's education facilities (including laboratories, lecture rooms, etc.). Residential areas surround the University and proposed beach site (Figure 4).

The ADZs occur at a distance greater than 2 km from land (Figure 1) in general with some located closer to shore in areas where the coast is uninhabited or screened by smaller islands. Potential noise sensitive receptors are therefore likely to be limited to marine life and tourists, divers and recreational boat users entering the vicinity of the ADZ on occasion.



# NIA: SEYCHELLES MMP



Figure 3: Noise sensitive receptors in the vicinity of the BQAF and Pilot facility



# NIA: SEYCHELLES MMP

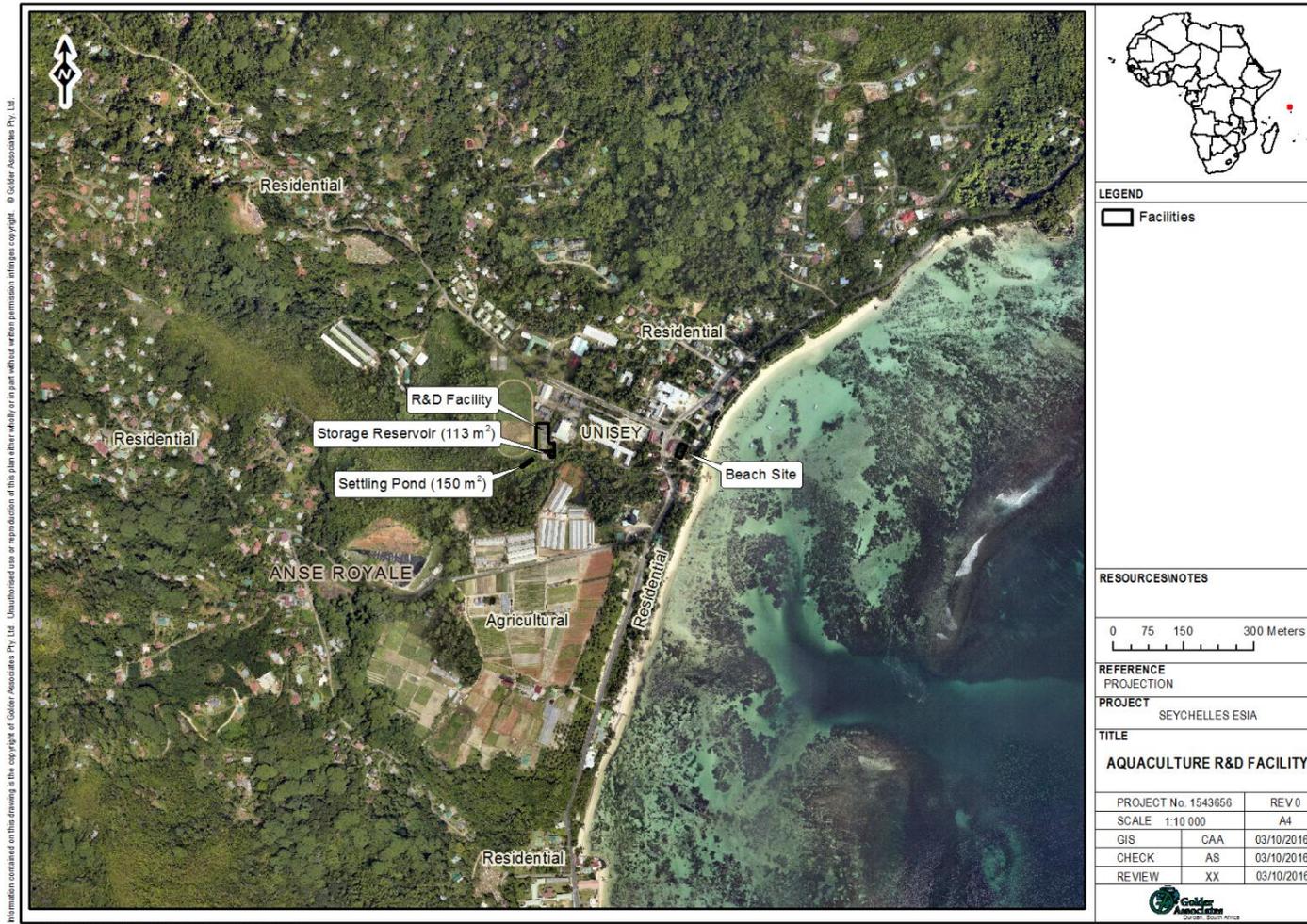


Figure 4: Noise sensitive receptors in the vicinity of the Aquaculture R&D Facility



## 4.2 Determination of the Baseline Noise Environment

Significant existing noise sources identified in the vicinity of the proposed MMP components are summarised in Table 1. These sources will characterise the baseline noise environment in which the MMP components will operate.

**Table 1: Existing noise sources in the vicinity of the proposed MMP components**

MMP Component	Significant existing noise sources
BQAF and Pilot Project (Figure 5)	Vehicle traffic: <ul style="list-style-type: none"> <li>■ Two main roads (Providence Highway and East Coast Road) running parallel to the coastline, between the proposed BQAF and residential areas; and</li> <li>■ Vehicles travelling to and from the various industries/ companies within the Providence Industrial Estate.</li> </ul>
	Providence Industrial Estate includes a variety of industrial, commercial and harbour related activities including (but not limited to): <ul style="list-style-type: none"> <li>■ Paint manufacturers &amp; products retail;</li> <li>■ Auto parts and repair industries;</li> <li>■ Mattress, foam and roofing manufacturers;</li> <li>■ Logistics companies;</li> <li>■ Food and beverage distributors;</li> <li>■ Timber suppliers;</li> <li>■ Vehicle hire; and</li> <li>■ Trading/ financial/ service based companies</li> </ul>
	Boat traffic: <ul style="list-style-type: none"> <li>■ The Providence Industrial Estate hosts smallcrafts harbours. It is assumed artisanal, semi-industrial and small industrial fishing boats as well as other boat users come and go from these harbours frequently.</li> <li>■ Recreational boat traffic from the surrounding residential areas and hotels are also anticipated to come and go frequently.</li> </ul>
	A quarry is located approximately 900 m south west of the proposed site, adjacent the Providence residential area (< 150 m to the closest resident). It is assumed the quarry is operational with noise sources including land excavation and heavy vehicles.
	Seychelles International Airport is located approximately 2.8 km from the proposed site. Aircraft are a significant, although short lived, source of noise.
R&D Facility (Figure 6)	Vehicle traffic: <ul style="list-style-type: none"> <li>■ Two main roads, Les Canelles and East Coast Road, run perpendicular and parallel to the coastline respectively; and</li> <li>■ Vehicles travelling in and around the University.</li> </ul>
	Boat traffic volumes are anticipated to be low and limited to recreational and smaller artisanal fishing boat users  University related activities: <ul style="list-style-type: none"> <li>■ Communication and interaction as students move between lectures or institutional facilities; and</li> <li>■ Infrequent sporting events, likely to be limited to weekends.</li> </ul>
ADZs (Figure 7)	Boat traffic including: <ul style="list-style-type: none"> <li>■ Larger vessels/ work boats on shipping routes (in the vicinity of M1 and M5);</li> <li>■ Boats frequenting dive sites;</li> <li>■ Passenger boats providing transport between islands; and</li> <li>■ Fishing boats.</li> </ul>

