

**HASKONING AUSTRALIA PTY LTD.**

The Owners  
c/o Peter Horton – Horton Coastal Engineering  
29, 31 and 33 Pacific Street and  
23a, 23b and 25c Ocean View Drive  
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Date:	08 March 2017	Contact name:	Greg Britton
Your reference:		Telephone:	+6128854 5002
Our reference:	PA1293-121_L001.F01_20170308	Email:	greg.britton@rhdhv.com
Classification:	Open		

Dear Peter

**Horton Coastal Engineering at NSW Coastal Panel  
Peer Review of Revised Application from a Coastal/Structural Engineering Perspective**

Further to our recent discussions, I am writing to set out my peer review advice in relation to the modified design for coastal protection works at 29, 31 and 33 Pacific Street and 23a, 23b and 25c Ocean View Drive Wamberal. I understand this advice will be submitted to the Land and Environment Court proceedings. Accordingly, prior to setting out my advice I have provided a brief biography. I have also attached a Curriculum Vitae.

**1 Experience of Greg Britton**

Greg is the Managing Director of Royal HaskoningDHV in Australia. He has 40 years professional experience in the investigation, design and documentation, planning, environmental assessment and project management of coastal, estuary and maritime projects.

He has provided expert advice on coastal, maritime and environmental engineering to the NSW Land and Environment Court, NSW Supreme Court, Queensland Supreme Court, Federal Court of Australia and several Commissions of Inquiry. Greg has fulfilled the role of a Court Appointed Expert (CAE) in the NSW Land and Environment Court.

Greg has been responsible for the design and environmental impact assessment of numerous coastal protection works along the NSW coast involving a variety of structural forms including rock, piling, permanent ground anchors, and geotextile containers.

He is retained by Northern Beaches Council to provide expert advice during coastal erosion emergencies at locations such as Collaroy Narrabeen Beach and recently prepared on behalf of Northern Beaches Council the Collaroy-Narrabeen Beach Coastal Protection Works Design Specifications.

**2 Design Development of the Coastal Protection Works**

I confirm I was involved in discussions with following key parties during the design development for the coastal protection works:

- Peter Horton (Horton Coastal Engineering): Coastal Engineer
- Paul Roberts (JK Geotechnics): Geotechnical Engineer
- Richard Yates (James Taylor & Associates): Structural Engineer

### 3. Available Information for Review

The following information was provided for review:

- report by Horton Coastal Engineering:  
*Horton Coastal Engineering Pty Ltd ats NSW Coastal Panel* (Land and Environment Court No. 324345 of 2016), Response to List of Information Required for Section 34 Conciliation Conference
- report by JK Geotechnics:  
Report on Geotechnical Assessment of Proposed Coastal Protection Works at 29, 31 and 33 Pacific Street and 23a, 23b and 25c Ocean View Drive Wamberal
- report by James Taylor & Associates:  
Structural Design Report for Coastal Protection Works at 29, 31 and 33 Pacific Street and 23a, 23b and 25c Ocean View Drive Wamberal
- drawings by James Taylor & Associates:  
Drawings S.01 to S.11, 3 March 2017

### 4. Advice on Key Matters

#### 4.1 Structural Form of the Coastal Protection Works

The structural form of the coastal protection works features two main elements:

- a fixed toe comprising vertical concrete piling and concrete capping beam, restrained by permanent ground anchors<sup>1</sup>;
- a 'flexible' rock revetment immediately landward of the toe.

Each of the above elements is common in coastal protection works. An example of recent use of CFA piles restrained by permanent ground anchors is at South Curl Curl Beach (Northern Beaches Council). Rock revetment structures have been constructed at numerous beach locations along the NSW coast including Stockton Beach (NSW Government). A rock revetment is currently under construction at Kingscliff Beach (Tweed Shire Council).

#### 4.2 Structural Stability

I have examined the reports by Horton Coastal Engineering, JK Geotechnics and James Taylor & Associates (including drawings) and am of the opinion that the proposed coastal protection works would exhibit satisfactory structural stability over the proposed life of 60 years.

