

# Aquaculture & Biosecurity

Services and Solutions



Clarity from complexity



**BMT is a leading international engineering, science and technology consultancy offering a broad range of products and services across the energy, environment, shipping, ports and logistics and defence sectors. Clients are served by professionals located in a network of international subsidiary companies across 5 continents.**

**All BMT companies implement and maintain management systems compliant with internationally recognised standards covering health and safety, quality and environment management, in line with the BMT Group Ltd. accreditation to ISO9001, ISO14001 and OHSAS18001.**

# From modelling environmental carrying capacity through to offering practical management tools, we provide aquaculture customers with end-to-end, integrated solutions.

Whether mapping the sea floor or estimating the benthic footprint and nitrogen carrying capacity of the local marine environment, we have evolved services that are not only highly innovative: they are immediately practical and relevant. Our collaboration with The University of Western Australia, for example, has seen us develop environmental modelling packages encompassing 3D-hydrodynamic, water quality, particle transport and sediment biogeochemical models. When coupled with relevant site-specific information, these integrated packages allow us to accurately predict the impact of sea-cage operations and sea-floor recovery timelines during fallowing.

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# 1

## Habitat Mapping & Site Selection

Site selection is critical to sustainable aquaculture development. We use advanced modelling tools and GIS mapping technologies to determine the suitability, depth and habitat complexity of sites.

BMT supplies spatial modelling tools and services to inform decisions regarding placement of aquaculture infrastructure and monitoring sites. Using local environmental, marine habitat, infrastructure and other salient information, we apply our spatial modelling tools to provide suitable options for aquaculture development. BMT's marine benthic habitat maps are produced by remote

sensing specialists, in consultation with our team of benthic marine ecologists. Depending on the depth and clarity of the water, mapping is undertaken using imagery (aerial or satellite), or hydroacoustic data (sidescan or multibeam backscatter) together with an appropriate amount of ground-truthing (towed video, Remotely Operated Vehicles or spot dives).



# 2

## Environmental Impact Assessment (EIA) & Approvals



Our team has a strong track record of environmental approvals relevant to the aquaculture industry, and a sound understanding of aquaculture logistics.

Sustainable development of marine aquaculture requires an understanding of the proposed production levels, site hydrodynamics, and the carrying capacity of the local environment.

Our understanding of regulatory requirements and aquaculture logistics, allows us to provide an integrated approach to EIA that satisfies the needs of the regulator, the customer and the community.

### The mapping procedure typically comprises:

- a semi-automated image segmentation or classification approach to extract boundaries of distinct benthic features based on ground-truthed data
- manual digitising, where required, to improve the boundary extraction
- validation of the classification based on a subset of the ground-truthed data to assess the accuracy of the classified habitat categories

### BMT provides industry leading advice across the following areas:

- approvals strategy and likely pathways and timing
- preparation of key documentation
- impartial technical advice on the level of environmental impact under differing scenarios
- consultation and liaison with the regulators and stakeholders on behalf of the customer
- development of technical scopes to meet regulator guidance
- implementation of marine and coastal technical studies required for the assessment and approval of projects
- development of environmental management plans
- responses to submissions and appeals
- auditing of compliance



# 3

## Baseline Monitoring

The design and execution of baseline and operational environmental monitoring programs forms a significant component of our work. Our programs consider the needs of the regulator, the safety and logistical constraints and the required statistical sensitivity of the program. This translates to programs which are robust, cost-effective and customer specific.

Our team has experience in the design and interpretation of surveys specific to marine aquaculture operations, and aquaculture infrastructure development. BMT's services are complemented by an expert understanding of environmental thresholds and trigger values. BMT has designed monitoring programs for marine sea-cage and abalone sea-ranching operations.

