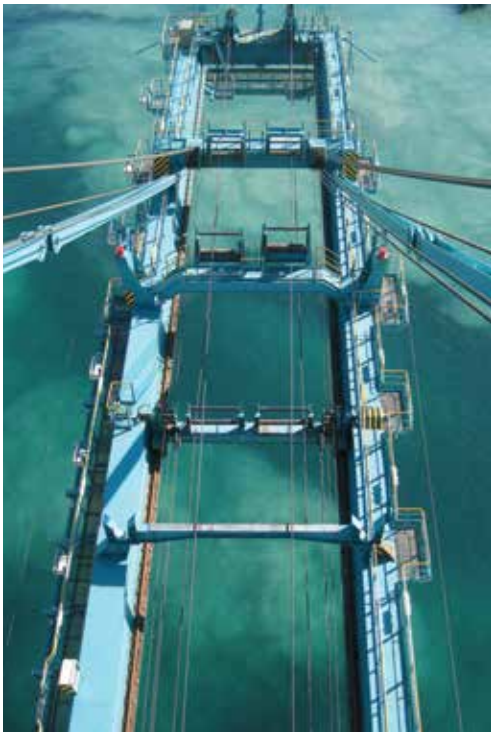
BMT

Clarity from complexity

Port environment and engineering in balance



Designing engineering practicality into environmental plans

Designing environmental impacts out of engineering projects

At BMT, we offer a collaborative and integrated approach in marine science and engineering. For port owners and operators, the law unintended consequences can be costly. For example, without an understanding of port engineering and construction, an environmental management plan may commit you to a monitoring and management plan that can unnecessarily impact your project delivery schedule and cost. Equally, without an understanding of marine science, you may adversely impact the environment, which will lead to both environmental and reputational damage.

Engaging BMT provides our clients access to:

- Our staff who are continually pioneering ways to do things better for our clients and our industry-leading work
- Our cross-disciplinary expertise allowing us to provide an integrated marine engineering and environmental solution to our clients including field data collection
- Robust and defendable technical assessments using our in-house numerical modelling software TUFLOW FV and other state-of-the-art tools
- Our strong relationships with regulatory agencies and a proven track record with gaining approvals
- Our professional reporting, presentation and communication skills.

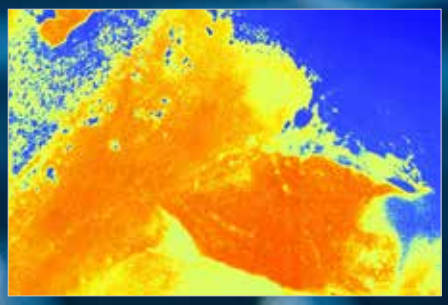
Environmental science, informed by engineering knowledge

Marine Dredging Programs

We have a wealth of experience and knowledge in the environmental management of both capital and maintenance dredging campaigns spanning methods from cutter-suction, trailer suction hopper and excavation to agitation and sand bypassing. This experience together with our complementary services, including hydrodynamic modelling, data analysis, field operations and project management, provides you with an integrated approach to dredge campaign management.

Our dredging expertise encompasses the following areas:

- Environmental impact assessment (EIA)
- Dredge material characterisation
- Preparation of sea dumping permits
- Reclamation advice
- Design of pre-, during- and post-dredging monitoring and management programs
- Preparation of environmental management plans
- Environmental and compliance reporting



Marine Habitat Mapping

We use custom mapping technologies to determine the habitat complexity of sites, including the positioning of potentially sensitive marine flora and fauna. Our mapping products, together with our complementary skills in marine ecology, add value to projects by supporting decisions regarding the positioning and timing of dredging operations. While the positioning of port and harbour infrastructure (including access channels and turning basins) is often constrained, our expertise is used to minimise environmental impact, without compromising project objectives, thus satisfying the needs of vested stakeholders. Our process typically comprises:

- A semi-automated image classification approach to delineate boundaries of distinct habitat
- Manual digitising, where required, to improve the delineation of marine habitat boundaries
- Validation of the habitat classification to assess the accuracy of the classified habitat categories

Biosecurity – 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, environmental impact assessments and conservation.

