SOUTH COAST MARICULTURE

Appendix 3

Water Quality and Benthic Environment Monitoring Program

Prepared By: Sam Gordon and Anni Conn

2020/07

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1. Introduction

The Water Quality and Benthic Environment Monitoring Plan has been developed to assess and mitigate potential impacts of the South Coast Mariculture Commercial Shellfish Aquaculture leases (SCMCAL) on water quality and the benthic environment. The Plan includes the Water Quality Monitoring Program, the Macrobenthic Invertebrate Monitoring Program and the Substrate Monitoring Program and has been prepared as a combined document as the three programs are interrelated.

In accordance with consent condition D12 of the State Significant Infrastructure Approval SS1-5657, the Macrobenthic Invertebrate Monitoring Program component of this document details the following:

a. The Proponent shall prepare and submit a Benthic Monitoring Program, to the satisfaction of the Secretary within 6 months of the date of this approval. The Program shall include but not necessarily be limited to:
b. Representative background monitoring to establish baseline conditions for the Leases, including benthic fauna and TOC parameters, for a suitable time.
c. The use of multiple control sites and identification of the frequency of sampling to ensure the monitoring program is spatially and statistically meaningful;
d. Collecting data at least annually after the Leases are approved, irrespective of whether the Leases are stocked with shellfish;
e. A minimum monitoring period of at least three years from the commencement of operation;
f. Identification of trigger(s) and ameliorative measures (including video surveys) in the event that adverse impacts to benthic fauna relevant to the development are identified;
g. Identify triggers that would decrease monitoring efforts; and
h. Reporting of the monitoring results to the Secretary and OEH annually within the Annual Report, including commentary on and effects of the Leases compared to relevant guidelines, pre-lease sampling or control sites.

In accordance with consent condition D10 & D11 of the State Significant Infrastructure Approval SS1-5657 the Water Quality Monitoring Program component of this document details the following:

- D10 The Proponent shall comply with Section 120 of the POEO Act

- D11 The Proponent shall monitor water quality in accordance with the NSW Shellfish Program *(see References)* administered by the NSW Food Authority under the Food Act 2003

The Water Quality and Benthic Environment Monitoring Plan will be supported with relevant policies, protocols, and safe work method statements to promote a comprehensive approach to all farming operations that have the potential to impact negatively on shellfish health and welfare. The Water Quality and Benthic Environment Monitoring Plan will be continuously reviewed and improvements employed to meet this goal. An "adaptive management" approach will be used to refine the monitoring programs to minimise the potential for broader environmental impacts, streamline monitoring processes and better ensure shellfish health.

1.1 Sampling Design

The Water Quality and Benthic Environment Monitoring Plan will employ a similar experimental design to that used by the Centre for Research on Ecological Impacts of Coastal Cities (University of Sydney, NSW) to assess the ecological effects of a Snapper farm located in Providence Bay (Underwood & Hoskin 1999; Hoskin & Underwood 2001), albeit with an expanded range of variables being assessed. These studies used a 'Before *vs.* After - Control *vs*. Impact' (BACI) sampling design, which is one means by which causality models can be rigorously tested in environmental investigations (Underwood, 1992; 1994).

The use of multiple control sites coupled with multiple sampling times before and during the aquaculture activities enables an estimate of natural temporal and spatial variation of the environment to be obtained (Green, 1979). Such estimates can then be used to determine if impacts from the South Coast Mariculture mussel leases cause greater variation in the environment than would occur naturally through time (Kingsford & Battershill, 1998). The use of this type of sampling design was strongly advocated in the 1996 guidelines of the United Nations Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) on monitoring the ecological effects of aquaculture (Hoskin & Underwood 2001).

NSW DPI currently requires other marine based aquaculture (finfish and mussel farms) to undertake benthic environment monitoring using a BACI sampling design (See Attachment 1).

1.2 The Adaptive Management Process

Adaptive management is a structured, iterative process of optimal decision making using the best science available with an aim to further improve our knowledge of the system over time using comprehensive monitoring. In this way, decision making simultaneously maximises one or more resource objectives and, either passively or actively, accrues information (e.g. by monitoring and modelling through fluctuating system conditions) needed to improve future management. Through adaptive management rigorous control can be applied that assures sustainable operation and development.

Adaptive management is a tool which should be used not only to change a system but also to learn about the system (Figure 1). Because adaptive management is based on a learning process, it improves long-run management outcomes. The challenge in using adaptive management approach lies in finding the correct balance between gaining knowledge to improve management in the future and achieving the best short-term outcome based on current knowledge.

The achievement of adaptive management objectives require an open management process which seeks to include past, present and future stakeholders. Adaptive management needs to at least maintain political openness but usually aims to create it. Adaptive management must therefore be a scientific and social process.

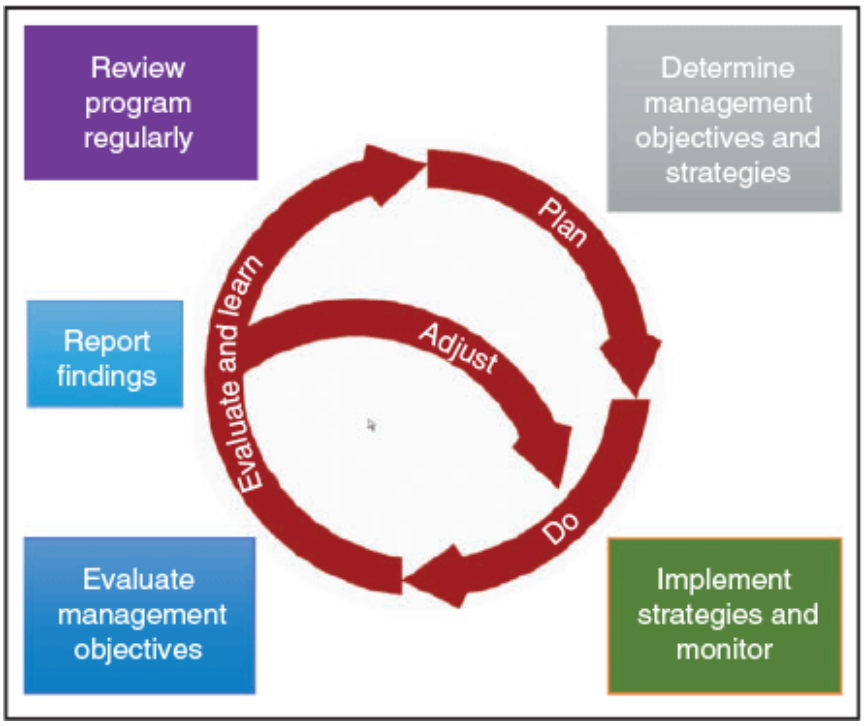


Figure 1: Example of an Adaptive Management Cycle as provided by CSIRO (Source: CSIRO, 2013)

At the core of the adaptive management process is a detailed and targeted environmental monitoring program and a whole-of-environment predictive model. An industry driven environmental monitoring strategy aimed at incorporating both company-specific and statutory monitoring requirements can be developed to optimise future production management and sustainability assessment within farming leases.