**BMT works closely with a suite of accredited laboratories to offer the following services relevant to water and sediment quality surveys:**

- water and sediment sampling, including the coordination of laboratory analyses
- monitoring program design, execution and interpretation
- statistical power and cost-benefit analysis to inform survey design
- extensive understanding of Australian (ANZECC/ARMCANZ (2000)) and Western Australian (EPA) environmental protection criteria as well as other jurisdictions
- use of diverless technologies (ROVs)
- extensive understanding of standard approaches to aquaculture monitoring



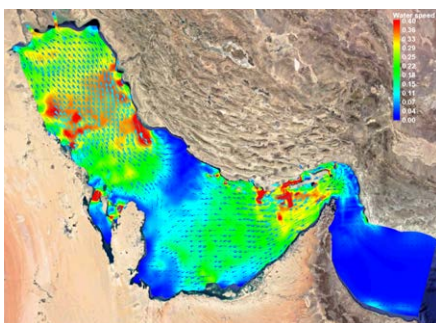
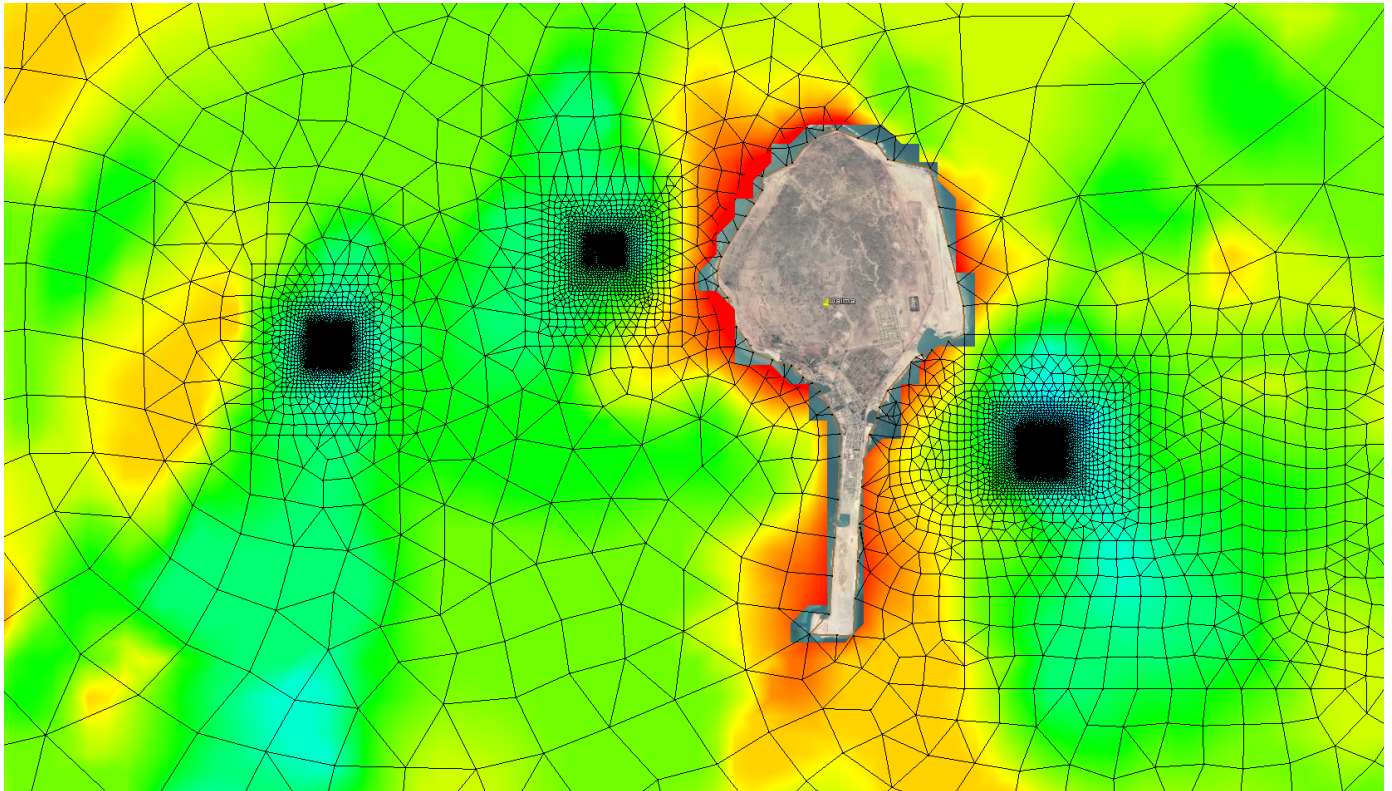




# 4

## Environmental Modelling

Modelling is an effective tool for understanding the dispersion of wastes from marine and coastal aquaculture developments. BMT's custom models assist customers with decisions regarding placement of infrastructure and determine the environmental footprint of the proposed operations.