This method offers many advantages over traditional surveying:

- Cost-effective with rapid sample collection that is non-destructive to habitats, flora and fauna
- Diverless monitoring techniques that reduce occupational safety risks
- Non-reliance on individuals with taxonomic expertise, provision of consistent results between monitoring programs, independent of surveyors
- More comprehensive data sets detecting an increased number of species
- Fast turn-around time for results

Water and Sediment Quality Monitoring

The design and implementation of water and sediment quality programs for ports and harbours 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 focused.

Our specialist services include:

- Water and sediment sampling and coordination of laboratory analyses
- Direct toxicity assessment and ecotoxicological assays
- Design and interpretation of biological and oceanographic surveys
- Assessing the relationship between water movement and exchange processes, pollutant loadings and resultant quality in natural waterways
- 1, 2 and 3D computer modelling of water quality within receiving waters such as lakes, estuaries and oceans
- Computational fluid dynamics modelling of diffuser releases

Marine, Freshwater and Terrestrial Ecology

We are experts in the design, execution and interpretation of ecological investigations. Our extensive field experience ensures our field surveys are planned and executed, with the highest regard for quality, safety and value. Our ecological node leaders have years of industry experience and have published extensively in the scientific literature. This translates to fit-for-purpose and robust survey designs. We specialise in:

- Seagrass and macroalgal, mangrove and coral health
- Flora and fauna species and community surveys
- Ecological monitoring programs and associated statistical analyses
- Coastal wetland mapping
- Introduced marine species and pests
- Ecotoxicology
- Stable isotope analysis
- Use of diverless technologies (ROVs)
- Use of innovative approaches, including eDNA technologies

Environmental Impact Assessment and Approvals

Our team has a strong track record of environmental approvals relevant to ports and harbours, and the expertise to offer an integrated approach to EIA in Australia and abroad. The construction and/or operation of ports and harbours carries with it inherent risks to the marine environment. We have the necessary expertise to advise customers on these risks and provide practical management solutions and approvals advice and enjoy strong, professional relationships with environmental regulators.

Our specialist services include:

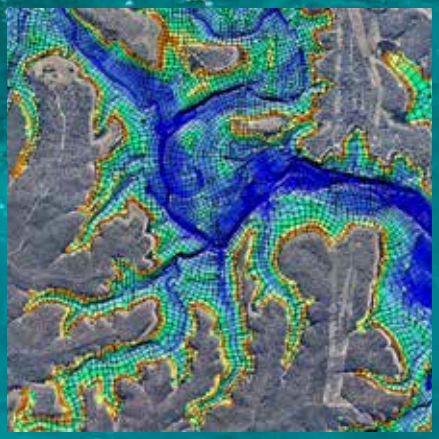
- Approvals strategy, likely pathways and timing
- Project management of large scale EIA involving other specialist suppliers
- Preparation of key approvals documentation
- Impartial technical advice on the likely level of environmental impact under differing scenarios
- Consultation and liaison with the regulators and stakeholder on behalf of the customer
- Responses to submissions and appeals
- Translation of final conditions into management plans
- Auditing of compliance
- Oil spill contingency plans
- Wastewater discharge EMPs (for wastewater treatment plants, desalination plants and other discharges)
- Seagrass meadow restoration (using an effective transplantation method developed in collaboration with Western Australian universities and industry)
- Assisting with the procurement process to ensure environmental outcomes are understood and integrated
- Sustainability assessment, planning and rating applications
- Climate change resilience planning

Flood Intelligence

BMT has developed a suite of flood study add-ons to ensure that the information developed in flood studies have meaningful, real-world applications.

Our services include:

- Real time assistance at incident control centres
- Review, improve and develop flood warning systems
- Hydrological assessments of changes to catchments
- Mapping, modelling, interpreting and presenting flood information in formats most useful to the end user
- FloodIntel: a highly intuitive online flood intelligence system
- GIS-based flood damage and evacuation capability assessments
- 2D/1D and 2D flood modelling of rivers, creeks and urban drainage systems
- TUFLOW: industry leading hydraulic modelling software



Hydrology and Flood Hydraulics

BMT has a specialist team of flood engineers with extensive experience in hydrologic and hydraulic studies using a wide range of modelling software, including in-house developed TUFLOW.