These processes focus on addressing the main risks to the wider aquatic environment and farmed shellfish (shellfish health). The ultimate aim of the adaptive management program is to monitor production over time and increase knowledge in relation to the sustainability and feasibility of farming operations. Monitoring any potential adverse environmental effects will be associated with the application of relevant mitigation measures based on the severity of the observed impacts.

Adaptive management by its nature provides for flexibility, for example:

- Sampling frequency can be targeted to high risk periods;
- Some parameters may be replaced by others, and/or new ones added;
- Some parameters may be removed if they no longer reflect an element of risk; and
- The relevance of survey sites may also change with time and some may need to be created, replaced or moved.

As a general rule, monitoring is carried out not simply to accumulate a wealth of data but rather to identify and tackle specific risks and uncertainties.

The prioritised risks are identified through consultation with the regulators, relevant experts and community stakeholders. The risks are managed by the adaptive management process with continued long-term stakeholder involvement. The following risks have been identified by the aquaculture industry:

- The marine aquaculture lease has potential to have an effect outside their lease area; examples include but are not restricted, to eutrophication and the particular requirements of areas and endangered/threatened species;
- Eutrophication of the overall water body will affect water quality on the marine aquaculture lease;
- The social licence to operate is jeopardised by not maintaining the water quality and general ecology of the waters we farm, and negatively impacting the local community and other industries in the region;
- Environmental conditions may contribute to or precipitate a fish health event; and

- Neighbouring leases will affect the quality of the water flowing through adjacent farming lease areas.

These risks drive both the strategies (modelling/limits) and implementation plans (environmental monitoring program) of the adaptive management process.

2. Water Quality Monitoring Program

2.1 Activities Impacting on Water Quality

The most important water quality parameter in mussel aquaculture is sanitary water quality and the most relevant guideline for sanitary water quality in mussel growing areas is the internationally accepted ASQAP Operations Manual 2019 *(see References)* and the NSW Shellfish Program Industry Manual 2018. These two manuals use faecal coliform bacteria in the water as an indicator of faecal pollution and phytoplankton testing for monitoring and identification of potentially toxic algae. The following monitoring plan has been designed in line with ASQAP and NSW Shellfish Program / NSW Food Authority requirements and is considered appropriate for the detection of water quality change prior to any broader significant degradation.

2.2 Water Quality Sampling

Maintenance of water quality is critical to the health of the cultured stock and to ensure food safety of the product for human consumption. The NSW Shellfish Program has been developed as a compulsory, industry funded program that assists in ensuring the public health safety of shellfish grown and harvested from NSW waters. The NSW Shellfish Program is administered by the NSW Food Authority under the Food Act 2003. The objective of the program is to protect the health of shellfish consumers through the administration and application of procedures described in the New South Wales Shellfish Program Industry Manual that:

- assess the risk of shellfish contamination by pathogenic bacteria and viruses,
- biotoxins from the growing area;
- control the harvest of shellfish in accordance with the assessed risk; and
- protect shellfish from contamination after harvesting.

The program requires that shellfish producers undertake a water quality monitoring program to ensure that the cultured shellfish are suitable for human consumption. An initial two-year monitoring period is required to determine the classification of Jervis Bay under the program.

The initial two-year monitoring period requires the collection of water samples at the leases and designated control sites. It also has two distinct recognised water sampling strategies, systematic random sampling and significant rainfall event / pollution event sampling.

Systematic sampling is to initially occur monthly, plus immediately following significant rainfall events, (microbiological sampling) and fortnightly (algal sampling) to obtain a general picture of the water quality of Jervis Bay. Significant rainfall events and/or pollution event sampling attempts to quantify the threat that potential pollution sources may represent. Consequently, the timing of sample collection is important and should coincide with conditions when faecal pollution will be at its worst e.g. a creek which flows after rainfall or a sewage release event.

Significant rainfall events that need to be included in the initial microbiological sampling schedule are when the area has received the following rainfall within a 24 hour period; 10–19 mm, 20–30 mm, 30-40mm and 40–60, and 60-100 mm. These samples are to be collected approximately 24 hours after the event and no later than 48 hours after the event. Sampling may also be based on salinity triggers; particularly where real-time salinity monitoring is available. This data will allow the development of a management plan for each harvest area.

During microbiological and algal water sampling, data on the climatic conditions, water temperature, salinity and tide will also be collected. All collected water samples will be analysed by a NATA accredited laboratory.

Once the classification of the water quality monitoring program for Jervis Bay is completed, the NSW Food Authority will then be in a position to develop any further requirements for ongoing water quality monitoring program that may be required for the South Coast Mariculture mussel leases. At this stage the requirements for food safety related monitoring will be set out in the harvest area management plan for each harvest zone as well as the NSW Shellfish Program Biotoxin Management Plan.

2.3 Microbiological Water Quality Monitoring Locations

Microbiological water samples will be collected at the South Coast Mariculture at NSW Food Authority designated sites (Figure 2) and will be sampled before the longlines are stocked at commercial levels and during.

Microbiological sampling will be undertaken in accordance with the requirements set out by the NSW Food Authority. The sample sites set by the NSW Food Authority to support the initial classification of the Callala and Vincentia harvest areas are shown in Figure 2.

The compliance sites will be approximately 20 - 40m from the edge of the South Coast Mariculture mussel leases, which is consistent with current regulatory practice for shellfish farming. The compliance sites have been located to the North and West of the Callala Bay leases and to the North, West and East of the Vincentia Bay leases, consistent with the dominant current flows for the lease location. Water samples will be collected at 10cm below the surface at each of the aforementioned 14 sampling sites. Microbiological water samples will be collected in accordance with the NSW Shellfish Program sampling requirements.