#### 4.3 Maintenance of the Works

The proposed coastal protection works can be expected to be a relatively low maintenance structure having regard to the design parameters adopted and the consideration given to durability in the individual

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<sup>1</sup> The vertical piling is to comprise contiguous 600mm diameter continuous flight auger (CFA) piles to full depth (-8m AHD) with smaller diameter CFA 'plug' piles behind to partial depth (below estimated scour level).

structural components. A maintenance management plan for the works should be prepared and approved by the consent authority. I note that such a plan is proposed to be prepared as indicated in the report by Horton Coastal Engineering.

#### 4.4 End Effects

During a severe storm, end effects can be expected to occur associated with the proposed coastal protection works. End effects are already a feature of the beach and in fact the subject properties are themselves prone to this effect from the Manyana development immediately to the south.

The report by Horton Coastal Engineering has demonstrated that the end effects associated with the proposed coastal protection would occur at the southern end of The Ruins and at 23 and 23a Pacific Street. The fate of the latter two properties is already dictated by end effects from other properties immediately to their north (Manyana) and south (19-21 Pacific Street).

In the case of The Ruins, inevitably it is necessary to make a judgement call regarding risk to dwellings and risk to open space. In the case of Collaroy Narrabeen Beach, as a relevant example, the decision was taken by Northern Beaches Council that protection of dwellings was a higher priority, and that end effects into adjacent public land from coastal protection works protecting private properties would be managed in a post storm setting by a combination of natural beach recovery and restoration works carried out by Council as required. Restoration works include regrading of steep erosion escarpments, beach scraping, and the like, with an emphasis on public safety, amenity and access.

I am aware that various consent conditions have been suggested to address any increased erosion of the beach or adjacent land caused by the presence of the works. This is a complex issue due, for example, to the number of end effects that may be at play concurrently and since the circumstances along the beach, such as existence of coastal protection works, can change over time.

My own view is that management of erosion impacts on the public beach should be undertaken by a single authority (local Council). The important matter to resolve is equitable funding to address any increased erosion and sunset clause provisions.

I trust the above meets your current requirements. Please do not hesitate to contact me should you require any clarification or additional information.

Yours faithfully  
Royal HaskoningDHV



Greg Britton  
Managing Director  
Maritime & Aviation



# Curriculum Vitae

## Greg Britton

Maritime & Waterways  
Coastal Maritime Specialist

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Greg is the Managing Director of Royal HaskoningDHV in Australia.

He has 40 years professional experience in the investigation, design and documentation, planning, environmental assessment, and project management of coastal, estuary and maritime projects .

Greg has provided expert advice on coastal, maritime and environmental engineering to the NSW Land and Environment Court, NSW Supreme Court, Queensland Supreme Court, Federal Court of Australia and several Commissions of Inquiry. Greg has fulfilled the role of a Court Appointed Expert (CAE) in the NSW Land and Environment Court.

Greg is a specialist consultant to the Commonwealth Department of Environment, advising on dredging operations and the disposal of dredged material under the Sea Dumping Act, and on coastal processes and coastal planning generally under the Environment Protection and Biodiversity Conservation (EPBC) Act.

### **Nationality**

**Australian**

### **Years of experience**

**40 years**

### **Years with Royal HaskoningDHV**

**5 years**

### **Qualifications and Specialist training**

**1976 University of NSW, BEng (Hons 1) (Civil), University Medal**

**1980 University of NSW, Design and Construction of Coastal and Offshore Structures**

**1981 University of NSW, MEngSc (Coastal Engineering)**

**1987 University of Queensland, Dredging Course**

### **Professional memberships**

**Fellow, Institution of Engineers, Australia**

### **Languages**

**English**

## Professional experience

### **Collaroy Narrabeen Beach June 2016 Storm Erosion**

2016, Collaroy Narrabeen Beach, Australia

Provision of emergency coastal engineering advice to Council, NSW Police, SES and NSW Fire & Rescue, during the severe June 2016 storms at Collaroy Narrabeen Beach. Work involved temporary coastal protection advice, design of temporary structures, advice on evacuation of properties, advice on re-occupation of properties, and advice on works to ensure public safety.