Our team of specialist engineers apply industry best-practice approaches to the following services:

- Development of practical floodplain management plans
- GIS-based flood damage and evacuation capability assessments
- Options assessment for developments and structural mitigation
- Coastal lake flooding and dynamic entrance breakout analysis
- Dam break analysis
- Urban stormwater pipe network and retardation basin design and analysis
- Flood impact assessments for property and infrastructure developments
- Flood data collection and interpretation
- Training and peer review

Environmental Management

We bring a clear understanding of the environmental management needs of the customer, the regulator and the community. Consistent with best-practice approaches, we apply a risk-based approach to EMPs using a series of practical, easy to measure, early warning triggers for environmental assessment and management. 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.

We specialise in:

- Dredging and reclamation EMPs
- Operational EMPs for ongoing management of infrastructure and vessels
- Water and sediment quality EMPs
- Marine habitat EMPs, e.g. seagrass or coral health management
- Introduced marine pest management plans
- Floodplain risk management plans including cost benefit assessments, flood risk and emergency response mapping

Coastal and marine engineering, informed by environmental knowledge

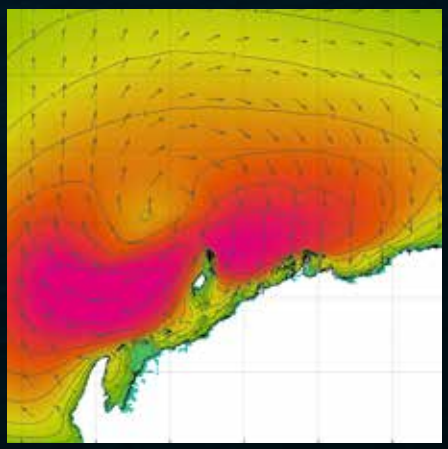
Masterplanning

'Site' and 'purpose' dictate the appropriate nature and design of many key components of many coastal, port and harbour developments. We manage the whole process from concept to construction but are particularly skilled in the technical and economic assessment of potential options.

With our environmental capabilities, we also focus on creating port masterplans that reduce the environmental impacts associated with their development. That is the consideration we bring to bear in our design and project management of wharf structures, breakwaters, seawalls, shipping channel and aids to navigation.

We are experienced in delivering the multidisciplinary approach required in your master-planning process. This includes:

- Defining port marine design criteria
- Site investigations
- Port planning and development
- Process and systems simulation modelling
- Barging and transhipment studies
- Channel design
- Mooring and berth operability studies
- Port optimisation (using BMT's REMBRANDT simulation model)
- Construction programme management



Hydrodynamic and Wave Modelling

Numerical hydrodynamic modelling is central to the design of ports and harbours development, informing assessments of potential impacts and environmental footprints.

Through our hydrodynamics and environmental impact work, we assess and advise on the water quality inside a port or harbour through flushing modelling, furthermore we are also able to advice on the tranquillity inside a port and ensure that it provides safe conditions to the users. Working with both our own industry standard modelling software (TUFLOW) and others, we provide the relevance and accuracy of data on which to base key decisions, grounded in our work for many major port and harbour facilities in Australia.

Our services include:

- Hydrodynamic, sediment transport and morphological modelling
- Water quality modelling (tidal flushing study) and monitoring
- Design and implementation of metocean data acquisition
- Management and implementation of metocean site investigation
- Wave modelling and establishment of design conditions
- Forecast and hindcast services
- Storm surge, cyclone and global wind monitoring

Dredging

Capital and maintenance dredging projects are very specialist areas, so when the need arises, it can be hard to find local resources and experience. We are fortunate to have covered most of such projects in the State and retain the knowledge and historical data from these projects to inform new challenges. As well as experience in design and site supervision, we have built up experience in negotiating with and working alongside the international and local dredging contractor community and offer the following services:

- Dredging studies and assessments
- Defining or scoping capital dredging works
- Option selection for dredged material disposal, reclamation and ground improvement works
- Managing hydrographical surveys
- Maintenance dredging works
- Offshore geotechnical investigations
- Sand bypassing and beach renourishment
- Unexploded and explosive ordnance investigation
- Reclamation design and simulation

Coastal Structure: Breakwaters and Seawalls

Having worked on many sites, we understand how specific site conditions affect the design and construction of breakwaters and seawalls, such as rock armour materials and/or concrete armour units. We work across the project lifecycle from concept to construction.