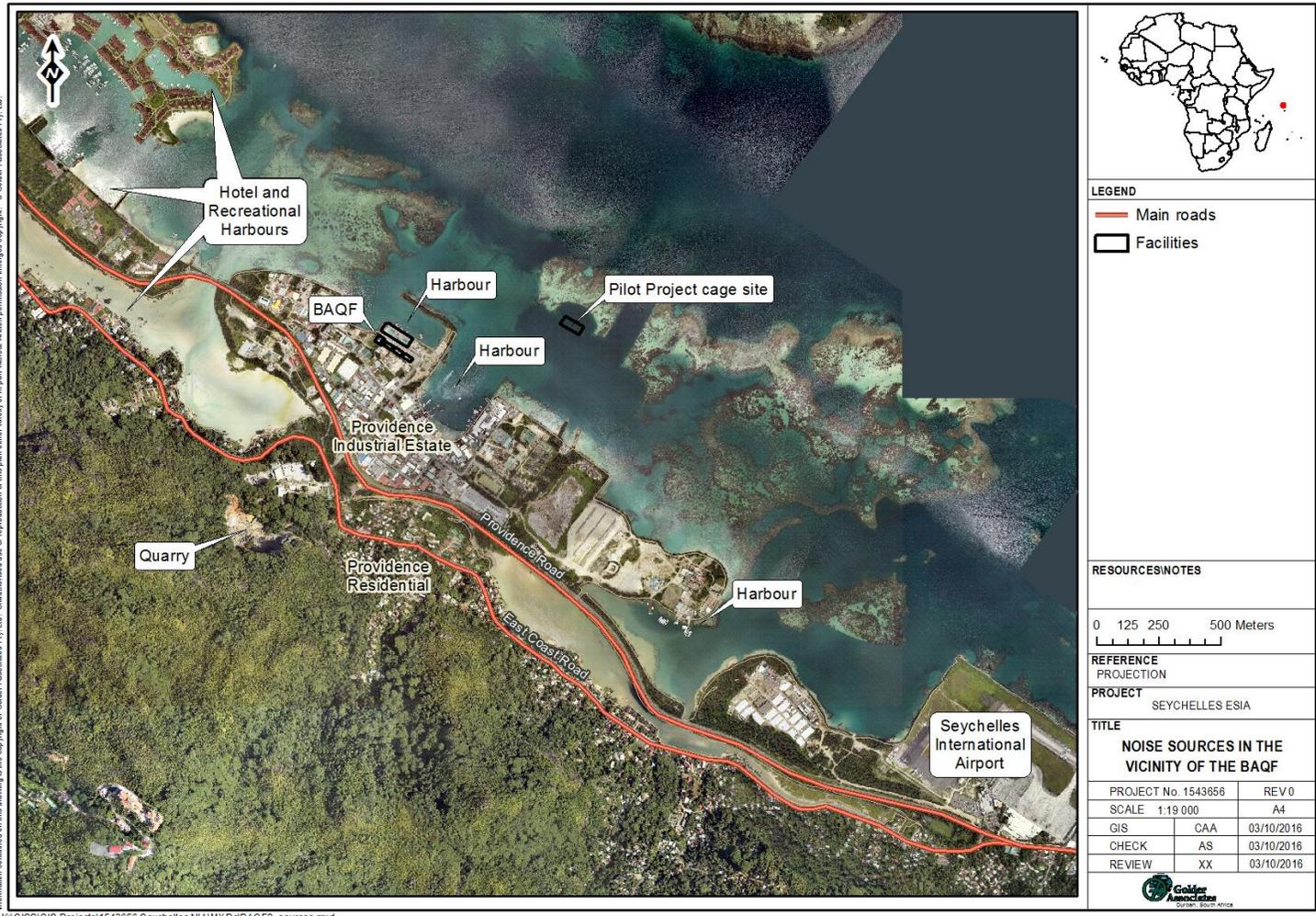


## NIA: SEYCHELLES MMP

<b>MMP Component</b>	<b>Significant existing noise sources</b>
	Sand extraction activities in the vicinity of M2, M3, M4, and M5



# NIA: SEYCHELLES MMP



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Figure 5: Significant noise sources in the vicinity of the BQAF and Pilot Project