BMT employs state-of-the-art models allowing detailed investigation of the fate and transport of excess feed and fish waste, and the carrying capacity of the marine environment. The models are fully customisable and can be tailored to suit the size of the project.

Through our collaboration with The University of Western Australia,

we have developed environmental modelling packages, encompassing 3D-hydrodynamic, water quality, particle transport and sediment biogeochemical models. These packages can be integrated with relevant site-specific information to allow for prediction of impacts from sea-cage operations and estimation of sea-floor recovery timelines during fallowing.



# 5

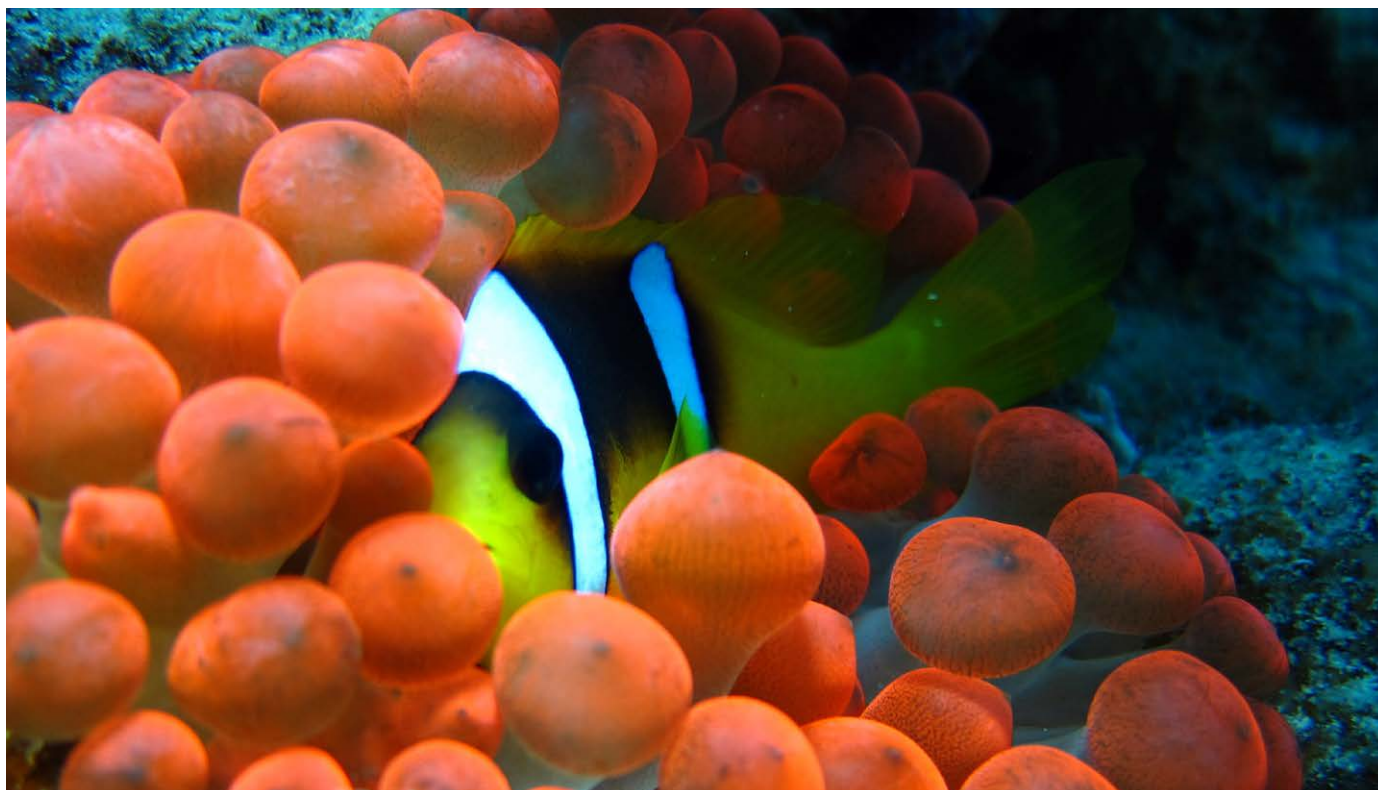
## Environmental Management

BMT is an industry leader in the development and application of environmental management frameworks for the aquaculture industry, from low-impact sea-ranching operations to major off-shore sea-cage developments.