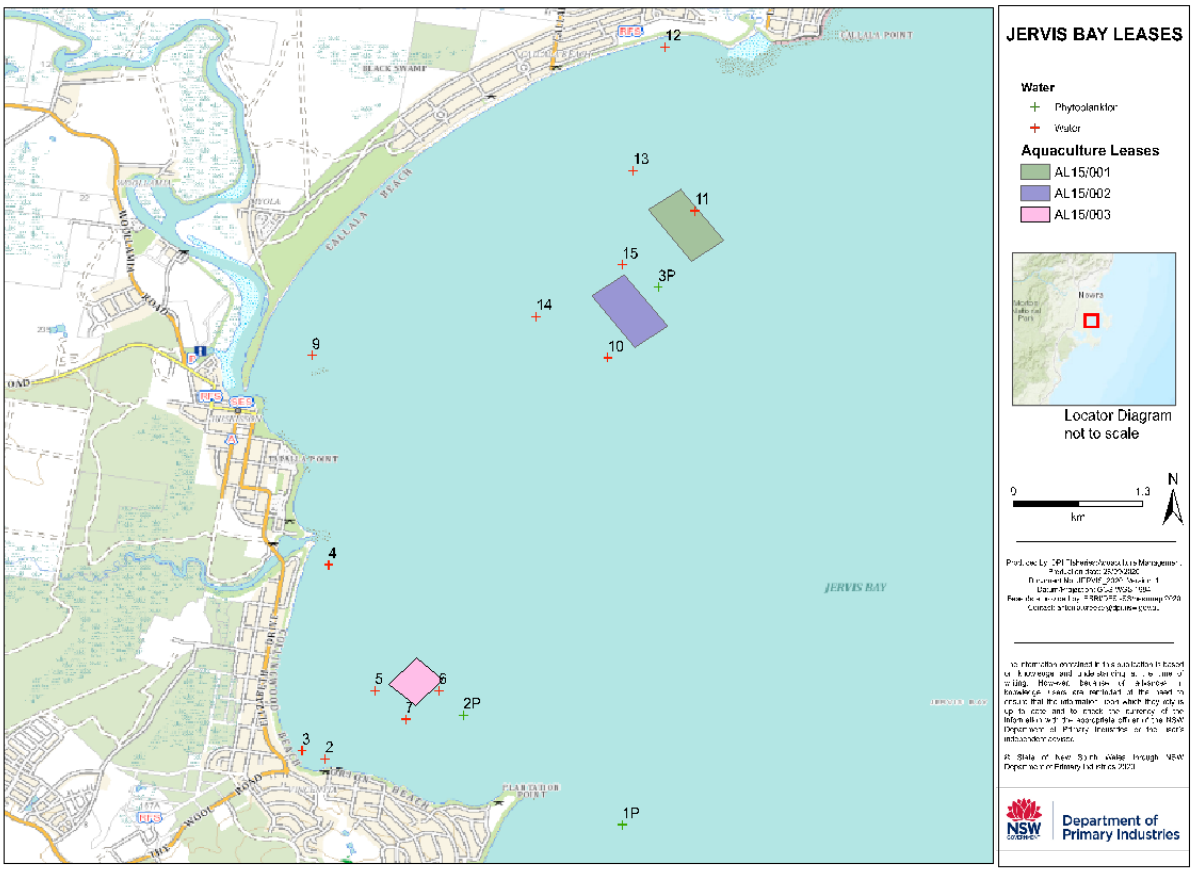


Figure 2: South Coast Mariculture Water Sampling Location Map (NSW Shellfish Program, NSW DPI 2018)

2.4 Phytoplankton Water Quality Monitoring Locations

Algal water samples will be collected in accordance with the NSW Food Authority shellfish program requirements for initial site classification. Samples will be taken before the longlines are stocked at commercial levels and routinely when commercial operations begin

post classification. Sample sites maybe adjusted by the NSW Food Authority as part of the annual review process.

The compliance sites have been located midway between the two Callala Bay leases and to the East of the Vincentia Bay lease, consistent with the dominant current flows for the lease location. Phytoplankton water samples will be collected in accordance with the NSW Shellfish Program Sampler Guide Book methodology, NSW Department of Primary Industries.

2.5 Reporting

All water quality data will be reported directly to the NSW Food Authority in accordance with NSW Shellfish Program requirements. Lease closures will be recorded and included in the Annual Environmental Report that will be made publicly available on the South Coast mariculture website: www.southcoastmariculture.com.au

2.6 Adaption of Water Quality Monitoring Program

The proposed monitoring program will provide the baseline conditions/parameters against which the Jervis Bay mussel leases will be classified by NSW Food Authority / NSW DPI. It will also allow for identification of any significant changes to the marine environment adjacent to the leases that may be occurring due to the presence of the farm and against which future fallowing and recovery can be assessed.

This monitoring program will be reviewed annually by the NSW Food Authority, if needed adjustments to harvest area management plans, including monitoring program requirements, will be made to ensure adequate food safety risk management is maintained. South Coast Mariculture will work collaboratively with the NSW Food Authority and other relevant government departments and organisations to ensure that potential food safety risks are identified and managed appropriately

3. Benthic Environment Monitoring Program

The benthic environment beneath and surrounding the longlines will be monitored biologically (e.g. benthic invertebrates), chemically (i.e. the composition of elements in sediment) and physically (e.g. the particle size of sediment and video footage/photo comparisons).

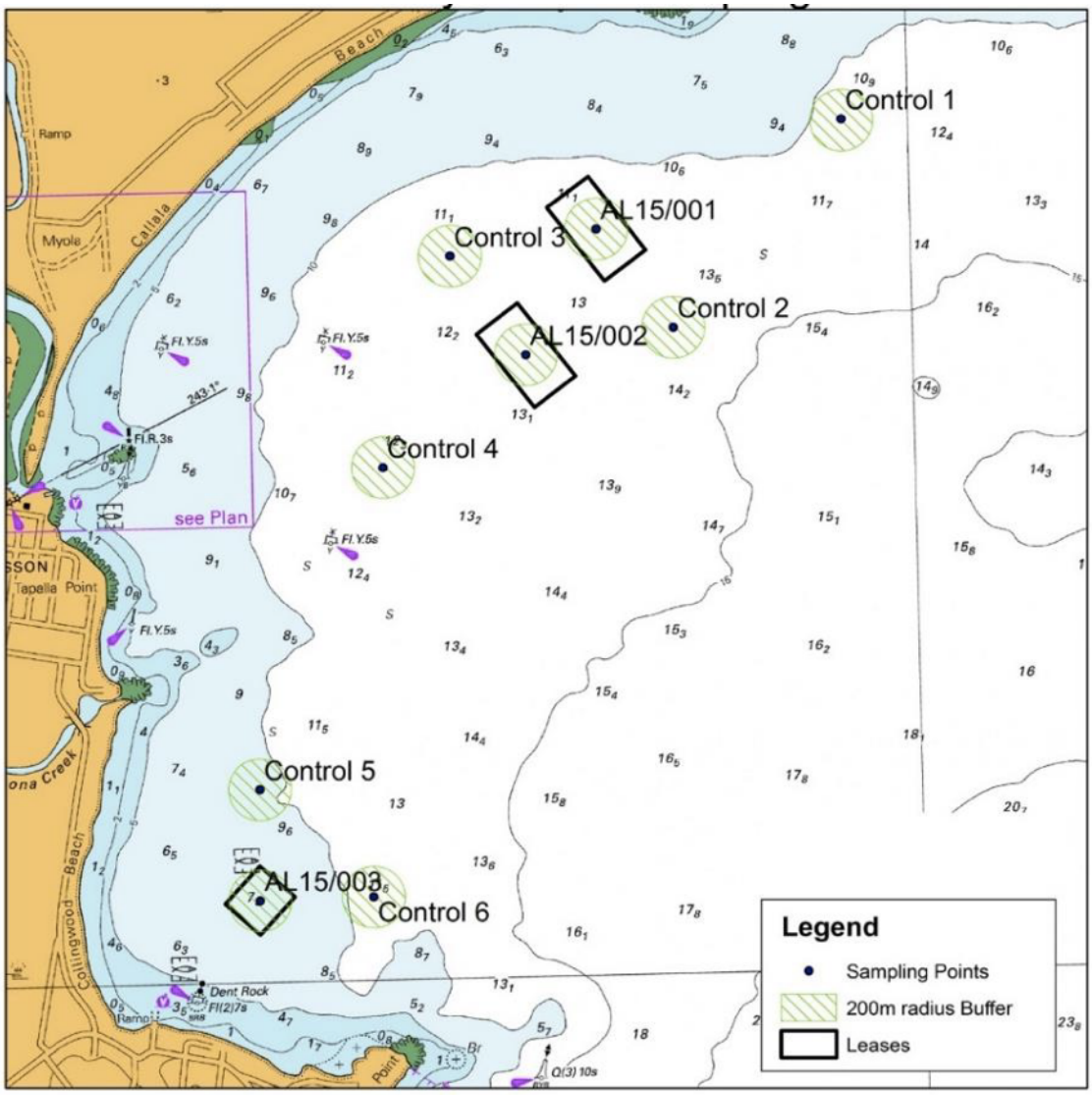
Sediment samples will be collected for determination of particle size, total organic carbon (TOC) and macroinvertebrate communities. Samples will be analysed using a simplified