Our services include:

- Development of concept: preliminary and detailed design
- Quarry assessment, tender preparation, management and evaluation
- Construction management and site supervision

Aids to Navigation (AtoN)

Aids to navigation is a critical part of a port's infrastructure. AtoN structures provide physical markers to ensure safety to navigation in and out of a port.

We assist you with:

- Selecting the best location for the placement of AtoN
- Design selection of AtoN to suit your need (e.g. chain buoy, spar buoy or fixed pile structure)
- Procurement, construction and installation of AtoN
- Condition inspection of existing AtoN

Coastal Processes and Management

Our experienced and highly-qualified team take a holistic approach to costal management informed by an understanding of the many interrelated processes at work in coastal zones: hydrology, contamination fate and transport, effects on biological receptors. We bring together skills in geomorphology, marine and coastal geology, oceanography and engineering to collect, compile and interpret the factors influencing the health of coastal zones.

We specialise in:

- Maintenance dredging
- Sand bypassing
- Shoreline (erosion) management
- Coastal climate change adaptation plans
- Coastal inundation hazard and risk assessments (storm tide and tsunami)
- Coastal erosion hazard and risk assessments
- Management of the development application and permitting for coastal management strategies

Asset Condition Assessments

Maritime structures are by their nature located in aggressive and corrosive environments, making ongoing monitoring and inspection critical to advising on remaining life, structural capacity and identifying maintenance and repair needs. Their environment can also hamper access and make these needs difficult to assess. Working in collaboration with local AS2299-qualified dive teams, we deliver asset condition assessment in accordance with the Ports Australia's WSCAM (Wharf Structure Condition Assessment Manual) rating system.

We specialise in:

- Assessments of jetties & wharfs, ports & berthing, breakwaters & seawalls, coastal protection & beach control structures
- Whole life asset management

Jetties and Wharfs

We bring a detailed understanding of the external conditions affecting these structures to design cost-effective, robust structures with the required level of protection that will remain safe and functional throughout their design life.

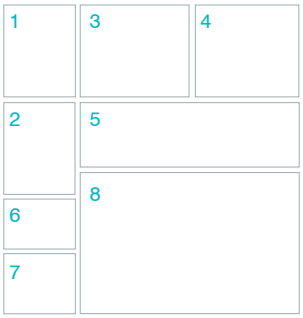
Our services include:

- Development of conceptual, preliminary and detailed designs
- Tender preparation, management and evaluation
- Construction management and site supervision

Additional Services

In addition to our local services in Australia, we and our customers have access to the fantastic credentials and knowledge of our BMT teams in Singapore and Hong Kong. Their work has covered major projects in Asia Pacific across Investment & Planning, Market & Economic Assessments, Machinery & Mechanical Design and Rail.

Selected environmental project portfolio



1. Environmental monitoring sub-programs, 2013-19, for the Port of Brisbane.

We managed and implemented monitoring of the condition of environmental assets (seagrass, mangroves, groundwater, surface water, reef flora and fauna), as well as potential stressors (weeds, dredge plumes, and marine pests). This project documented the health and long-term trends of the environmental condition within and around the port, which provides evidence-based information to support and inform current and future port planning and projects.

2. Drivers-Pressure-State-Impacts-Response (DPSIR) reporting.

Our DPSIR report for the Department of Water and Environmental Regulation, Kwinana Industries Council and the cities of Rockingham and Kwinana focused on Cockburn Sound, an inlet from the Indian Ocean. We provided a thorough assessment of the current and emerging driving forces and pressures on the Sound, its current condition and trends, impacts and management responses. The assessment is helping to identify, plan for and manage existing and emerging risks to protect and maintain the environmental values of the Sound.