Development of EMPs is a core element of BMT business. BMT has a clear understanding of the needs of the customer, the regulator and stakeholders. Consistent with best-practice approaches to environmental management, BMT applies a risk-based approach to EMPs using a series of practical, easy to measure, early warning triggers.

Triggers are based upon known environmental thresholds. Development of thresholds requires expert knowledge of relevant environmental 'cause-effect' pathways, the response of key biological indicators, and the point at which measured changes in the indicators become ecologically relevant.

EMPs are critical documents that provide confidence to the regulator and the community that the wastewater discharge is sustainable and manageable under Australian and internationally approved environmental quality management frameworks.



BMT has prepared EMPs for the following sectors:

- aquaculture (finfish & abalone)
- treated wastewater (primary & secondary treated sewage)
- post desalination process 'brine'
- salt production waste 'bitterns'
- industrial cooling water

We provide practical management solutions via:

- development of appropriate guidelines/environmental triggers
- implementation of a risk-based approach to management
- use of simple, easy to measure environmental indicators
- consideration of safety, logistical constraints and budget
- recommendations for contingency responses/planning
- deployment of diverless monitoring technologies (ROVs)
- use of innovative approaches, including research into the application of eDNA technologies

## Recovery Modelling

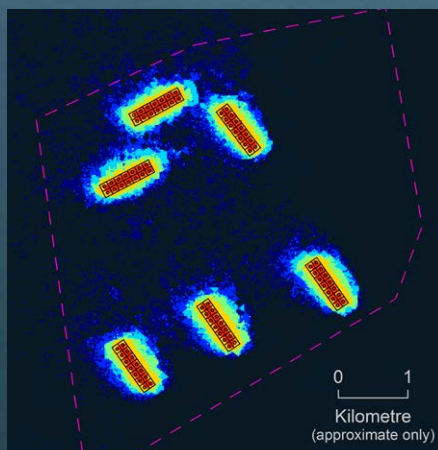
BMT has developed a suite of practical modelling tools, including a recovery module which can be used to inform management decisions.

BMT's modelling tools were developed under the Australian regulatory environment where it is important to not only understand the likely impacts of aquaculture operation but also the extent to which impacts are manageable.

BMT has developed a recovery module which links directly with the hydrodynamic and particle tracking model. Recovery times are estimated by calculating the time required for the benthic environment to return to base conditions.

The approach has successfully been applied in Australia, where the module was used to inform likely fallowing times and the size of the zone required to sustain ongoing aquaculture operations. The module bridges the gap between the EIA process and the need to determine whether the impacts are manageable (and therefore acceptable) under established environmental management frameworks.





**BMT's modelling tools, combined with our scientific and ecological expertise, provide our customers with answers to the following questions:**

- Where should the infrastructure be placed to achieve the required environmental outcomes?
- What is the environmental footprint of the proposed operation under differing scenarios?
- Will aquaculture feed and faecal wastes impact sensitive marine flora and fauna?
- What is the carrying capacity of the local environment?
- What level of production can be achieved without compromising environmental objectives?
- Are the estimates provided by historical models accurate and can they be improved?



# 7

## Biosecurity - Application of Environmental DNA Technologies

Environmental DNA (eDNA) is an exciting new approach for detecting the presence of marine species.



eDNA are trace amounts of DNA obtained from environmental substrates (such as water or sediment), rather than directly from a biological source. This preserved, but often degraded, genetic material provides a means to audit species composition and communities at a given location.

### Potential applications of eDNA include:

- biosecurity: to detect the presence/absence of introduced marine species
- conservation: to detect the presence/absence of threatened species
- environmental impact assessment: baseline/ongoing monitoring and evaluation; audit
- climate change impact: understanding regional changes in species composition

### Benefits

BMT is funding the Trace and Environmental DNA (TrEnD) Laboratory at Curtin University, in an Australian Government ARC-Linkage funded (2016-2019) project, to develop eDNA tools for our customers.