BACI sampling program similar to that outlined in Hoskin & Underwood (2001) and that is currently required for other marine aquaculture activities in NSW (See Attachment 1).

The monitoring program will include the pre-existing lease (Vincentia), which used raft culture and ceased operation in 2008 (Joyce et al., 2010) and the two new leases (Callala North and Callala South) to the north (Fig. 2). For each of the lease sites there are two control sites which will form the experimental design for the Baseline Survey (nine sites in total). Baseline sampling of the water quality and seabed environment at these nine sites (Fig. 3), prior to the deployment of live mussels, will be carried out in July 2019, following the guidelines established in the South Coast Mariculture (2015) Benthic Monitoring Plan for Jervis Bay that was submitted to the DPI, and with further sampling included.
For the purposes of this monitoring program:

AL 15/001 = Callala North Lease (CN.L) with Control 1 and 2 (CN.C1 & CN.C2)
AL 15/002 = Callala South Lease (CS.L) with Control 3 and 4 (CS.C3 & CS.C4)
AL 15/003 = Vincentia Lease (V.L) with Control 5 and 6 (V.C5 & V.C6)

The results from this Baseline Study will provide a robust background, based on water quality, gross seabed characteristics, sedimentary characteristics (including % Total Organic Carbon), benthic macroinvertebrates and fish, against which any potential future changes from mussel aquaculture activities can be detected. It is noted that this survey and the same method of sampling will be repeated at the same time of year (winter), with the next occasion expected to be in July 2020 and then annually up to a minimum of three years from the commencement of operations.



SITE	LATITUDE	LONGTITUDE
AL15/001	35° 1' 22.967"	150° 42' 41.398" E
AL15/002	35° 1' 49.131"	150° 42' 23.020" E
AL15/003	35° 3' 42.802"	150° 41' 13.188" E
Control 1	35° 1' 0.958" S	150° 43' 43.429" E
Control 2	35° 1' 44.008"	150° 43' 0.162" E
Control 3	35° 1' 27.997"	150° 42' 4.545" E
Control 4	35° 2' 12.196"	150° 41' 46.531" E
Control 5	35° 3' 19.414"	150° 41' 13.744" E
Control 6	35° 3' 42.530"	150° 41' 41.706" E

Source: data from NSW DPI and Australian Hydrographic Service
Datum: GDA94 MGA Zone 56

NOT TO BE USED FOR NAVIGATION
The State of New South Wales, the Department of Primary Industries and Australian Hydrographic Service, their employees, officers, agents or servants are not responsible for the result of any actions taken on the basis of the information contained on the map, or for any errors,

Prepared by Aquaculture Management October 2015

NSW GOVERNMENT Department of Primary Industries

Figure 3: Map showing sampling points for benthic sampling program (Source: NSW DPI 2015). Benthic Environment Monitoring Program

3.1 Macrobenthic Invertebrate Monitoring Program

Observing benthic fauna is a common environmental monitoring tool worldwide (de Jong & Tanner, 2004). Many studies have demonstrated that benthic fauna is a reliable indicator of

environmental changes that are induced by increased nutrient and sediment loads (Ritz *et al*., 1990; Weston, 1990).

A range of factors that may affect the abundance and species diversity of macrofauna within Jervis Bay were identified from available literature, such as depth, sediment size, organic content of sediment, salinity, habitat type, temporal variation, temperature and nutrients (Table 2). These factors were taken into account when developing the sampling design.

Factor	**Approach**
Depth	Controlled (8 to 10 m)
Sediment size	Controlled (sand and coarse sand) / measured
Organic content sediment	Measured
Salinity	Controlled/measured (equivalent areas)
Habitat type	Controlled (all soft sediment)
Temporal variation	Small scale (animal activity) – Controlled (samples collected same time of day) Medium scale (season) – Controlled (sites sampled in seasons) Large scale (annually) – Controlled (sites sampled each year)
Temperature	Measured
Nutrients	Measured (both for sediment samples and water)

Table 1: Important factors that may affect the abundance and species diversity of macrofauna within Jervis Bay and how this study will address them

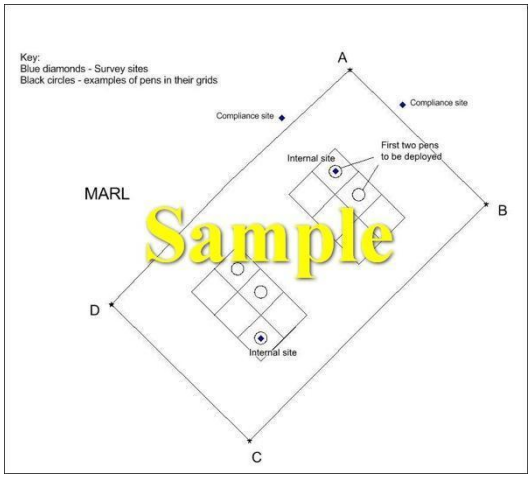
3.1.1 Invertebrate Monitoring Locations

Sites will be monitored within the leases, adjacent to the leases (compliance sites – Control 2 & 3. 5 & 6) and at two control sites – Control 1 & 4). The compliance sites will be located approximately 300 m from the boundary of the lease. The control sites will be located not less than 500m from the lease boundary.