### **Collaroy Narrabeen Coastal Protection Works**

2016-2017, Collaroy Narrabeen Beach, Australia

Preparation of a concept alignment and concept design for coastal protection works along Collaroy-Narrabeen Beach in the aftermath of the June 2016 storms. Key issues involved the location and integrity of existing coastal protection works, geotechnical conditions and constructability. The work included preparation of engineering Design Specifications for the coastal protection works for adoption by Applicants.

### **Wentworth Point Marina, Sediment Disturbance**

2016-2017, Parramatta River, Australia

Investigation of the potential for sediment disturbance and migration of suspended sediment associated with a proposed marina development at Wentworth Point on the Parramatta River. The work involved field trials of disturbance using a design vessel, insitu measurements, calibration of empirical formulae and hydrodynamic modelling.

### **Stockton Boatharbour Redevelopment**

2016-2017, Stockton, Australia

Investigation, concept design, detailed design and environmental assessment for a proposed 26 berth floating marina and related infrastructure at Stockton Boatharbour. Works included dredging and excavation, revetments, and a floating wave attenuator.

### **Collaroy Rock Pool Remedial / Upgrade Works**

2016-2017, Collaroy, Australia

Investigation of remedial/upgrade options for Collaroy Rock Pool in respect of a range of themes established through stakeholder consultation including cleaning operations and maintenance, water quality, safety, accessibility, structural condition, fit for purpose and function, signage and shade.

### **Maintenance Dredging Strategy GBRWHA Ports**

2015 - 2016, Great Barrier Reef, Australia

Preparation of a maintenance dredging strategy for ports within the Great Barrier Reef World Heritage Area (GBRWHA). Considerations included sediment transport environment and sedimentation mechanisms, dredging equipment, environmental risk assessment, beneficial reuse options, sustainability, and economic factors.

### **Palm Beach (Queensland) Submerged Control Structure**

2015 - 2016, Palm Beach, Australia

Investigation, design and documentation, and environmental assessment, in relation to a proposed submerged control structure off Palm Beach with the aim of providing beach stability and enhancing surfing conditions. Work involved extensive numerical modelling and 3D physical modelling, material selection assessment and constructability.

### **Tweed River Entrance Sand Bypassing Project (TRESBP) Management Review**

2016, Tweed River, Australia

Review of background information, operational records and impacts of the TRESBP over a 15 year period, and preparation of advice in relation to future management of the project, particularly for six key review issues. Involved consideration of a Deed of Agreement, Concession Agreement and the performance of the system relative to two key project objectives; maintenance of a clear navigation channel and supply of sand to Queensland.

### **Eden Cruise Terminal Third Party Review**

2015 - 2016, Eden, Australia

Third party review of the detailed design of a proposed cruise terminal at Eden, NSW to cater for ships up to 311m in length. Key issues to address were dredging and dredged material disposal, and the impacts of wash from ships bow thrusters and tugs.

### **Rock Groyne at The Entrance**

2015 - 2016, The Entrance, Australia

Investigation, detailed design and documentation and environmental assessment of a rock groyne and beach nourishment to improve beach amenity for South Entrance Beach at The Entrance.

#### **South Curl Curl Beach Erosion Protection Works**

2015, South Curl Curl, Australia

Investigation, concept design, environmental impact assessment, and detailed design and documentation of erosion protection works. The design solution includes secant piling, capping beam, permanent ground anchors, and rock works.

#### **Oceanlinx Wave Generator**

2015, Port Kembla, Australia

Investigation, preparation of scope of work and specification for removal and disposal of the Oceanlinx Wave Generator. This is a steel framed structure which was placed in the sea, broke free from its original moorings, and is now located approximately 135m from the shoreline off Coniston Beach, Port Kembla.

#### **Cattle Bay Marina Development**

2012 - 2016, Eden, Australia

Investigation, concept design, environmental impact assessment, stakeholder consultation, preparation of CEMP and OEMP, for a fixed wave attenuator and 154 berth floating marina.

#### **Shell Cove Boatharbour and Marina**

2004 – 2016, Shellharbour, Australia

Investigation, design, documentation, environmental management plans and approvals, and construction advice for a Boat Harbour development at Shellharbour on the NSW South Coast with a total estimated construction cost in excess of \$150M.