### We expect that eDNA tools will become an accepted approach in future aquaculture monitoring and management programs. eDNA sampling and analysis has many potential advantages over traditional surveying methods, including:

- highly cost-effective monitoring compared to traditional survey methods
- more comprehensive data sets detecting an increased number of species when compared to traditional visual surveys (e.g. eDNA provides differentiation of closely related species and identification of cryptic individuals)
- rapid sample collection that is non-destructive to habitats, flora and fauna
- accurate method for undertaking species census studies
- diverless monitoring techniques that reduce occupational safety risks
- fast turn-around time for results.
- provision of consistent results between monitoring programs, independent of surveyors

# 8

## Diverless Monitoring – Application of ROVs

BMT has developed systems to remotely collect video footage, images and samples from beneath aquaculture infrastructure.

ROVs are remotely operated vehicles that can be deployed as an alternative to SCUBA diving. BMT has access to a range of ROVs. Observation class ROVs are used for portability and ease of deployment. Larger inspection- or work-class ROVs are used for larger payload, deeper work or stronger currents. Our ROVs are fitted with high-definition camera systems. Lasers are used to accurately measure benthic features such as coral colony size or areas on the seafloor.

**ROVs are small enough for air transportation, and can be sent anywhere in the world at short notice. BMT has the capacity to utilise ROV survey techniques for:**

- habitat mapping and habitat health surveys (coral, seagrass, macroalgae, marine invertebrates)
- Identification and enumeration of marine fauna, including demersal fin-fish species
- water and sediment sampling
- deployment and retrieval of water quality monitoring equipment
- aquaculture site inspection
- aquaculture compliance monitoring





# 9

## Project Management & Field Operations

BMT will deliver your project safely, on time and to the highest technical standard.

### Field operations

The safety of our personnel when collecting environmental data is paramount to BMT's work.

To ensure field work is undertaken effectively, BMT has a dedicated operations team, which includes an Operations Manager and Dive Officer. All field trips are coordinated by a dedicated Field Lead who is responsible for the daily field operations. Each of BMT's Field Leads has a strong understanding and experience with BMT's HSEQ systems and field procedures. BMT's fieldwork is supported by our comprehensive suite of well-maintained field equipment and all diving is undertaken to a minimum of AS/NZS 2299.1.2015.

### Project management

Our commitment to timely and effective execution of projects is underpinned by BMT's OHSAS 18001, ISO 14001 and ISO 9001 accredited Integrated Management System. Our Integrated Management System ensures compliance with legislative requirements and incorporates an Integrated Policy, procedures, safe systems of work and structured roles and responsibilities for all staff.



**BMT understands that good project management is critical to the success of a project. All our projects incorporate the following project management principles:**

- clear communication: with the customer and the regulator (and where necessary, the community)
- procedures: formalised procedures for project management, project knowledge control, document filing and resourcing
- systems: commitment to systems development, maintenance and review
- training: ongoing training for technical and administrative staff
- indexing: the use of a project-based document indexing system coupled with a fully-integrated enterprise resource planning software
- team work: collection, analysis and presentation of project data is coordinated through BMT's dedicated operations and data management teams
- project closeout: evaluation of project performance to ensure completion and identification of best practices for application in future projects

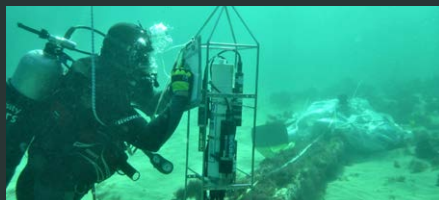




# Innovating across sectors

At BMT we strive to do it smarter, safer and faster while maintaining consistently high standards. This is reflected in our commitment to offer high quality service at a competitive price and our ability to continuously develop new and innovative products across a range of business sectors.

## Water & Wastewater



We help customers predict, monitor and manage the environmental impacts of ocean outfalls. Over two decades, we've built up an unsurpassed level of corporate knowledge about the local issues affecting ocean discharge in both temperate and tropical waters.

## Resources



Over the past two decades, we have provided our scientific and engineering expertise to assist customers in the Resources sector to obtain and maintain their social licence to operate.

## Energy



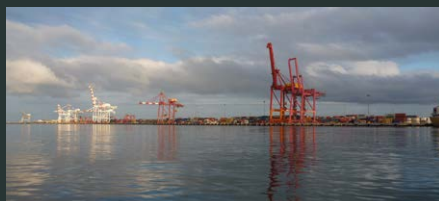
We know the regulatory pressures and demand for high quality, safe environmental monitoring faced by our Energy customers, and use ROVs and other novel data collection methods to provide them with safe, high quality, cost-effective solutions.