# NIA: SEYCHELLES MMP

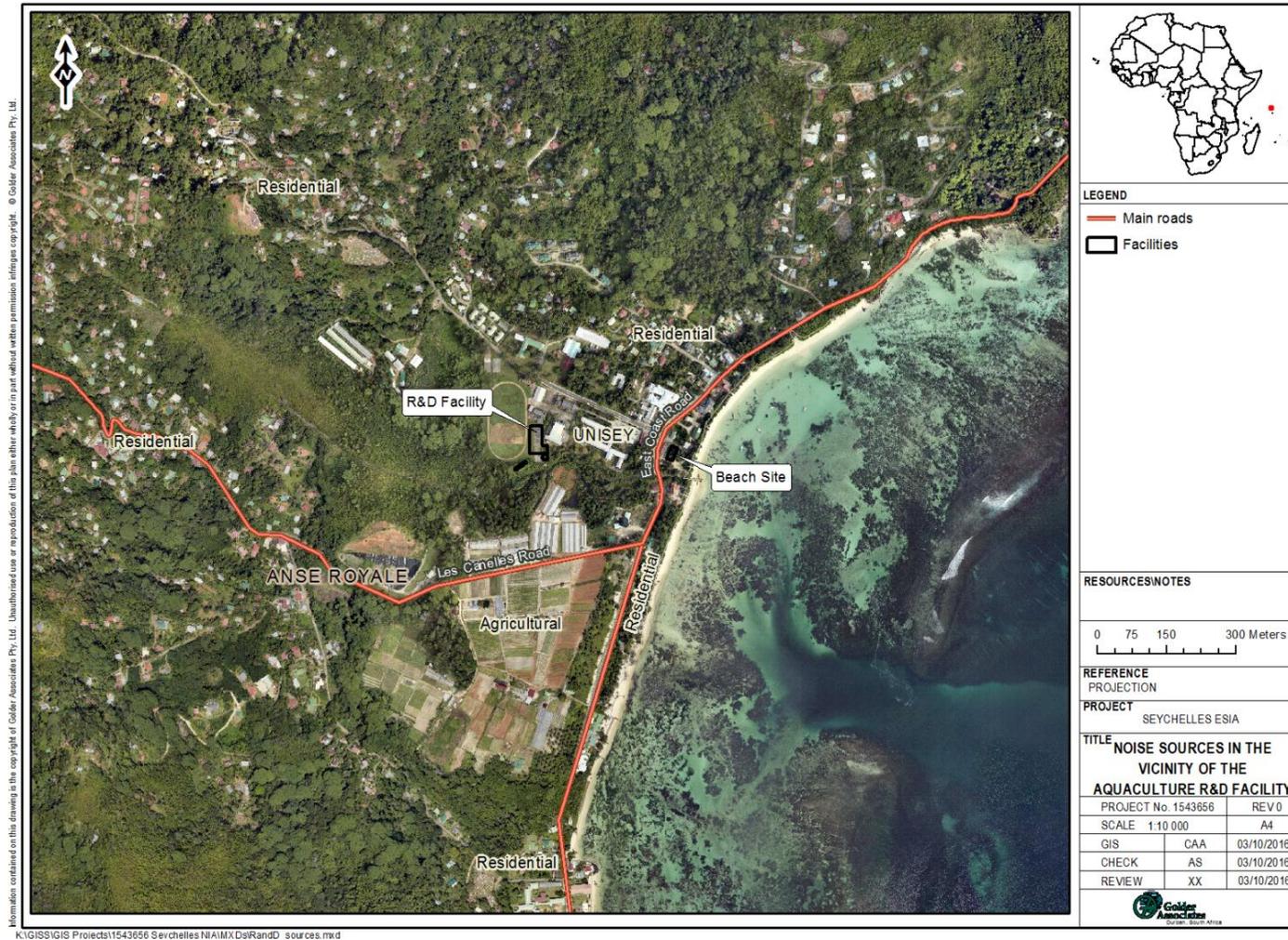


Figure 6: Significant noise sources in the vicinity of the Aquaculture R&D Facility



# NIA: SEYCHELLES MMP

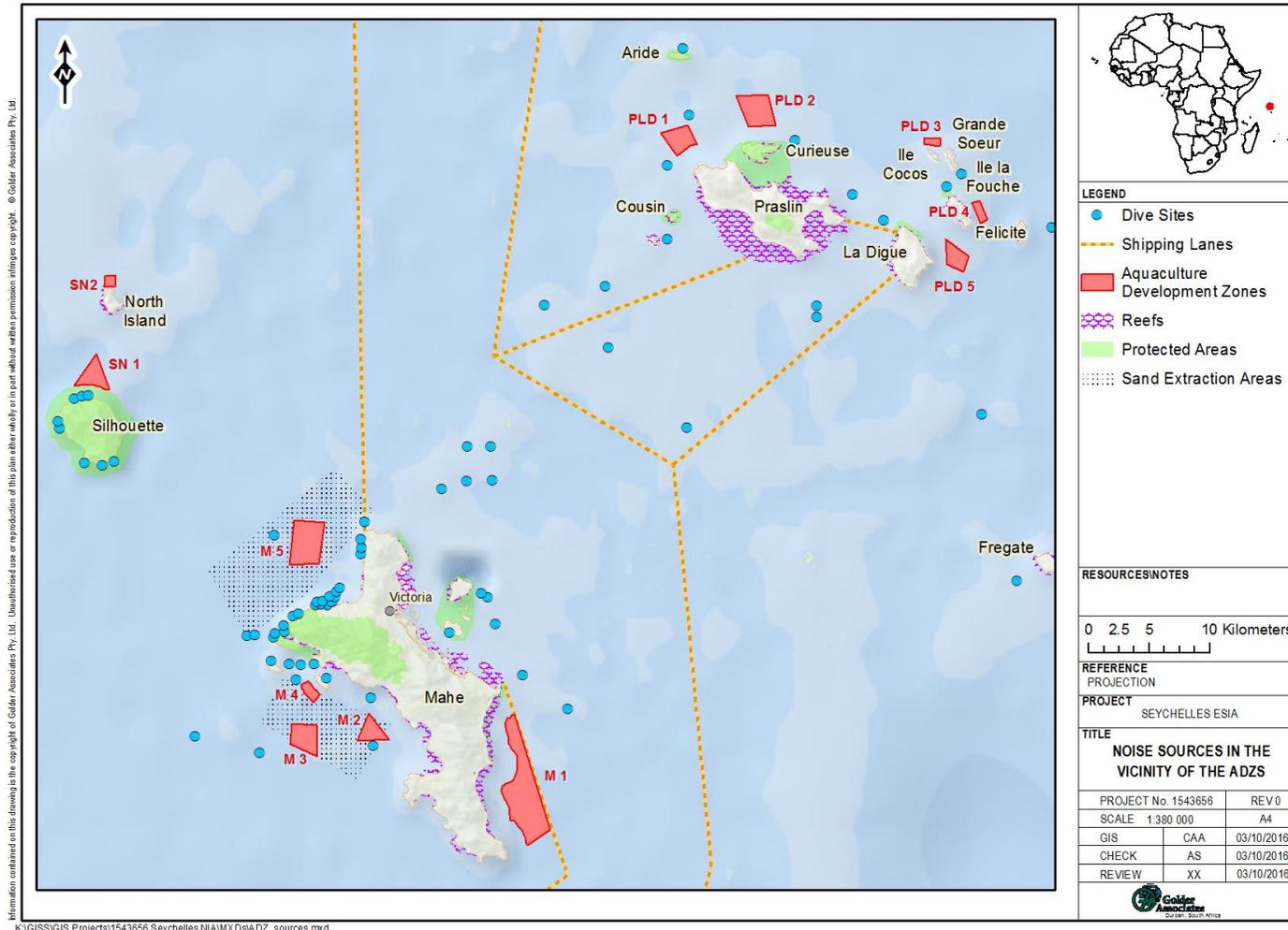


Figure 7: Significant noise sources in the vicinity of the Aquaculture R&D Facility



In the absence of measured baseline noise data, it is assumed that the baseline noise levels at the various MMP components are in line with typical noise levels for their respective host environments (Table 2). These typical noise level ratings for various environments were sourced from the South African National Standard (SANS 10103) Code of Practice (Table 3). These values are in line with the The International Finance Corporation (IFC) Environmental, Health, and Safety (EHS) Guidelines for noise management (IFC, 2007).