#### **Port of Hastings Development**

2014 - 2015, Hastings, Australia

Investigation, concept design, and environmental assessment for a major port development. Work included metocean data collection through deployment of instrumentation (wind, waves, currents), numerical modelling of physical processes, and the assessment of dredging and dredged material disposal.

#### **Eden Safe Boating Options Study**

2014, Eden, Australia

Feasibility level study to identify options to improve safety, boating access and storage for recreational craft in Eden, NSW. Work involved review of existing site conditions, review

of wave attenuator options, review of existing boating infrastructure, assessment of options, and preparation of cost estimates.

#### **Environmental Due Diligence for Port Transactions**

2014 - 2016, Various locations

Investigation and preparation of Vendor Environmental Due Diligence (VEDD) reports for the sale of a number of ports, with a focus on dredging and dredged material disposal. Ports included Port Kembla, Port of Newcastle, Port of Melbourne, Port of Townsville and Gladstone Port.

#### **Barangaroo Development Foreshore Cove**

2012 – 2013, Sydney, Australia

Concept design, environmental assessment and detailed design for the development of a new foreshore cove as part of the Barangaroo development including consideration of the condition of existing structures, excavation/dredging of foreshore sediments, provision of new seawall and suspended deck structures, stormwater and water quality. Particular consideration is being given to ecological engineering features to establish and enhance aquatic habitat.

#### **Ichthys Project Dredging Expert Panel**

2012 – 2013, Darwin, Australia

Member of the Ichthys Project Dredging Expert Panel (IPDEP) that advises Inpex and the Commonwealth and Northern Territory Regulators on dredging operations for the Inpex Ichthys project in Darwin Harbour. Particular role involves consideration of modelling and water/suspended sediment dynamics.

#### **SEWPaC Panel Member**

2005 – 2013, Australia

Specialist advisor to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) on dredging operations and disposal of dredged material under the Sea Dumping Act and the Environment Protection and Biodiversity Conservation (EPBC) Act. Locations of projects have included Weipa, Darwin, Port Hedland, Cape Lambert, Dampier, Albany and Lakes Entrance.

#### **Port Kembla Outer Harbour Development**

2012 – 2013, Port Kembla, Australia

Specialist advisor to the design team and Port Kembla Port Corporation (now NSW Ports) in relation to the environmental issues associated with dredging and port development, including confirmation of approvals process, preparation of submissions for permits, and review of impact assessments and monitoring plans.

#### **Collaroy Narrabeen Beach Coastline Management Plan**

2012 – 2013, Sydney, Australia

Preparation of the Management Plan to guide sustainable development and conservation of a highly urbanised coastal embayment on the Northern Beaches of Sydney including consideration of coastal hazards such as erosion, recession, inundation and climate change. Extensive stakeholder consultation involving a wide range of interest groups.

#### **Coffs Harbour Eastern Breakwater Rehabilitation**

2012, Coffs Harbour, Australia

Investigation, design and Peer Review of the proposed rehabilitation of a very exposed breakwater involving use of concrete armour units (Hanbars) and rock. Significant considerations included hydraulic stability, buildability and public safety. Investigations involved extensive 2D and 3D physical model testing and quarry assessments.

#### **Greenfield Port, Mozambique**

2011 – 2013, Mozambique, Africa

Order of Magnitude (OoM) study for a new greenfield port site on the Mozambique coast, including review of metocean data, historical hydrographic surveys, aerial photography and satellite imagery, site inspections, concept design of coastal and maritime facilities, preliminary environmental impact assessment, and preparation of cost estimates.

#### **Greenfield Port, Sierra Leone**

2010 - 2011 Sierra Leone, Africa

Planning of a port development on a 'greenfield' site, which included shipping channel design, ship handling simulation, preparation of detailed design documentation, participation in risk management workshops and procurement of dredging contractors.

#### **Farm Cove Seawall**

2013 – to date, Sydney Harbour, Australia

Design and management of specialist studies for reconstruction works to a heritage seawall surrounding the Royal Botanical Gardens. Works include dismantling of the existing seawall, construction of new foundations and rebuilding the sandstone seawall. Design is being undertaken in close consultation with heritage experts.

#### **Cattle Bay Marina**

2012 – to date, Eden, Australia

Investigation, concept design and environmental impact assessment for a floating marina and fixed wave attenuator.