3. Kwinana Quay Outer Harbour Development.

Fremantle Ports have proposed to develop a major outer harbour port facility (Kwinana Quay) within Cockburn Sound to accommodate long-term container trade growth. We advised on the environmental impact and the approvals required for the marine component of this proposal, executing the various technical studies required (hydrodynamic modelling, coastal processes, water and sediment quality, benthic habitat, marine fauna, fisheries, ecosystem integrity, marine pests).

4. Sunshine Coast airport expansion.

For this major expansion of the airport at Mudjimba we prepared the marine ecology inputs to the Environmental Impact Statement, filling knowledge gaps in existing baseline values. Using a risk-based approach to assess potential impacts, we created an accurate view of the habitats through acoustic and video surveys and offered strategies to mitigate environmental impacts from construction and operation.

5. Setting the dredging agenda at Outer Harbour, Port of Adelaide.

We have been instrumental in negotiating the scope of environmental investigations and conditions of approval with regulatory agencies on behalf of Flinders Ports for the widening of channels at the Port of Adelaide. Where required, we have worked to improve dredge methodologies to minimise environmental and social impacts and monitor the satisfaction of regulatory agencies and community stakeholders.

6.Yarra River Dredge: investigating options.

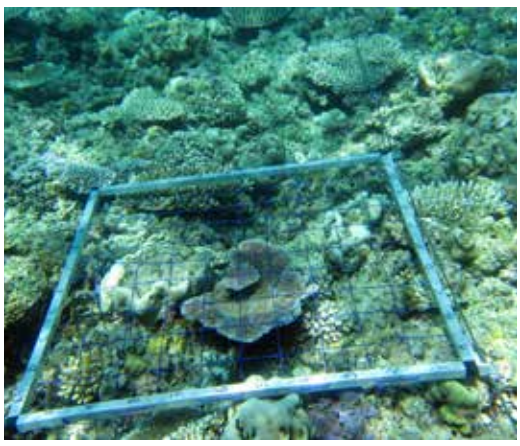
In Victoria, we conducted a soil contamination investigation to provide baseline levels prior to dredging approval. Results of chemical analyses were compared with the draft State Environment Protection Policy (SEPP) for waters of the Yarra River (downstream of Victoria Dock) to give a clear view of impacts from turbidity and water quality to plume formation and spoil dispersion.

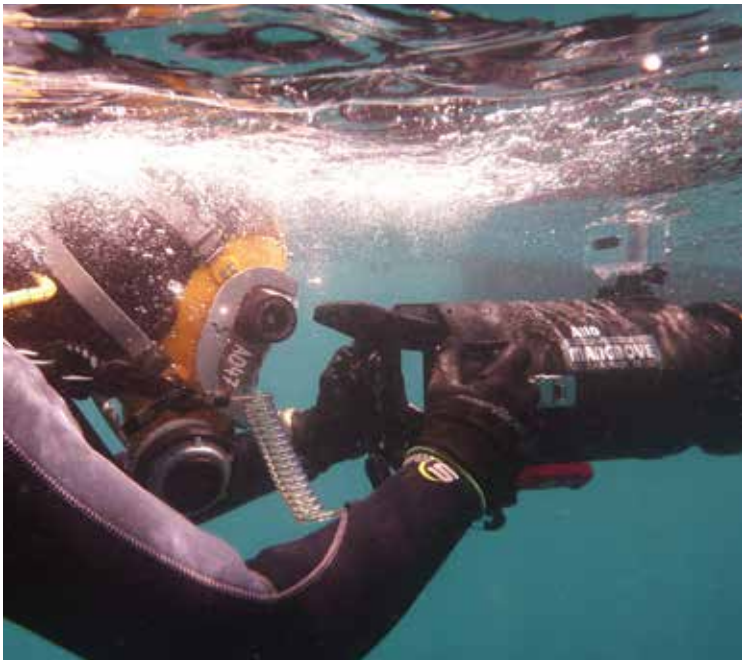
7. Mapping marine ecology.

Our marine ecological assessment for Ports North working on the Cairns Shipping Development programme deployed innovative ways of mapping the marine habitats. Establishing the baseline for proposed dredging and port development saw us using remote sensing, acoustic and video-based techniques as well as more traditional methods such as surveys of fish and crab assemblages using a variety of trap and netting techniques and surveys of benthic macroinvertebrate assemblages using grab sampling.