The minimum distance of 500 m from the South Coast Mariculture mussel lease is considered to be sufficient for the control sites to be independent of the lease based on the results of previous studies on more intense nutrient producing activities such as sewage outfalls. A control site at the creek mouth may be considered for monitoring the Vincentia lease to help to validate the impact of background nutrient levels discharged from the creek. A 10 ML daily discharge of secondary treated sewage for example, is generally limited to

within 300 m of an outfall for the majority of variables (Smith, 1996; Smith, 2000). GPS coordinates of each site will be recorded so that subsequent sampling can be undertaken within the same area.

A)



B)

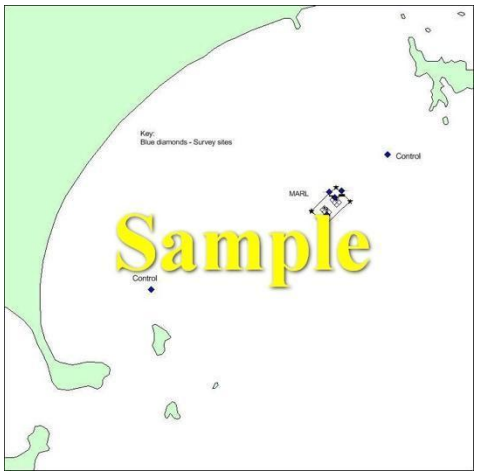


Figure 4: Examples of sampling locations (A) within and adjacent (compliance: 300 m) to the lease and (B) remote (control) to the lease

3.1.2 Sampling Parameters

Data on the abundances and species diversity (e.g. richness, Shannon-Wiener, evenness) of benthic macroinvertebrate taxa will be subjected to both univariate and multivariate analyses to determine whether any impacts are present. Thus, the overall abundance of individuals and the different measures for species diversity will be subjected to ANOVA (factors of site and time) with data transformations undertaken as appropriate. The presence of significant differences between sample sites (and any interactions with times following subsequent sampling events) will be used to infer whether impacts are present. If appropriate, taxa will be allocated to functional groups, such as feeding guilds or “pollution-

tolerance" guilds, and similar univariate analyses undertaken. If certain taxa are ubiquitous and sufficiently abundant, then they may be also subjected to ANOVA.

For multivariate analyses, data on the numbers of individuals of each of the different taxa will be subjected to the Bray-Curtis similarity measure (following appropriate transformation) and non-metric multidimensional scaling (nMDS) ordinations used to visualise any trends in the data using PRIMER 7 (Clark *et al*., 2014).

Permutational Analysis of Variance (PERMANOVA - Anderson *et al*., 2008), will be used to detect whether there are any significant differences between sample sites (and any interactions with times, following subsequent sampling events), with these being used to infer whether impacts are present.

Analysis of Similarities (ANOSIM - Clarke & Green, 1988), and the accompanying R-statistic value, will also be used to determine the extent to which the benthic macroinvertebrate assemblages are related to sample site or time. Similarity Percentages (SIMPER - Clarke, 1993) were used to determine the taxa which typified the benthic macroinvertebrate assemblages in each sample site and/or time and which distinguished between those *a priori* groups, taking any interactions into account.

3.1.3 Sampling and Analysis

Six sediment samples will be collected at each sampling location by using an appropriate sample grab. Macrofauna (animals greater than 1.0 mm) will be extracted from the core samples by sieving through a 1mm mesh brass sieve within one day of collection onsite. The sieve residue will be stored in 70% ethanol and transported to contracted laboratory for analysis.

Taxa will be counted and identified to family level for polychaetes, bivalves and gastropods and certain crustaceans and to order, class or phylum for other taxa and the measures of abundance and species diversity will be recorded. These two variables have been chosen as they have been successfully used in many studies investigating the ecological effects of nutrient producing activities (e.g. sewage pollution) by the means of examining community structures (Underwood & Peterson 1988; Roper, 1990; Underwood & Chapman, 1995). Macrofauna samples will be preserved in buffered formalin in seawater (Underwood & Hoskin, 1999).

Samples to be used for compliance monitoring will be collected in the presence of an independent party for verification (e.g. University of Newcastle survey staff). All samples that cannot be processed by the University or Environmental/Biological contractor are to be processed by a NATA accredited laboratory.

ROVs may be used to obtain video footage of the seabed along transects that extend from beneath the lease to the compliance monitoring site. This footage can illustrate changes in floral and faunal assemblages that are indicative of impact. ROVs are used to monitor changes and implement management strategies before significant impacts occur.

3.1.4 Invertebrate Sampling Frequency

Background invertebrate sampling will be collected prior to the installation of the South Coast Mariculture mussel leases and at least annually after the lease is granted, irrespective of whether the lease is stocked with shellfish. Annual invertebrate sampling as outlined in Section 3.1.3 will be undertaken in winter in June, July or August.

The estimated standing biomass on the South Coast Mariculture mussel leases will be noted at the time of sampling.

Additional invertebrate sampling will be conducted for experimental purposes at the discretion of the proponent and in accordance with needs for the development of the adaptive management approach.

3.2 Substrate Monitoring Program

3.2.1 Substrate Monitoring Locations

To coincide with the invertebrate monitoring program, substrate monitoring will occur within the South Coast Mariculture mussel farm adjacent to the leases (compliance sites – Control 2, 3, 5 & 6) and at two control sites (Control 1 & 4) - Figure 3. The compliance sites will be located approximately 300m from the boundary of the South Coast Mariculture leases.

The control sites will be located not less than 500 m from the South Coast Mariculture lease/s boundary. The minimum distance of 500 m from the South Coast Mariculture lease/s is considered to be sufficient for the control sites to be independent of the lease based on the results of previous studies on more intense nutrient producing activities such as sewage outfalls. A control site at the creek mouth may be considered for monitoring the Vincentia

lease to help to validate the impact of background nutrient levels discharged from the creek. A 10 ML daily discharge of secondary treated sewage for example, is generally limited to within 300 m of an outfall for the majority of variables (Smith, 1996; Smith, 2000). GPS coordinates of each site will be recorded so that subsequent sampling can be undertaken within the same area.

3.2.2 Sampling Parameters

Sediment samples will be collected for determination of particle size and total organic carbon (TOC).

3.2.3 Sampling and Analysis

Six sediment samples will be collected from each sampling location using a suitable grab sampler. The same sites and plots used to collect the cores for macrofauna analysis will be used to collect these samples. The cores of sediment will be refrigerated or frozen until analysed in order to prevent microbial degradation.

The Total Organic Carbon (TOC) in the sediments will be estimated using appropriate analytical techniques e,g, ASTM D 4129-82 Modified

Grain size will be assessed using a sediment shaker containing a nested series of sieves from 0.063mm to 4mm and GRADISTAT (Blott & Pye 2001) used to calculate mean grain size and percentage mud in each sample.

Video and photo documentation of the seafloor beneath the longlines may also be used to assess the impacts of the South Coast Mariculture leases on the benthic environment at various stages. Recovery rates; fallowing for example, may be assessed using this technique. These results will also be used to monitor and assess the impact of *in situ* cleaning of biofouling.