#### **Boydton Sand Extraction**

2013 – to date, Boydton, Australia

Investigation, concept design, and environmental impact assessment for a large scale commercial sand extraction operation.

#### **Collaroy Narrabeen Beach Stormwater Outfall**

2013 – to date, Collaroy, Australia

Peer Review of a major stormwater outfall crossing Collaroy Beach including consideration of wave loading, geotechnical conditions, buildability, safety and environmental impacts.

#### **Merewether Ocean Baths**

2013 – to date, Newcastle, Australia

Investigation, concept design and detailed design for a major upgrade to the Ocean Baths, including condition assessment, geotechnical investigation, pumping/water quality assessment, and consideration of climate change impacts.

#### **Lake Cathie Coastal Hazard Study Review**

2013 – to date, Lake Cathie, Australia

Peer Review of a coastline hazard assessment with particular consideration of results of photogrammetric analysis, an understanding of coastal processes, and behaviour of cemented (indurated) sands.

#### **Port Kembla Management of Declared Depths**

2010 - 2011 Port Kembla, Australia

Assessment of hydrosurvey methods, historical sedimentation trends, sources and mechanisms for siltation within the harbour, potential dredging and non-dredging solutions for management of existing and ongoing harbour siltation and

development of an outline strategy for future management of declared depths.

#### **Garden Island Maintenance Dredging**

2009 - 2010 Sydney Harbour, Sydney, Australia

Preparation of a technical specification and detailed design drawings for tender documentation. Provision of specialist dredging advice to assist Defence in the procurement of dredging contractors and management of the contractor during execution of the works.

#### **Kooragang Island Berths K8 and K9**

2005 - 2007 Newcastle, Australia

Preparation of site specific dredging strategies involving selection of plant and equipment to achieve efficient removal and disposal methods for different dredged materials. Preparation of fill and water management strategies for reclamation of land with dredged material, which involved the design of the layout of reclamation ponds, estimation of earthworks quantities, sizing of settlement ponds and determining alignments of dredge pipeline and return water routes. Estimation of construction costs for dredging and harbour works including harbour channel and shipping berth dredging, disposal of dredged material offshore, land reclamation works and foreshore protection. Involvement in the procurement process to secure dredging contractors including preparation of tender documentation, technical assessment of bids received and 'face-to-face' workshops with dredging contractors to obtain bid clarifications and discuss proposed work methods.

#### **Port Kembla Coal Terminal Berth 101 Upgrade**

2011 - 2012 Port Kembla, Australia

Marine environmental assessment associated with the construction of a deeper berthing area and disposal of dredged material including cement stabilisation pilot trials. Environmental issues included marine ecology, water quality, odour and sediment quality (including suitability for sea disposal).

#### **Zambezi River Coal Barging**

2011 – to date, Zambezi River, Mozambique

Prefeasibility Study (PFS) for barging of up to 20 Mtpa of coal over 550 km along the Zambezi River to an offshore floating transfer station (FTS) off the coast of Mozambique, including approximately 20M m<sup>3</sup> of dredging. Input to Environmental and Social Impact Assessment (ESIA).

#### **Newcastle Coal Infrastructure Group (NCIG) Stage 2 Due Diligence**

2010 – 2011, Newcastle, Australia

Specialist Technical Review of the NCIG Stage 2 Coal Export Terminal Feasibility Study on behalf of ANZ Bank, in particular all dredging and environmental assessment and approvals. This project has an estimated capital cost of AU\$1.15 Billion and expands the export terminal to 66Mtpa capacity.

#### **Sydney Cove Infrastructure, Usage and Public Improvement Plan**

2010 – 2011, Sydney Cove, Australia

The preparation of this Plan covers the iconic waterway and foreshore space between the Sydney Opera House and Sydney Harbour Bridge. The work involves assessment of maritime infrastructure, assessment of waterway and foreshore usage patterns under a range of scenarios, consultation with key stakeholders, preparation of options plans and final master plans, and cost estimates.