8. Environmental approvals at Port of Townsville (POTL).

BMT was contracted by POTL to undertake environmental and planning studies and preparation of environmental statutory application documents for the construction of a new Berth 12. This multi-disciplinary assessment identified potential environmental impacts and mitigation measures, requiring detailed assessment of both the State and Federal legislative frameworks.



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DESIGN
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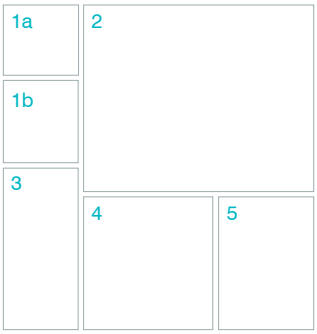
Selected engineering project portfolio.



1. Abbot Point: one location, many roles.

1a. Our work has made a major contribution to Abbot Point in Queensland. For the expansion of Abbot Point's coal terminal, we were able to fast track our detailed design for the jetty, terminal deck and new wharves by embedding our team with our customer in India. Using our expertise in large-scale project management, our team continued from design to the management of this major expansion.

1b. Also at Abbot Point, our work for the Growth Gateway Project for customer Golder Associates has seen us involved in the dredging of 1.1 million cubic meters of material. We provided the detailed design for the size and layout of material containment ponds. Our onshore solution will see materials pumped 5km away to minimise impacts on the Great Barrier Reef Marine Park. As well as designing the ponds, we went on to prepare drawings and contract documentation and seconded a Project Manager to be an integral part of our customer's team.

2. Inner Harbour Deepening Monitoring

Fremantle Ports deepened the Deep Water Channel, Entrance Channel and Inner Harbour to allow 14 m draft ships to access the Fremantle Inner Harbour, which involved the reclamation of seabed at Rous Head. The project involved the dredging of approximately 3.1 million cubic metres of material, with BMT working on the dredging, reclamation and disposal as well as environmental monitoring aspects.

3. Opening Cairns to large cruise ships.

Following on from our earlier work with partners Arup on the Port of Cairns' Cruise Shipping Demand Study, in 2017 we designed a dredged material containment pond for the Port of Cairns' channel improvement project.

The project will see the widening and deepening of Cairns' entrance channel to accommodate large cruise ships, and involves the dredging of 800,000 cubic metres of material. The project saw us bring together technical expertise from marine ecology, marine water quality, coastal modelling and assessment, detailed dredging and reclamation design, flood modelling and geotechnical analysis together with our experience in stakeholder management, consultancy and customer service.