**Table 2: Estimated baseline noise levels**

MMP component	Host environment	Estimated baseline noise levels		
		Day-night	Day	Night
BQAF	Industrial	70	70	60
Pilot project	Rural with frequent traffic	50	50	40
R&D Facility	Urban	60	60	50
ADZ	Rural	45	45	35

**Table 3: Typical Rating Levels for Ambient Noise (SANS 10103)**

Type of environment	Equivalent continuous rating level ( $L_{Req,T}$ ) for noise (dB(A))					
	Outdoors			Indoors, with open windows		
	Day-night $L_{R,dn}$	Day-time $L_{Req,d}$	Nigh time $L_{Req,n}$	Day-night $L_{R,dn}$	Day-time $L_{Req,d}$	Night time $L_{Req,n}$
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

Notes:

- 1) If the measurement or calculation time interval is considerably shorter than the reference time intervals, significant deviations from the values given in the table might result.
- 2) If the spectrum of the sound contains significant low frequency components, or when an unbalanced spectrum towards the low frequencies is suspected, special precautions should be taken, and specialist advice should be obtained. In this case the indoor sound levels might significantly differ from the values given in Column 5 to 7.
- 3) In districts where outdoor  $L_{R,dn}$  exceeds 55 dB, residential buildings (e.g. dormitories, hotel accommodation and residences) should preferably be treated acoustically to obtain indoor  $L_{Req,T}$  values.
- 4) For industrial districts, the  $L_{R,dn}$  concept does not necessarily hold. For industries legitimately operating in an industrial district during the entire 24 h day/night cycle,  $L_{Req,d} = L_{Req,n} = 70$  dB can be considered as typical and normal.
- 5) The values given in columns 2 and 5 in this table are equivalent continuous rating levels and include corrections for tonal character, impulsiveness of the noise and the time of day.
- 6) The values given in columns 3, 4, 6 and 7 in this table are equivalent continuous rating levels and include corrections for tonal character and impulsiveness of the noise.
- 7) The noise from individual noise sources produced, or caused to be produced, by humans within natural quiet spaces such as national parks, wilderness areas and bird sanctuaries should not exceed a maximum A-weighted sound pressure level of 50 dBA at a distance of 15 m from each individual source.



**Table 4: IFC Ambient noise level guidelines (2007)**

Receptor	Maximum allowable ambient noise Levels	
	1-hour L <sub>Aeq</sub> (dB(A))	
	Day time	Night time
	07:00 – 22:00	22:00 – 07:00
Residential/ institutional/ educational	55	45
Industrial/ commercial	70	70

## 5.0 IMPACT ASSESSMENT

### 5.1 Methodology

From a technical, conceptual or philosophical perspective the focus of impact assessment ultimately narrows down to a judgment on whether the predicted impacts are significant or not. The concept of significance is at the core of impact identification, prediction, evaluation and decision-making. The determination of significant impacts relates to the degree of change in the environmental resource measured against some standard or threshold. This requires a definition of the magnitude, prevalence, duration, frequency and likelihood of potential change. The following criteria are used for the description of the magnitude and significance of impacts.

The consequence of impacts can be derived by considering the following criteria:

- Extent or spatial scale of the impact;
- Intensity or severity of the impact;
- Duration of the impact;
- Potential for mitigation;
- Acceptability;
- Degree of certainty/probability;
- Status of the impact; and
- Legal requirements.

Potential impacts were assessed using the calculations and rating system, as provided in Table 5 and Table 6.

**Table 5: Impact ranking matrix**

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Magnitude (severity) of impact	Scale / extent of impact

*Note: To assess each impact, the following four ranking scales are used*

PROBABILITY	DURATION
5 - Definite/don't know	5 - Permanent
4 - Highly probable	4 - Long-term



<b>PROBABILITY</b>	<b>DURATION</b>
3 - Medium probability	3 - Medium-term (8-15 years)
2 - Low probability	2 - Short-term (0-7 years) (impact ceases after the operational life of the activity)
1 - Improbable	1 – Immediate
0 - None	
<b>SCALE</b>	<b>MAGNITUDE</b>
5 - International	10 - Very high/don't know
4 - National	8 - High
3 - Regional	6 - Moderate
2 - Local	4 - Low
1 - Site only	2 - Minor
0 - None	

The significance of the two aspects, occurrence and severity, is assessed using the following formula:

$$SP \text{ (significance points)} = (\text{magnitude} + \text{duration} + \text{scale}) \times \text{probability}$$

The maximum value is 100 significance points (SP). The impact significance points are assigned a rating of high, medium or low with respect to their environmental impact as follows (Table 6):

**Table 6: Significance ratings**

<b>SP &gt;75</b>	Indicates <b>high</b> environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
<b>SP 30 – 75</b>	Indicates <b>moderate</b> environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
<b>SP &lt;30</b>	Indicates <b>low</b> environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
<b>+</b>	Positive impact	An impact that is likely to result in positive consequences/effects.

## 5.2 Legislation, Standards and Guidelines

The Seychelles Environment Protection Regulations (SI No. 49 of 1999) Noise Emission Standards are provided in Table 7. According to the IFC EHS Guidelines for noise management (IFC, 2007), noise impacts should not exceed specified levels, or result in a maximum increase in background levels of 3 dB(A) at the nearest receptor location off-site.

**Table 7: Seychelles noise standards**

<b>Area</b>	<b>Definition</b>	<b>Time</b>	<b>Limit (dB (A))</b>
Residential	An area mainly occupied by private houses	06:00 - 23:00 23:00 - 06:00	60 L <sub>eq</sub> 55 L <sub>eq</sub>



Area	Definition	Time	Limit (dB (A))
Industrial	An area of land developed for the siting of trade and manufacturing enterprises	At all times	(1.1) 75 (measured at the boundary of the site)
Audible intrusion in Pristine acoustic environment	A natural environment of particular value because of its quietness, beauty or natural sounds	At all times	60 L <sub>eq</sub>

### 5.3 Construction

The noise levels created by construction equipment will vary greatly depending on factors such as the type of equipment, the specific model, the operation being performed and the condition of the equipment. The equivalent sound level (L<sub>eq</sub>) of the construction activity also depends on the fraction of time that the equipment is operated over the time period of construction. Construction equipment can be broken down into two classes:

- **Stationary Equipment:** Stationary equipment consists of equipment that generates noise from one general area and includes items such as pumps, generators, compressors, etc. These types of equipment operate at a constant noise level under normal operation and are classified as non-impact equipment. Other types of stationary equipment such as pile drivers, jackhammers, pavement breakers, blasting operations, etc., produce variable and sporadic noise levels and often produce impact-type noises. Impact equipment is equipment that generates impulsive noise, where impulsive noise is defined as noise of short duration (generally less than one second), high intensity, abrupt onset, rapid decay, and often rapidly changing spectral composition. For impact equipment, the noise is produced by the impact of a mass on a surface, typically repeating over time; and
- **Mobile Equipment:** Mobile equipment such as dozers, scrapers, graders, etc., may operate in a cyclic fashion in which a period of full power is followed by a period of reduced power. Other equipment such as compressors, although generally considered to be stationary when operating, can be readily relocated to another location for the next operation.