#### **Kooragang Island Berth K7 Coal Expansion**

2009 – 2011, Newcastle, Australia

Management of this project includes engineering design for the dredging, reclamation and foreshore protection systems. The project involves the development of additional coal storage areas, stackers, reclaimers, conveyor system, wharfage, rock revetment and dredging of shipping channels and a berth pocket. PWCS is the World's largest coal handling facility and has a current capacity of 77Mtpa. The K7 expansion will increase capacity to beyond 100Mtpa.

#### **Port Botany Second Bulk Liquids Berth**

2009 – 2011, Port Botany, Australia

The design of the second Bulk Liquids Berth at Port Botany with an estimated total installed cost of \$80M. The berth would provide a new common user facility that handles hazardous and non-hazardous bulk liquids and gases that will be transferred by pipeline to nearby storage and distribution



facilities. The berth will accommodate a range of vessels up to 120,000 DWT and 270m in length.

#### **Norah Head Boat Ramp**

2009 – 2011, Wyong, Australia

Options report and concept design for improvements to existing open ocean boat ramps including access and car park. Considerations included wave loading, beach erosion, geotechnical conditions and buildability.

#### **Newcastle Harbour**

1989 – 2011, Newcastle, Australia

Investigation, design and environmental assessment of a range of projects including Port of Newcastle maintenance Dredging, Port of Newcastle capital dredging, Honeysuckle Marina, Honeysuckle Cove, Stockton Boatharbour Redevelopment, wharf development, and ship and boat repair facilities.

#### **Sydney Desalination Project Water Delivery Alliance**

2007 – 2010, Botany Bay, Australia

Alliance Leadership Team (ALT) member for this major infrastructure project with an estimated construction cost of AU\$650M, and Specialist Technical Reviewer for all coastal/maritime elements including maritime structures and dredging within Botany Bay for the pipeline crossing.

#### **Homebush Bay Contaminated Sediments**

2000 – 2000, Homebush Bay, Australia

Investigation of contamination in Homebush Bay, particularly dioxin contamination, and the preparation and evaluation of options for remediation of the Bay involving dredging, treatment of sediments, and disposal.

#### **Boydton Boatharbour Development**

1999 – 1999, Eden, Australia

Investigation and detailed design of coastal and maritime development including breakwaters and seawalls and environmental impact assessment for disposal of some 550,000 m<sup>3</sup> of excavated and dredged material.

#### **Port Kembla Port Corporation Various projects**

1999 – 1999, Port Kembla, Australia

MPB3 & EB4 capital dredging sediment sampling and testing, offshore disposal sites issues paper, investigations of spoil ground, preparation of a permit application for offshore

disposal, preparation of REF for MPB3 & EB4 dredging, preparation of dredging Environmental Management Plan (EMP) and input into tender documents.

#### **South Arm Master Plan Dredging, Hunter River**

1999 – 1999, Newcastle, Australia

Review of existing data, preparation of a sampling and analysis plan, management of all testing including ecotoxicological testing (with particular emphasis on PAHs), evaluation of data, assessment of land disposal and sea disposal options, preparation of an Environmental Impact Statement (EIS) for some 11.5 million m<sup>3</sup> of dredged material.

#### **Tweed River Entrance Sand Bypassing Project (Stages 1 and 2)**

1999 – 1999, Tweed Head, Australia

Provision of specialist input on coastal processes and alternative dredging plant and equipment systems for the removal and placement of 500,000 m<sup>3</sup> annually to achieve navigation and nourishment objectives. Phases of the project comprised environmental assessment, tender document preparation and formulation of performance criteria.

#### **Manly Lagoon Management Study**

1990 – 1990, Manly, Australia

Multi-faceted investigation of Manly Lagoon including consideration of water quality, sediment quality, flooding, entrance dynamics and beach processes, dredging, and provision of gross pollutant traps, water pollution control ponds and landscape improvements.

#### **Patonga Jetty**

1987 – 1987, Patonga, Australia

Investigation and preliminary design of a new jetty at Patonga on the NSW Central Coast.

#### **Coffs Harbour Recreational Boating Facilities**

1987 – 1987, Coffs Harbour, Australia

Master planning of additional recreational boating facilities at Coffs Harbour.

#### **Sydney Harbour Marina Facilities**

1986 – 1986, Sydney, Australia

Preliminary investigation of sites for provision of additional marina facilities within Sydney Harbour.