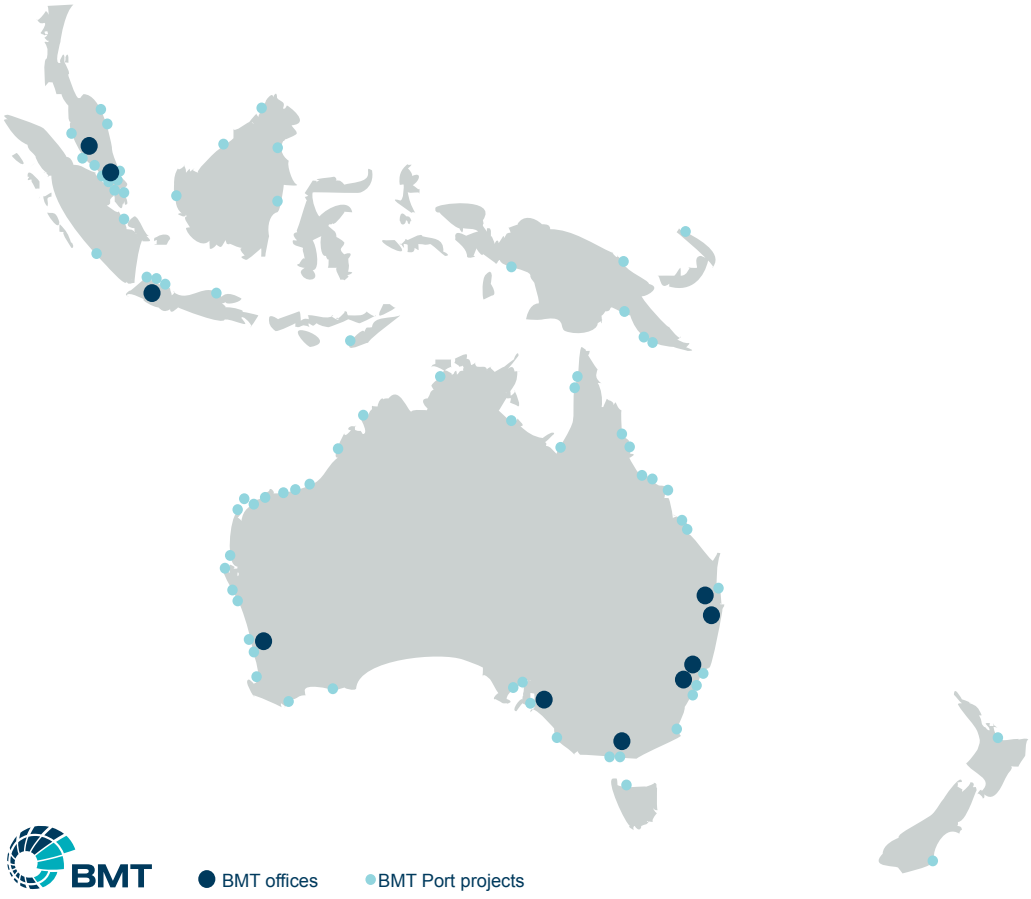
4. James Point: designing and building for bulk products, livestock and Ro-Ro traffic.

As well as creating the reference design for this multi-product, import/export port, we provided overall management of the Preconstruction Phase works for all port and marine components. We also designed the port revetment, making effective use of available materials in a design that proved both robust and cost-effective.

5. Toliara Port, Madagascar: weighing options for a 500,000 tonne p.a. mineral sand export terminal.

We are advising on the siting of this new facility, exploring the practicalities of direct material loading versus transhipment, designing the entrance channel, turning basin, wharf, jetty and armoured causeway, and value engineering each option. Our work has given World Titanium Resources a clear view of the CAPEX and OPEX implications of the decision available to them.

Clarity from complexity



Perth Office

Level 4, 20 Parkland Road
Osborne Park, Western Australia 6017

T: +61 (0)8 6163 4900
E: environment.env@bmtglobal.com

Brisbane Office

Level 8, 200 Creek Street
Brisbane, Queensland 4000 Australia

T: +61 (0)7 3831 6744
E: environment.env@bmtglobal.com

Adelaide Office

5 Hackney Road, Hackney
South Australia 5069 Australia

T: +61 (0)8 8614 3402
E: defence-security.das@bmtglobal.com

Melbourne Office

Level 5, 99 King Street
Melbourne, Victoria 3000 Australia

T: +61 (0)3 8620 6100
E: environment.env@bmtglobal.com

Sydney Office

Suite G2, 13-15 Smail St, Ultimo
Sydney, New South Wales 2007 Australia

T: +61 (0)2 8960 7755
E: environment.env@bmtglobal.com

Bangalow Office

Suite 5, 20 Byron Street
Bangalow, New South Wales 2479
Australia

T: +61 (0)2 6687 0466
E: environment.env@bmtglobal.com

Newcastle Office

126 Belford Street, Broadmeadow
Newcastle, New South Wales 2292

T: +61 (0)2 4940 8882
E: environment.env@bmtglobal.com

Malaysia Office

16-8, Q Sentral, 2A Jalan Stesen Sentral 2
Kuala Lumpur 50470 Malaysia

T: +60 3 2282 8107
E: built-environment.ci@bmtglobal.com

Indonesia Office

Perkantoran Hijau Arkadia, Tower C,
P Floor, Jl TB Simatupang Kav 88
Jakarta 12520 Indonesia

T: +(62) 21 782 7639
E: environment.env@bmtglobal.com

Singapore Office

456 Alexandra Road
#15-01 Fragrance Empire Building
Singapore 119962

T: +65 6517 6800
E: coastal-infrastructure.ci@bmtglobal.com

www.bmt.org