Typical noise levels associated with commonly used construction equipment is provided in Figure 8. It is envisaged that noise sources associated with the construction of the BQAF and R&D Facility will include trucks transporting equipment, waste and project components, welders, diesel generators, pile drivers, air compressors, diggers, cutting and drilling equipment and mobile cranes.

It is anticipated that the construction of the BQAF and R&D Facility will generate noise in excess of the ambient noise standards<sup>1</sup> and pose a significant annoyance to those in close proximity to the activity particularly with regards to impact noise which is considered more intrusive than continuous noise.

Receptors at the University (in the vicinity of the R&D Facility) are likely to be more sensitive to elevated noise levels compared to receptors at the Providence Industrial Estate (BQAF). At both sites however, noise impacts will be short lived and limited to the duration of the construction phase.

<sup>1</sup> Residential: 60 L<sub>eq</sub> (day) and 55 L<sub>eq</sub> (night); Industrial: 75 (At all times, measured at the boundary of the site)

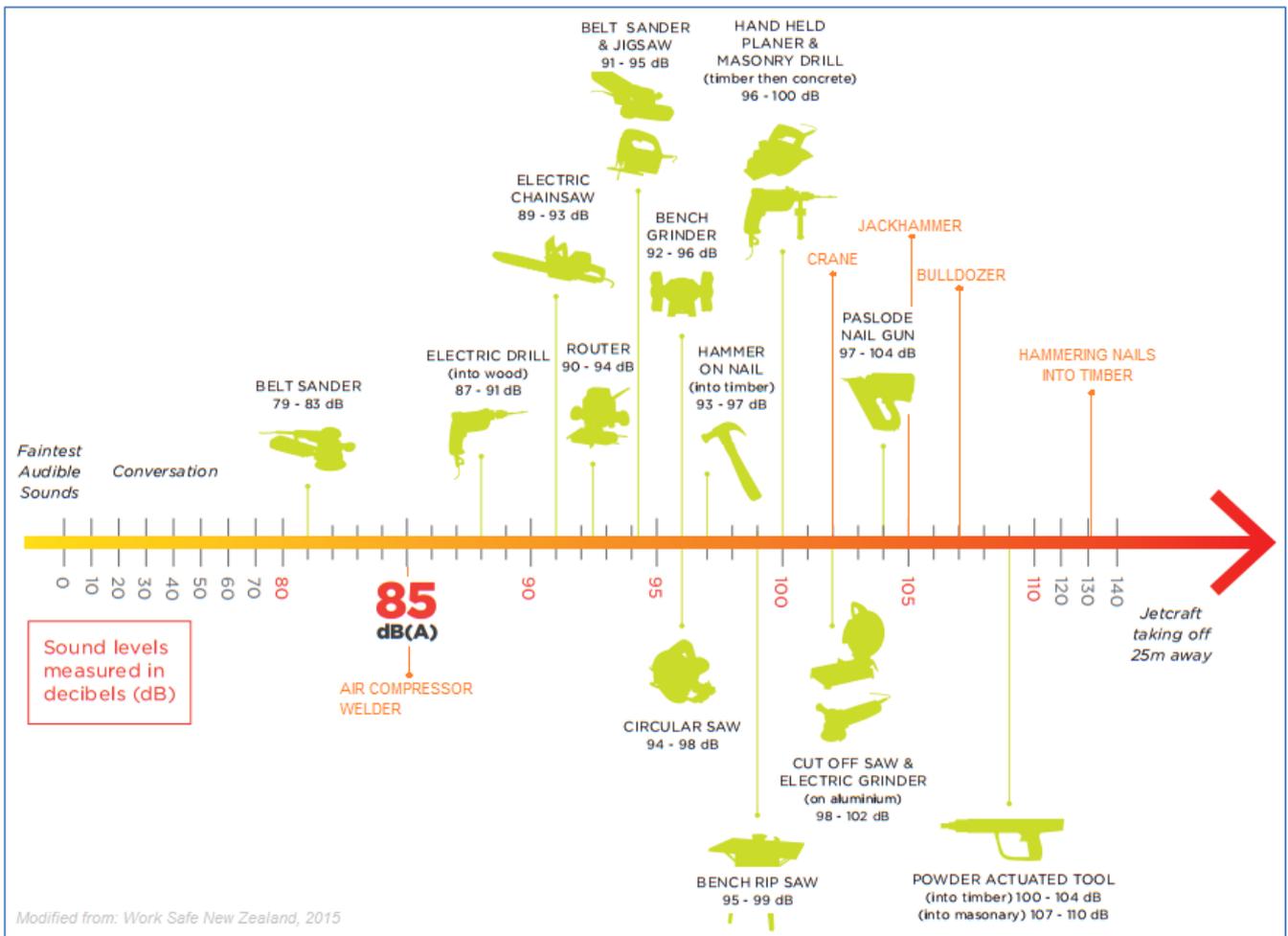


Figure 8: Typical noise levels associated with commonly used construction equipment (modified from Work Safe New Zealand, 2015)

The potential impact of construction noise at the proposed BQAF and R&D Facility sites was assessed as being of **moderate (SP = 48)** significance. The following mitigation measures<sup>2</sup> are recommended to reduce the impact to one of **moderate (SP = 40)** significance:

- Schedule noisy construction activities to periods when University lectures are not in session such as during breaks or after classes, or during University holidays where practical;
- Notify neighbours prior to commencing activities that will generate significant noise. Good communication can prevent complaints from arising, and resolve concerns before there is a problem. A phone number where the foreman can be reached should be provided prior to the work commencing;
- A complaints reporting procedure should be established and all complaints logged. Investigations into the cause of the complaints should be initiated and appropriate mitigation measures applied timeously;
- Construct noise barriers, such as temporary walls or piles of excavated material between noisy activities and noise-sensitive receptors (in extreme cases where a sensitive receptor is located close by);

<sup>2</sup> Mitigation measures sourced from: Work Safe New Zealand (2015); U.S. Department of Transportation, (2006); South Australian Environmental Protection Agency (2014); British Standard (1997).