Samples to be used for compliance monitoring must be collected in the presence of an independent party for verification (e.g. University of Newcastle survey staff). All samples that cannot be processed by the University or Environmental/Biological contractor are to be processed by a NATA accredited laboratory.

3.2.4 Substrate Sampling Frequency

Substrate sampling beneath the longlines, at the compliance and at the control sites will occur prior to the commencement of activities and will be conducted concurrently with water quality sampling.

Background substrate sampling will be collected prior to the installation of the South Coast Mariculture lease/s and at least annually after the lease is granted, irrespective of whether the lease is stocked with shellfish. Annual substrate sampling as outlined in Section 3.2.3 will be undertaken in winter (June, July or August).

The estimated standing biomass on the South Coast Mariculture mussel leases will be noted at the time of sampling.

Additional substrate sampling will be conducted for experimental purposes at the discretion of the proponent and in accordance with needs for the development of the adaptive management approach.

3.3 Reporting

Results for all sites will be reported in the Annual Environmental Report and will also be made publicly available on the South Coast Mariculture website within 12 weeks of the data being obtained from third party monitoring contractors.
(www.southcoastmariculture.com.au)

3.4 Adaptation of Monitoring Program and Response to Significant Impact.

The proposed monitoring program has been designed to identify if any significant changes to the marine benthic environment immediately adjacent to the lease are occurring due to the presence of the farm and will provide the baseline conditions/parameters against which future fallowing and recovery can be assessed. The monitoring program as a whole will utilise total organic carbon (TOC), particle size analysis (physical) and benthic fauna through sampling and visual means (ROV) of the sediments next to the lease areas, at control sites and within the lease to monitor changes that may occur. This monitoring program will be reviewed after a period of time (two years or three sampling events) has elapsed to permit sufficient samples to be collected to provide a high degree of certainty that there are no significant long term impacts resulting from the aquaculture farming activities.

If however, during the monitoring program significant impacts are found then appropriate management regimes such as destocking or fallowing will be employed to allow the natural environmental processes to ameliorate these impacts.

Each site at the start and end of each transect (Figure 4-A) will constitute the compliance sampling locations. At these compliance sites all benthic parameters will be sampled six times. Each active lease area is to have two control sites associated for assessment (Figure 4-B). Each of the control sites is also to have all samples taken six times. These control samples are to be collected concurrently (annually) with the lease monitoring samples. The aquaculture permit holder is to have all triplicate samples and ROV footage analysed at baseline. For the annual surveys all ROV, chemical and physical samples are to be analysed and the benthic fauna samples preserved for subsequent analysis should that be required at both the compliance and control sites.

If a significant impact is found at the compliance sites at the lease boundary from the initial analysis then the benthic fauna samples from each site are to be analysed at the expense of the permit holder and a repeat ROV survey is to be undertaken at all transect sites within a month of the initial survey (Figure 5). If it is determined from the analysis of the ROV footage and/or the benthic fauna samples that a significant impact has occurred then appropriate management regimes will be employed to ameliorate these impacts.

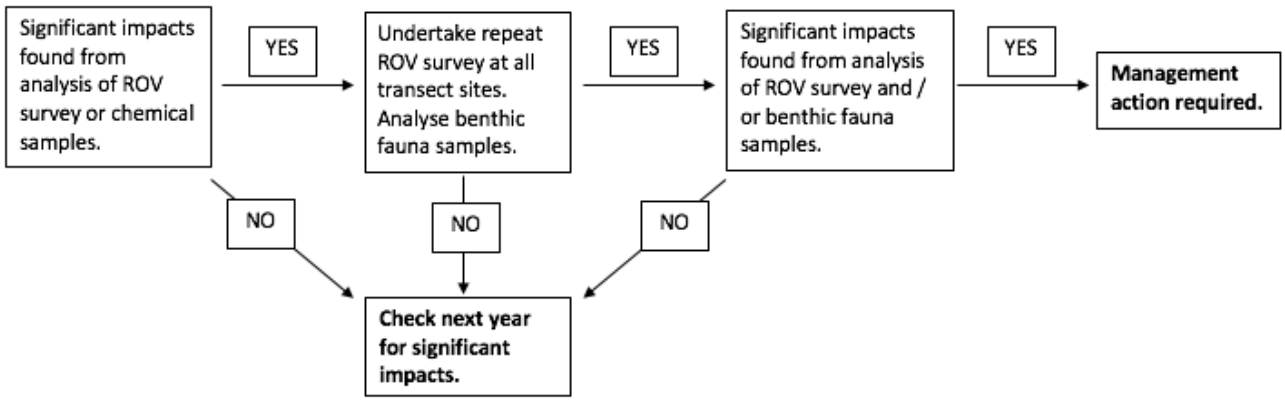


Figure 5: Management process in response to compliance site monitoring

4. SSI-5657 Consent Conditions Table of Reference

The table below lists the SSI – 5657 Jervis Bay Shellfish Aquaculture Lease consent conditions and references the location in the EMP and Appended Sub Plans that the condition has been addressed.

Table 2: SSI – 5657 SCMCAL Consent Conditions and Reference Location in EMP and Appended Sub Plans

Condition	Location of Reference
Condition E1 – Environmental Management Plan Prior to the commencement of operation, the Proponent shall revise and update the draft Environmental Management Plan (EMP), included with the RTS for the development to the satisfaction of the Secretary. The revised EMP is to include: (a) the strategic framework for environmental management of the development; (b) the statutory requirements that apply to the development; (c) the role, responsibility, authority, and accountability of all the key personnel involved in environmental management of the development; (d) the management measures that would be implemented to address environmental issues; (e) how the environmental performance of the development would be monitored and managed; (f) the procedures that would be implemented to respond to any non-compliances and emergencies including a contact number to report emergency events; and (g) include copies of the various strategies and plans that are required under the development.	**The South Coast Mariculture Environmental Management Plan (EMP) plus Sub Plans – Appendices 1 to 7.** a) Strategic framework is set out in Section 2.1. b) Statutory framework is set out in Section 2.2 c) Roles and responsibility of key personnel are set out in Section 2.1. d) Management measures are set out in the individual management plans provided as appendices to the EMP, and briefly outlined in the EMP e) Environmental performance of the development would be managed through annual reporting and independent environmental audits, as set out in Section 2.3, monitoring of water quality & the benthic environment is outlined in section 4.1.3, 4.3 f) Procedures for non-compliances / incidences are set out in Section 2.3 and 2.6 and in the Emergency Protocol in Appendix 4. An emergency contact list is provided at Attachment 7. It is noted that the Planning Secretary must be notified of all incidents/emergencies in accordance with condition E8 and E9 of the approval. g) Copies of all plans have been provided as appendices to the EMP.