## Industrial & Power



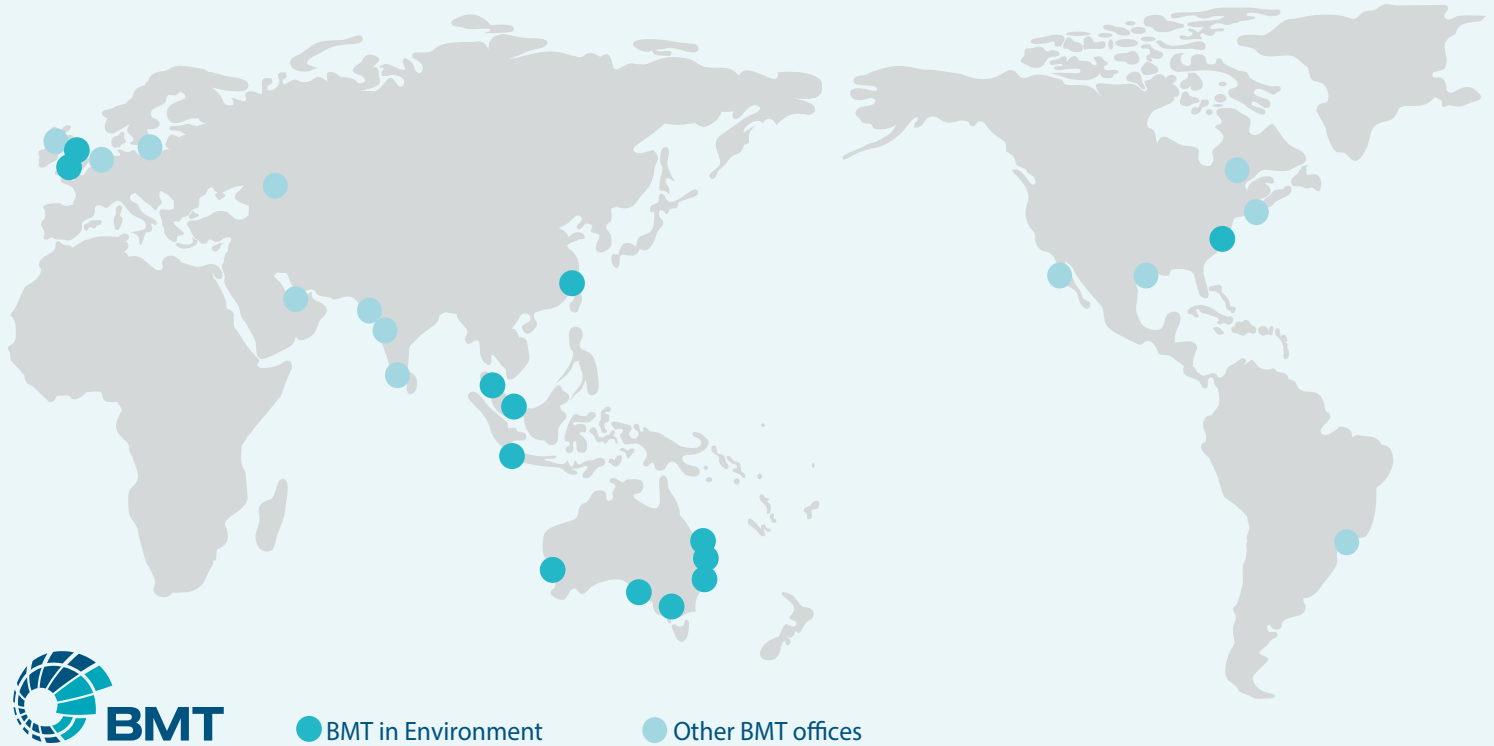
Through our understanding of regulatory processes and the first-principles of trigger level derivation, we have been able to assist our Industrial customers move to more workable and appropriate licence conditions.

## Ports & Harbours



We have developed web-linked remote camera systems for monitoring dredge plume trajectories and beach wrack; real-time independent dredge tracking tools and innovative water quality monitoring techniques for our customers, including the use of the latest eDNA techniques.

**BMT provides environmental services to marine aquaculture developments and has a thorough understanding of related technical issues, management approaches and regulatory requirements.**



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