- Re-route truck traffic away from residential streets where possible;
- Position noise generating equipment such as generators and air compressors on the construction lot as far away from noise sensitive receptors as possible;
- Shut down or throttle down equipment (such as backhoes, cranes, bobcats, loaders and generators) whenever they are not in actual use;
- Combine noisy operations to occur in the same time period. The total noise level produced will not be significantly greater than the level produced if the operations were performed separately;
- Avoid night-time construction activities. Sensitivity to noise increases during the night-time hours and should be avoided;
- Select quieter equipment where possible. For example, while most compressors are powered by diesel or gasoline engines, many are contained or have baffles to help abate noise levels. Electric compressors are significantly quieter than diesel or gasoline engine powered compressors.
- Use newer equipment where possible as it is generally quieter than old equipment for many reasons, including technological advancements and the lack of worn, loose, or damaged components. Some equipment manufacturers have designed their equipment to function quieter in recent years and have achieved significant reductions over older equipment. In some cases, the use of over- or under-powered equipment may be an unexpected source of excessive noise. The types of engines and power transfer methods also plays a significant roll in achieving lowered equipment noise. The use of electric powered equipment is typically quieter than diesel, and hydraulic powered equipment is quieter than pneumatic power;
- Ensure equipment is well maintained. Poor maintenance of equipment typically causes excessive noise levels. Faulty or damaged mufflers and loose engine parts such as screws, bolts, or metal plates contribute to increased noise levels. Removal of noise-reducing attachments and devices such as mufflers, silencers, covers, guards, vibration isolators, etc., will, to varying degrees, increase noise emission levels. Old equipment may be made quieter by simple modifications, such as adding new mufflers or sound absorbing materials. Loose and worn parts should be fixed as soon as possible;
- Construct temporary walled enclosures around especially noisy activities or clusters of noisy equipment where required. These techniques can significantly reduce noise levels and, in many cases, are relatively inexpensive. These barriers can typically be constructed on the work site from common construction building material (plywood, block, stacks, or spoils). To be effective, the length of a barrier should be greater than its height, the noise source should not be visible, and any barrier should be located as close as possible to either the noise source or the receiver. In addition, providing increased distance between a noise source and a noise receiver can also be considered a form of abatement; and
- Ensure personnel are trained to carry out their respective tasks. Careless or improper operation or inappropriate use of equipment can increase noise levels. Poor loading, unloading, excavation, and hauling techniques are examples of how lack of adequate guidance and training may lead to increased noise levels.

Degree of confidence in prediction of impact: **High**. Noise associated with construction is well documented and understood.

It is assumed that the cage components for the Pilot Project and ADZ will be prefabricated and assembled on site. It is therefore anticipated that the noise sources will be limited to the work boats transporting the prefabricated components to the various sites.



The potential impact of the work boats was assessed as being of **low (SP = 27)** significance. The following mitigation measures<sup>3</sup> are recommended to reduce the impact to one of **lower (SP = 24)** significance:

- Plan routes to avoid known dive sites and/ or tourism routes;
- Ensure boats and engines are well maintained; and
- Avoid night-time activities. Sensitivity to noise is increased during the night-time hours.

Degree of confidence in prediction of impact: **Moderate**. The noise levels may differ from those anticipated as the technology selection has not yet been finalised.

### 5.4 Operation

The MMP will have a lifespan of 25 years at the least, possibly much longer. The following sources are likely to generate noise during the operation of the MMP:

- Work boats servicing the Pilot Project and ADZ; and
- Life support systems at the BQAF and Research & Development Facilities, including:
  - Water treatment units;
  - Air blowers;
  - Oxygen generators;
  - Seawater pumps; and
  - Diesel generators (it is assumed this will only be used when electrical supply is interrupted).

Noise emanating from the workboats transporting staff, feedstock and harvested fish to and from the Pilot Project and ADZs are likely to be in similar frequency and intensity ranges as those of existing commercial fishing and transport operations. For marine mammals, the effects of the sounds from these sources are usually transitory, or the animals can habituate to such sounds with regular exposure. However, the range of effects can be large, and cumulative effects cannot be ruled out for the louder vessels (Olesiuk, Lawson and Trippel, 2010). This study, however, does not consider the potential effects in marine life or any other underwater acoustic effects.

The potential impact of the work boats was assessed as being of **Moderate (SP = 30)** significance. The following mitigation measures are recommended to reduce the impact to one of **low (SP = 24)** significance:

- Plan routes to avoid known dive sites and/ or tourism routes and use existing transport routes where possible;
- Ensure boats and engines are well maintained; and
- Avoid night-time activities. Sensitivity to noise increases during the night-time hours and should be avoided.

Degree of confidence in prediction of impact: **Moderate**. The noise levels may differ from those anticipated depending on the size and type of vessel/ work boat used.

Noise levels generated by the life support systems at the BQAF and Research & Development Facilities are anticipated to be low and continuous and have little/no impact on the baseline noise levels beyond the site

<sup>3</sup> Mitigation measures sourced from: Work Safe New Zealand (2015); U.S. Department of Transportation, (2006); South Australian Environmental Protection Agency (2014); British Standard (1997).



boundary. Elevated noise levels may however result from the use of the diesel generators, although it is assumed the generators will only be used when electrical supply is interrupted (i.e. infrequently).

The potential impact was therefore assessed as being of **Moderate (SP = 36)** significance. The following mitigation measures are recommended to reduce the impact to one of **low (SP = 27)** significance:

- Noise mitigation measures should be implemented at all noise sources radiating noise in excess of 85.0 dB(A). Such measures may include:
  - Installing suitable mufflers on engine exhausts and compressor components;
  - Installing acoustic enclosures for equipment such as pumps and generators causing radiating noise;
  - Installing vibration isolation for mechanical equipment;
- Equipment/ technology with lower sound power levels should be prioritised in the procurement process;
- All equipment should be well maintained and frequently inspected to ensure optimum operation;
- The use of the generators should be limited to when electrical supply is interrupted; and
- A complaints reporting procedure should be established and all complaints logged. Investigations into the cause of the complaints should be initiated and appropriate mitigation measures applied timeously.

Degree of confidence in prediction of impact: **Moderate**. The noise levels may differ from those anticipated based on the technology selected.

### 5.5 Decommissioning

Noise impacts similar to those of the construction phase are likely to occur during the decommissioning of the MMP, but over a shorter period of time and restricted to the demolition and transport of waste material to a waste management facility.

It is anticipated that the decommissioning of the BQAF and R&D Facility will generate noise in excess of the ambient noise standards<sup>4</sup> and pose a significant annoyance to those in close proximity to the activity particularly with regards to impact noise which is considered more intrusive than continuous noise, however this will occur over relatively short periods. It is possible that the facilities are not entirely dismantled and that alternate uses can be made and that only removal of equipment and minor stripping of the interior takes place which will have relatively limited noise associated with these activities compared to fully decommissioning the facilities.

It is assumed that the cage components for the Pilot Project and ADZ will be disassembled on site and transported. It is therefore anticipated that the noise sources will be limited to the work boats transporting the components back to the island.

The potential impact of decommissioning noise at the proposed BQAF and R&D Facility sites was assessed as being of **moderate (SP = 40)** significance. The following mitigation measures<sup>5</sup> are recommended to reduce the impact to one of **moderate (SP = 32)** significance:

- Schedule noisy construction activities to periods when University lectures are not in session such as during breaks or after classes, or during University holidays where practical;
- Notify neighbours prior to commencing activities that will generate significant noise. A phone number where the foreman can be reached should be provided prior to the work commencing;

<sup>4</sup> Residential: 60 Leq (day) and 55 Leq (night); Industrial: 75 (At all times, measured at the boundary of the site)

<sup>5</sup> Mitigation measures sourced from: Work Safe New Zealand (2015); U.S. Department of Transportation, (2006); South Australian Environmental Protection Agency (2014); British Standard (1997).