**Appraisal of Dredging and Disposal of Material**

1986 – 1986, Sydney, Australia

Preliminary appraisal of alternative means of dredging and disposal of material for embayments within Sydney Harbour.

**Guidelines for Marinas**

1986 – 1986, Sydney, Australia

Preparation of guidelines for wind loading, wave loading and current loading on marinas, for the Public Works Department, NSW.

**Master Planning of Boatharbour Facilities**

1986 – 1986, Gosford, Australia

Investigation and master planning of boatharbour facilities at Gosford.

**Recreational Boating Facilities**

1986 – 1986, Brisbane Water, Australia

Investigation and preliminary planning of additional recreational boating facilities in Brisbane Water.

**Pyrmont Wharf 25**

1986 – 1986, Pyrmont, Australia

Investigation and design of new maritime facilities at Wharf 25, Pyrmont for the NSW Water Police.

**Batemans Bay Coastal and Estuary Processes Investigation**

1986 – 1986, Batemans Bay, Australia

Investigation of coastal and estuary processes at the mouth of the Clyde River, Batemans Bay, for proposed resort development.

**Review of Surging/Seiching Problems**

1985 – 1985, Port Kembla, Australia

Review of surging/seiching problems in Port Kembla Outer Harbour.

**Wisemans Ferry Mooring Jetty**

1985 – 1985, Hawkesbury, Australia

Investigation and design of a mooring jetty for 1200 tonne ferry at Wisemans Ferry.

**Port Hacking Alternative Breakwater Options**

1985 – 1985, Port Hacking, Australia

Engineering assessment of alternative breakwater options at Port Hacking, NSW.

**Coffs Harbour Timber Jetty**

1985 – 1985, Coffs Harbour, Australia

Engineering assessment of restoration and maintenance options for a 450 metre long timber jetty at Coffs harbour.

**Batemans Bay Boatharbour Development**

1985 – 1985, Batemans Bay, Australia

Preparation and evaluation of master plan options for boatharbour development at Batemans Bay.

**Neutral Bay Craft Facilities**

1985 – 1985, Neutral Bay, Australia

Investigation and preliminary design of small craft facilities at Neutral Bay, Sydney.

**Port Hacking Hydrodynamic and Sedimentary Processes**

1985 – 1985, Port Hacking, Australia

Investigation of hydrodynamic and sedimentary processes in Port Hacking, NSW, involving preparation of reports on bedform migration and sediment transport; sand drolover movement; wave refraction; remote data collection system and data processing; and harmonic tidal analyses.

**Port Hacking Sand Extraction**

1985 – 1985, Port Hacking, Australia

Preparation of a concept plan for extraction of 2 million cubic metres of sand from Port Hacking.

**Mona Vale Seawall Protection**

1985 – 1985, Mona Vale, Australia

Investigation and preliminary design of seawall protection at Mona Vale, NSW.

**Nambucca River Tidal Processes Review**

1985 – 1985, Nambucca, Australia

Review of tidal processes in the Nambucca River, NSW and assessment of the potential impact of a canal subdivision on these processes.

**Brotherson Dock Mooring System Concept Design**

1985 – 1985, Port Botany, Australia

Conceptual design of a mooring system for tugs berthed in Brotherson Dock, Port Botany.

**Mount Newman Mining Ore Wharf**

1985 – 1985, Port Hedland, Australia

Preparation of contract documentation for removal of sediments and ore spillage from below and adjacent to Mount Newman Mining Ore Wharf, Port Hedland, WA.

**Port Hedland Tug Berth Facility**

1985 – 1985, Port Hedland, Australia

Investigation of engineering feasibility of tug berth facility construction at Port Hedland, WA.

**Currumbene Creek Tidal and Fluvial Processes**

1985 – 1985, Currumbene Creek, Australia

Investigation of tidal and fluvial processes in lower Currumbene Creek associated with a proposed marina development and access channel dredging.

**Major Port Upgrading at Port Hedland**

1984 – 1984, Port Hedland, Australia

Review of report prepared for Mount Newman Mining Company outlining the proposed new system of navigational aids associated with major port upgrading at Port Hedland, Western Australia.