Condition	Location of Reference
Condition E2 – Management Plan Requirements The Proponent shall ensure that the Management Plans required under this approval are prepared in accordance with any relevant guidelines, and include: (a) detailed baseline data; (b) a description of: • the relevant statutory requirements (including any relevant approval, licence or lease conditions); • any relevant limits or performance measures/criteria; and • the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures; (c) a description of the measures that will be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria; (d) a program to monitor and report on the: • impacts and environmental performance of the development; and • effectiveness of any management measures (see € above); (e) a program to investigate and implement ways to improve the	**The South Coast Mariculture EMP and attachments covers this requirement.**

environmental performance of the development over time; (f) a protocol for managing and reporting any: • incidents; • complaints; • non-compliances with statutory requirements; and • exceedances of the impact assessment criteria and/or performance criteria; and (g) a protocol for periodic review of the plan.	
Condition	**Location of Reference**
Condition C1 – Deployment of Lease Infrastructure The Proponent shall prepare and implement a Construction and Deployment Environmental Management Plan, to the satisfaction of the Secretary. The plan must be prepared in consultation with Council and any other relevant stakeholders, and: (a) be approved by the Secretary at least one month prior to deployment; (b) include details of the species to be farmed; (c) include detailed plans of infrastructure to be used at each of the proposed Leases, including the final lease layout and mooring plans, and include maximum number, type and colour of buoys to be used at each Lease site; (d) detail all reasonable and feasible design measures used to minimise the potential visual impact of the development from Callala Beach and Vincentia (including orientation); (e) detail the location of the land-based site(s) (if any) for the construction or storage of Lease Infrastructure and indicative timeframe for all deployment activities;	**Appendix 1 - Construction Deployment and Traffic Management Plan.** a) The plan has been submitted to the Secretary for approval. b) Species to be farmed are outlined in Section 2. These align with the approved list of species in the approval. c) Detailed plans of infrastructure to be used are provided in Section 6. d) A qualitative commentary around measures to be implemented to minimise visual impacts is provided in Section 8. e) Details of land-based sites are provided at Section 3. Timetable for deployment is provided at Section 4. f) Details on traffic, noise and waste management are provided at Section 5. g) A Community Stakeholder Communication Management Plan (**Appendix 2**) has been prepared to provide the mechanisms for disseminating information during operation. An outline of communication tools is

(f) include if necessary, details on traffic, noise and waste management; (g) describe the procedures that would be implemented to keep the local community and relevant agencies informed about construction/deployment activities; and procedures to receive and handle complaints; and describe the procedures to decommission any construction site including removal of all construction facilities and restoration of the site to its original state.	provided in Section 10. Details of complaints management is at Section 12. h) Decommissioning is outlined in Section 13.
Condition	**Location of Reference**
Condition C11 – Structural Integrity and Stability Monitoring Program The Proponent shall prepare and implement a Structural Integrity and Stability Monitoring Program, prior to deployment and to the satisfaction of the Secretary. The Program shall include but not be limited to: a) weekly monitoring including an inspection checklist to investigate the effectiveness of the infrastructure design, including how often repairs are made and whether line tautness is being maintained; and b) details of servicing requirements of anchors, ropes, chains and connectors. Servicing must be undertaken at least annually; c) details of actions that would be undertaken to rectify any structural integrity issues, particularly in the event that infrastructure breaks away from the Leases after storm events.	**A Structural Integrity and Stability Monitoring Program is provided in Attachment 8 of the South Coast Mariculture EMP** a) A monitoring schedule is provided at Table A of Attachment 8. b) Details of servicing requirements are provided in Table A. c) Actions to rectify structural integrity issues are outlined in Table B.
Condition	**Location of Reference**

Condition D5 – Disease, Parasite and Pest Management Plan a) The Proponent shall prepare a Disease, Parasite and Pest Management Plan in accordance with the Draft EMP, to assist in the identification and treatment of potential diseases, parasites and pests. **b)** The Plan shall include details on the monitoring of the health of cultured stock and inspection of longline infrastructure to identify any disease or parasite issues that may arise.	**Appendix 7 – Disease, Parasite and Pest Management Plan** a) Details on the monitoring of the health of cultured stock are provided at Section 4 Hatchery. **b)** Details on the inspection of longline infrastructure to identify any disease or parasite issues are provided at Section 5 including details of the removal and harvest of diseased and dead stock is provided at Section 6.
Condition	**Location of Reference**
Condition D9 – Marine Fauna Interaction Management Plan The Proponent shall finalise and implement the Marine Fauna Interaction Management Plan detailed in the Draft EMP prior to the commencement of operation, to the satisfaction of the Secretary. The Plan shall detail measures to remedy, alleviate and reduce the incidence of marine fauna entanglements. The Marine Fauna Interaction Management Plan shall include: a) procedures for the recording of all observations of marine fauna interactions with the lease areas including longlines and vessels, as outlined in the EIS and the RTS; b) contact details of an Entanglement Committee, which would monitor the implementation and effectiveness of the Marine Fauna Interaction Management Plan, and provide advice to the Proponent in the unlikely event of marine fauna entanglement with the Lease infrastructure; and c) response procedures, drills and training that would be carried out to ensure appropriate responses to deal with entanglement incidences.	**Appendix 6 - Marine Fauna Interaction Management Plan** a) Procedures for the recording of all observations of marine fauna interactions are outlined in the Observer Protocol in Section 3. b) Contact details for the Entanglement Committee are provided at Table 1 in Section 4. c) Training and response are outlined in Section 4.2.

Condition	Location of Reference
Condition D12 – Benthic Monitoring Program The Proponent shall prepare and submit a Benthic Monitoring Program, to the satisfaction of the Secretary within 6 months of the date of this approval. The Program shall include but not necessarily be limited to: a) representative background monitoring to establish baseline conditions for the Leases, including benthic fauna and TOC parameters, for a suitable time period; b) the use of multiple control sites and identification of the frequency of sampling to ensure the monitoring program is spatially and statistically meaningful; c) collecting data at least annually after the Leases are approved, irrespective of whether the Leases are stocked with shellfish; d) a minimum monitoring period of at least three years from the commencement of operation; e) identification of trigger(s) and ameliorative measures (including video surveys) in the event that adverse impacts to benthic fauna relevant to the development are identified; f) identify triggers that would decrease monitoring efforts; and g) reporting of the monitoring results to the Secretary and EES annually within the Annual Report, including commentary on any effects of the Leases compared to relevant guidelines, pre-lease sampling or control sites.	**Appendix 3 - Water Quality and Benthic Environment Monitoring Program** a) Representative background monitoring for benthic fauna and TOC conditions is described in Section 3. Baseline sampling will be carried out before stocking and then annually for a minimum of 3 years. b) South Coast Mariculture uses a BACI (Before After Control Impact) approach to monitoring. Six control sites have been identified. A sampling design is outlined in Table 1. c) Section 3.1.4 confirms the sampling will occur prior to installation of the leases and at least annually after the lease is granted, irrespective of whether the lease is stocked with shellfish. d) Baseline sampling will be carried out before stocking and then sampling will be carried out annually for a minimum of 3 years e) Section 3.1.6 and Section 3.2.6 note that if any 'significant changes' to the marine benthic environment are identified, then appropriate management regimes will be employed to ameliorate these impacts (e.g. destocking or fallowing). ROV survey and footage is proposed to be used. f) Section 3.2.6 states that monitoring efforts would be decreased if no significant long-term impacts have been identified. g) Commitment to report monitoring results in the Annual Report is detailed in Section 2.5