- A complaints reporting procedure should be established and all complaints logged. Investigations into the cause of the complaints should be initiated and appropriate mitigation measures applied timeously;
- Mitigate noise from power equipment or other noise producing activities with sound barriers, muffling devices, lower settings on power equipment and limit 'noisy' work periods;
- Construct noise barriers, such as temporary walls or piles of excavated material between noisy activities and noise-sensitive receptors (where necessary or appropriate);
- Reroute truck traffic away from residential streets where possible;
- Position noise generating equipment such as generators and air compressors on the construction lot as far away from noise sensitive receptors as possible;
- Shut down or throttle down equipment (such as backhoes, cranes, bobcats, loaders and generators) whenever they are not in actual use;
- Combine noisy operations to occur in the same time period. The total noise level produced will not be significantly greater than the level produced if the operations were performed separately;
- Avoid night-time activities. Sensitivity to noise increased during the night-time hours;
- Prioritise the procurement and use of equipment with lower noise levels;
- Ensure the equipment is well maintained;
- Construct temporary walled enclosures around especially noisy activities or clusters of noisy equipment; and
- Ensure personnel are trained to carry out their respective tasks. Careless or improper operation or inappropriate use of equipment can increase noise levels. Poor loading, unloading, excavation, and hauling techniques are examples of how lack of adequate guidance and training may lead to increased noise levels.

Degree of confidence in prediction of impact: **High**. Noise associated with construction is well documented and understood.

The potential impact of the work boats was assessed as being of **moderate (SP = 30)** significance. The following mitigation measures<sup>6</sup> are recommended to reduce the impact to one of **low (SP = 24)** significance:

- Plan routes to avoid known dive sites and/ or tourism routes;
- Ensure boats and engines are well maintained; and
- Avoid night-time activities. Sensitivity to noise increased during the night-time hours.

Degree of confidence in prediction of impact: **Moderate**. The noise levels may differ from those anticipated as the technology selection has not yet been finalised.

<sup>6</sup> Mitigation measures sourced from: Work Safe New Zealand (2015); U.S. Department of Transportation, (2006); South Australian Environmental Protection Agency (2014); British Standard (1997).



## 5.6 Summary of Environmental Impacts

### 5.6.1 Construction Phase

Table 8 below summarises those impacts directly related to the Construction Phase of the proposed project, and provides a significance rating for each impact before and after mitigation.

**Table 8: Environmental Impact Assessment Matrix for the Construction Phase of the Proposed Seychelles MMP**

POTENTIAL ENVIRONMENTAL IMPACT: CONSTRUCTION PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	SP	Rating	M	D	S	P	SP	Rating
<b>Construction of the BQAF and R&amp;D Facility</b>												
Site preparation, earthworks, clearing, transport, construction of the facilities and installation of the pumps, tanks etc.	8	2	2	4	48	Moderate	6	2	2	4	40	Moderate
<b>Construction of the Pilot Project cage site and ADZ</b>												
Construction of the cages	6	1	2	3	27	Low	4	2	2	3	24	Low

### 5.6.2 Operational Phase

Table 9 below summarises those impacts directly related to the Operational Phase of the proposed project, and provides a significance rating for each impact before and after mitigation. The operational period will be a minimum of 25 years, possibly much longer.

**Table 9: Environmental Impact Assessment Matrix for Operational Phase of the Proposed Seychelles MMP**

POTENTIAL ENVIRONMENTAL IMPACT: OPERATIONAL PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	SP	Rating	M	D	S	P	SP	Rating
<b>Operation of the Pilot Project and ADZ cage sites</b>												
Stock transport vehicles /vessels servicing the Pilot Project and ADZ	6	2	2	3	30	Moderate	4	2	2	3	24	Low



POTENTIAL ENVIRONMENTAL IMPACT: OPERATIONAL PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	SP	Rating	M	D	S	P	SP	Rating
<b><i>Operation of the BQAF and R&amp;D Facility</i></b>												
Life support systems at the BQAF and Research & Development Facilities	4	4	1	4	36	Moderate	4	4	1	3	27	Low

### 5.6.3 Decommissioning Phase

Table 10 below summarises those impacts directly related to the Decommissioning Phase of the proposed project, and provides a significance rating for each impact before and after mitigation.

**Table 10: Environmental Impact Assessment Matrix for the Decommissioning Phase of the Proposed Seychelles MMP**

POTENTIAL ENVIRONMENTAL IMPACT: DECOMMISSIONING PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	SP	Rating	M	D	S	P	SP	Rating
<b><i>Decommissioning of the BQAF and R&amp;D Facility</i></b>												
Demolition, clearing and transport of waste offsite	6	2	2	4	40	Moderate	4	2	2	4	32	Moderate
<b><i>Decommissioning of the Pilot Project cage site and ADZs</i></b>												
Disassembly of the cages and transport back to the island	6	2	2	3	30	Moderate	4	2	2	3	24	Low

## 6.0 ENVIRONMENTAL MANAGEMENT PLAN FOR NOISE

The EMP and specific mitigation measures and monitoring actions for the identified impacts in Section 5.6 are presented in this section. The mitigation measures associated with each of the construction, operational and decommissioning phases are described in Table 11.



Table 11: Noise EMP

Section No	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	Monitoring and Reporting Frequency
<b>CONSTRUCTION PHASE</b>								
5.0	Noise	Excessive noise at the BQAF and R&D Facility sites causing annoyance or disturbance	To remain within national standards at site perimeter and at sensitive receptors	No exceedances of standards in Section 5.2 attributable to project	<ul style="list-style-type: none"> <li>■ Notify neighbours prior to commencing activities that will generate significant noise.</li> <li>■ A complaints reporting procedure should be established and all complaints logged. Investigations into the cause of the complaints should be initiated and appropriate mitigation measures applied timeously.</li> <li>■ Construct noise barriers between noisy activities and noise-sensitive receptors.</li> <li>■ Reroute truck traffic away from residential streets where possible.</li> <li>■ Site noise generating equipment such as generators and air compressors on the construction lot as far away from noise sensitive receptors as possible.</li> <li>■ Shut down or throttle down equipment (such as backhoes, cranes, bobcats, loaders and generators) whenever they are not in actual use.</li> <li>■ Combine noisy operations to occur in the same time period.</li> <li>■ Avoid night-time construction activities.</li> <li>■ Select quieter equipment where possible.</li> <li>■ Use newer equipment where possible.</li> <li>■ Ensure equipment is well maintained.</li> <li>■ Construct temporary walled enclosures around especially noisy activities or clusters of noisy equipment.</li> <li>■ Ensure personel are trained to carry out their respective tasks.</li> </ul>	ECO appointed by Contractors	Duration of Construction Activities	Complaints should be logged and reported weekly.