**Mount Newman Mining Ore Loading Wharf**

1984 – 1984, Port Hedland, Australia

Analysis of the structural behaviour of Mount Newman Mining Ore Loading Wharf (Port Hedland) following proposed harbour deepening and fender upgrading.

**Wollongong Harbour Fishing Facilities Improvement**

1984 – 1984, Wollongong, Australia

Planning of improved land based and water based facilities for the commercial fishing industry in Wollongong Harbour, NSW.

**Pittwater Berth Marina**

1984 – 1984, Pittwater, Australia

Conceptual planning for proposed 300 berth marina in Pittwater, NSW.

**Lake Illawarra Artificial Lake Viability**

1984 – 1984, Lake Illawarra, Australia

Investigation of artificial lake viability adjacent to Lake Illawarra, NSW with particular reference to tidal flushing and circulation, the impact of flooding, bank stability, and shoaling and navigation.

**Port Hacking Sand Movement Study**

1984 – 1984, Port Hacking, Australia

Study of the complex processes associated with extensive shoaling in Port Hacking and means of overcoming the need for continual and costly maintenance dredging.

**Tweed River**

1982 – 1982, Tweed Head, Australia

Investigation of storm surge propagation and its interaction with freshwater flooding, entrance bar behaviour, influence of bed morphology on magnitude and phasing of tidal constituents, and relationships between tidal bedforms and sediment transport.

**Avoca Lake**

1982 – 1982, Avoca, Australia

Investigation of the hydraulic and sedimentary aspects of lake entrance behaviour, particularly related to flood induced breakout; suitability of lake bed sediments for information of frontal dunes, review of dredging proposals..

**Yamba Waters Coastal Engineering Study**

1981 – 1981, Yamba, Australia

Study of coastal processes to establish development set back distances for a proposed \$200 million tourist resort development.

**Destination Bay, Tuncurry**

1981 – 1981, Tuncurry, Australia

Physical and numerical model studies of tidal flushing and tidal circulation within an artificial lake associated with a proposed \$100 million residential development.

**Cronulla Seawall**

1981 – 1981, Cronulla, Australia

Supervision of physical model testing carried out by the Water Research Laboratory to examine the stability and overtopping behaviour of a proposed major seawall utilising Seabee armour units.

**Wollongong Harbour Planning**

1980 – 1980, Wollongong, Australia  
Planning of the upgrading of facilities for the commercial fishing industry.

**Kiama Harbour Planning**

1980 – 1980, Kiama, Australia  
Planning of facilities for the commercial fishing industry and pleasure craft.

**Greenwell Point Fishermens Jetty**

1980 – 1980, Greenwell Point, Australia  
Control on quality of construction of fishermens jetty.

**Ulladulla Harbour Planning**

1979 – 1979, Ulladulla, Australia  
Planning of improvements to land based facilities for the commercial fishing industry, and investigation of resonant surge problems.

**Batemans Bay Marina**

1979 – 1979, Batemans Bay, Australia  
Control on quality of construction of jetty and boat harbour for the commercial fishing industry and pleasure craft.

**Bermagui Fishermens Jetty**

1979 – 1979, Bermagui, Australia  
Conceptual design and control of quality of construction of fishermens jetty.

**Eden Harbour Mooring Jetty**

1979 – 1979, Eden, Australia  
Preparation of contract documentation for construction of a new mooring jetty.

**Port Kembla Coal Loader**

1978 – 1978, Port Kembla, Australia  
Conceptual design of wharf structure and fendering system.

**Alexandria Canal**

1978 – 1978, Alexandria, Australia  
Analysis of bank stability and dredging proposal.

**Newcastle Harbour Floating Dock**

1978 – 1978, Newcastle, Australia  
Detailed design of mooring system.

**Lord Howe Island Jetty**

1978 – 1978, Lord Howe Island, Australia  
Investigation and detailed design of a new cargo handling jetty.

**Newcastle Harbour Fishing Fleet**

1978 – 1978, Newcastle, Australia  
Conceptual design of alternative mooring systems.

**Bellambi Bank Protection**

1977 – 1977, Bellambi, Australia  
Detailed design of revetment protection for Housing Commission subdivision.