Condition	Location of Reference
Condition D14 – Waste Management Plan The Proponent shall develop a Waste Management Plan prior to the commencement of operation, to the satisfaction of the Secretary. The plan is to include measures to ensure that: (a) all waste including biofouling is appropriately stored, handled and disposed of in a timely manner; (b) waste generated by the project is minimised; (c) details of where all waste would be stored; and (d) all waste generated by the Project is classified in accordance with the EPA's Waste Classification Guidelines and disposed of to a facility that may lawfully accept the waste.	**Appendix 5 - Waste Management Plan** a) Measures to ensure waste is appropriately stored, handled and disposed of are detailed in Section 3. b) Minimisation of waste generated is outlined in Section 4. c) Section 3 outlines how waste will be collected and disposed. d) Wastes have been classified and disposal destinations identified for each waste type in Table 1 in Section 2.
Condition	**Location of Reference**
Condition E5 – Community Stakeholder Plan The Proponent shall prepare and implement a Community Stakeholder Plan for the development to the satisfaction of the Secretary. This plan must be approved by the Secretary prior to commencement of deployment, and include: (a) identification of all relevant community and other stakeholders; (b) details of procedures and mechanisms used to inform the community (including local aboriginal communities) and stakeholders of the development's progress and potential employment opportunities; (c) processes to receive and manage feedback and complaints; and	**Appendix 2 - Community and Stakeholder Communications Management Plan** a) A list of community and other stakeholders is provided at Section 2. b) Details of procedures to inform the community are outlined in Section 3. c) Feedback and complaints processes are outlined in Section 4. d) Contact details are provided in Section 5 and Section 6, including a 24-hour contact number.

(d) phone, email and mail contact details for the development, including a 24-hour contact number.	

5. Document Control Register

Appendix 3 – Water Quality and Benthic Environment Monitoring Program						
Version Number	**Date Issued**	**Date Submitted to Department**	**Date Reviewed by Department**	**Revisions Requested by Department or other stakeholders**	**Comments**	**Version Approved by Department**
1	October 2020	22 June 2021	June / July 2021	Yes	Assessed by NSW EES and NSW Fisheries	Revisions required
2	July 2021	29 July 2021	August 2021	Yes	Assessed by NSW EES, NSW Fisheries and NSW Marine Parks	Revisions required
3	August 2021	03 September 2021	September 2021			

6. Consultation

In the preparation of the Water Quality and Benthic Environment Monitoring Plan the following personnel were consulted.

- Dr. Margaret Platell, School of Environmental and Life Sciences, University of Newcastle;
- Anthony Zammit, Manager NSW Shellfish Program, NSW Food Authority, NSW DPI
- Wayne O'Connor, Senior Principal Research Scientist, NSW DPI Port Stephens
- Graeme Bowley (*Senior Policy Officer, Aquaculture),* NSW Department of Primary Industries.

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8. Attachment 1 – Twofold Bay Mussel Farming Monitoring Program

The monitoring program provided below has been designed to identify if there are any significant changes to the marine benthic environment due to the presence of the mussel farms. The monitoring program utilises the parameters of Total Organic Carbon (TOC) and benthic fauna in sediments under lease areas and at control sites to monitor any changes that may occur. This monitoring program is reviewed after a period of time that enables a sufficient number of samples to be collected to provide a high degree of certainty that there are no significant long term impacts resulting from the mussel aquaculture activities. If however, during the monitoring program significant impacts are found then appropriate management regimes will be employed to ameliorate these impacts.

Sampling regime

Within Twofold Bay there are three lease areas which have two associated control sites. Six samples are collected at each site for both TOC and benthic fauna, which results in a total of 12 samples per site. Thirty six samples are collected per lease area and the associated control sites (i.e. 18 TOC samples and 18 benthic samples). These samples are taken annually at a nominated time of the year and in accordance with methods approved by NSW DPI. Aquaculture permit holders are required to provide appropriate facilities to fix, label and store all samples in a secure location approved by NSW DPI.

Processing of samples

Prior to the processing of any samples the aquaculture permit holder has to provide details of the laboratory/s to be utilised for processing of samples, for approval by NSW DPI.

The aquaculture permit holder is to have three of the six lease samples and three of the samples from each of the two control sites analysed for TOC annually. The result of this analysis is to be forwarded to NSW DPI for consideration. If a significant impact is found from the initial analysis then the remaining three samples from each site are to be analysed for TOC by the permit holder. If it is determined from the results of this further TOC analysis that a significant impact has occurred then the fauna benthic samples are required to be analysed and the results provided to NSW DPI. If it is determined from the analysis of the benthic

fauna samples that a significant impact has occurred then appropriate management regimes will be employed to ameliorate these impacts.

The diagram below outlines the process above.

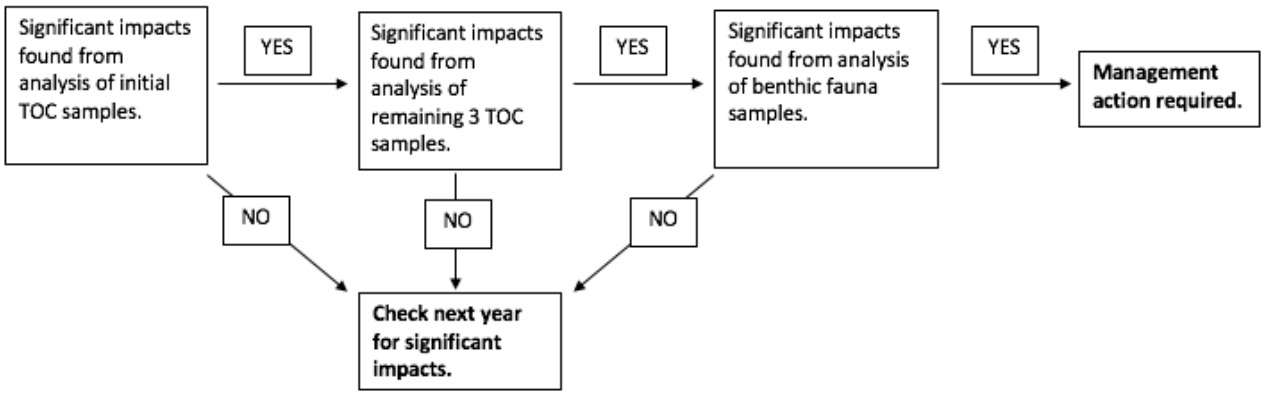

Figure 7: Management process in response to TOC monitoring and compliance