## NIA: SEYCHELLES MMP

Section No	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	Monitoring and Reporting Frequency
5.0	Noise	Excessive noise at the Pilot Project and ADZ sites causing annoyance or disturbance	To remain within national standards at site perimeter and at sensitive receptors	No exceedances of standards in Section 5.2 attributable to project	<ul style="list-style-type: none"> <li>■ Plan routes to avoid known dive sites and/ or tourism routes;</li> <li>■ Ensure boats and engines are well maintained; and</li> <li>■ Avoid night-time activities. Sensitivity to noise increased during the night-time hours.</li> </ul>	ECO appointed by Contractors	Duration of Construction Activities	Complaints should be logged and reported weekly.
<b>OPERATIONAL PHASE</b>								
5.0	Noise	Excessive noise at the BQAF and R&D Facility sites causing annoyance or disturbance	To remain within national standards at site perimeter and at sensitive receptors	No exceedances of standards in Section 5.2 attributable to project	<ul style="list-style-type: none"> <li>■ Noise mitigation measures should be implemented at all noise sources radiating <b>noise in excess of 85.0 dB(A)</b>. Such measures may include:               <ul style="list-style-type: none"> <li>■ Installing suitable mufflers on engine exhausts and compressor components;</li> <li>■ Installing acoustic enclosures for equipment such as pumps and generators causing radiating noise;</li> <li>■ Installing vibration isolation for mechanical equipment;</li> </ul> </li> <li>■ Equipment/ technology with lower sound power levels should be prioritised in the procurement process</li> <li>■ All equipment should be well maintained and frequently inspected to ensure optimum operation;</li> <li>■ The use of the generators should be limited to when electrical supply is interrupted; and</li> <li>■ A complaints reporting procedure should be established and all complaints logged. Investigations into the cause of the complaints should be initiated and appropriate mitigation measures applied timeously.</li> </ul>	ECO/ SHEQ officer (from SFA)	Duration of the Operation	Complaints should be logged and reported monthly.



## NIA: SEYCHELLES MMP

Section No	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	Monitoring and Reporting Frequency
5.0	Noise	Excessive noise at the Pilot Project and ADZ sites causing annoyance or disturbance	To remain within national standards at site perimeter and at sensitive receptors	No exceedances of standards in Section 5.2 attributable to project	<ul style="list-style-type: none"> <li>■ Plan routes to avoid known dive sites and/ or tourism routes and use existing transport routes where possible;</li> <li>■ Ensure boats and engines are well maintained; and</li> <li>■ Avoid night-time activities. Sensitivity to noise increased during the night-time hours.</li> </ul>	ECO/ SHEQ officer (from SFA)	Duration of the Operation	Complaints should be logged and reported monthly.
<b>DECOMMISSIONING PHASE</b>								
5.0	Noise	Excessive noise at the BQAF and R&D Facility sites causing annoyance or disturbance	To remain within national standards at site perimeter and at sensitive receptors	No exceedances of standards in Section 5.2 attributable to project	<ul style="list-style-type: none"> <li>■ Notify neighbours prior to commencing activities that will generate significant noise.</li> <li>■ A complaints reporting procedure should be established and all complaints logged. Investigations into the cause of the complaints should be initiated and appropriate mitigation measures applied timeously.</li> <li>■ Construct noise barriers between noisy activities and noise-sensitive receptors.</li> <li>■ Reroute truck traffic away from residential streets where possible.</li> <li>■ Site noise generating equipment such as generators as far away from noise sensitive receptors as possible.</li> <li>■ Shut down or throttle down equipment (such as backhoes, cranes, bobcats, loaders and generators) whenever they are not in actual use.</li> <li>■ Combine noisy operations to occur in the same time period.</li> <li>■ Avoid night-time activities.</li> <li>■ Select quieter equipment where possible.</li> <li>■ Use newer equipment where possible.</li> <li>■ Ensure equipment is well maintained.</li> </ul>	ECO appointed by Contractors	Duration of decommissioning Activities	Complaints should be logged and reported weekly.



## NIA: SEYCHELLES MMP

Section No	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	Monitoring and Reporting Frequency
					<ul style="list-style-type: none"> <li>■ Construct temporary walled enclosures around especially noisy activities or clusters of noisy equipment.</li> <li>■ Ensure personnel are trained to carry out their respective tasks.</li> </ul>			
5.0	Noise	Excessive noise at the Pilot Project and ADZ sites causing annoyance or disturbance	To remain within national standards at site perimeter and at sensitive receptors	No exceedances of standards in Section 5.2 attributable to project	<ul style="list-style-type: none"> <li>■ Plan routes to avoid known dive sites and/ or tourism routes;</li> <li>■ Ensure boats and engines are well maintained; and</li> <li>■ Avoid night-time activities. Sensitivity to noise increased during the night-time hours.</li> </ul>	ECO appointed by Contractors	Duration of decommissioning Activities	Complaints should be logged and reported weekly.



## **7.0 RECOMMENDATIONS**

This qualitative noise assessment describes the potential noise impacts of the proposed MMP components based on identified existing and anticipated key noise sources. Should a quantitative noise assessment be required, the following may be implemented:

- Baseline noise monitoring undertaken at the BAQF and R&D Facility prior to construction commencing; and
- Noise propagation modelling based on the noise design parameters for the proposed equipment/technology to assess the impact of the land based components of the MMP at identified sensitive receptors.

## **8.0 REFERENCES**

British Standard (1997) Noise and Vibration Control on Construction and Open Sites. Part 1. Code of Practice for Basic Information and Procedures for Noise and Vibration Control. BS 5228. ICS 17.140.20; 17.160; 91.200.

International Finance Corporation (IFC) 2007 Environmental Health and Safety Guidelines for Noise management.

Olesiuk, P.F. Lawson, J. W. and Trippel, E. A. (2010) Pathways of effects of noise associated with aquaculture on natural marine ecosystems in Canada. Canadian Science Advisory Secretariat. Research document 2010/025. ISSN 1499-3848.

Seychelles Environment Protection Regulations (SI No. 49 of 1999) Noise Emission Standards

South African Standard - Code of practice, SANS 10103:2008, the measurement and rating of environmental noise with respect to annoyance and to speech communication.

South Australian Environmental Protection Agency (2014) Construction Noise Information Sheet. EPA 425/14. Updated April 2014.

U.S. Department of Transportation, (2006) Federal Highway Administration: Construction Noise Handbook. DOT-VNTSC-FHWA-06-02, August 2006.

Work Safe New Zealand (2015) Noise levels created by common construction tools. Available at: <http://construction.worksafe.govt.nz/assets/resources/WSNZ-1311-Construction-Machinery-Fact-Sheet-v5.pdf>. Accessed: 3 October 2016.

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# **APPENDIX A**

## **Document Limitations**

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