Safer Shipping | Smarter Ports

OMC INTERNATIONAL

Statement of Capabilities

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Background

OMC International Pty Ltd (OMC) is a specialist company providing consulting services and operational systems to the international maritime industry. OMC is the world's only provider of independently validated and widely operational real-time under keel clearance technology, the proprietary Dynamic Under-keel Clearance System (DUKC®).

DUKC® has safely facilitated 200,000+ transits for 120 ports, terminals and waterways, and is the most comprehensively validated UKC management system. On average, a vessel sails under DUKC® advice somewhere in the world every hour.

DUKC® is the standard underkeel clearance management tool adopted by more than twenty ports within Australia, and internationally, including the world's largest bulk export ports, container ports, and tanker facilities. DUKC® is recognised as the leading UKC management system in the world.

In addition to DUKC®, the services and systems provided by OMC to our clients include:

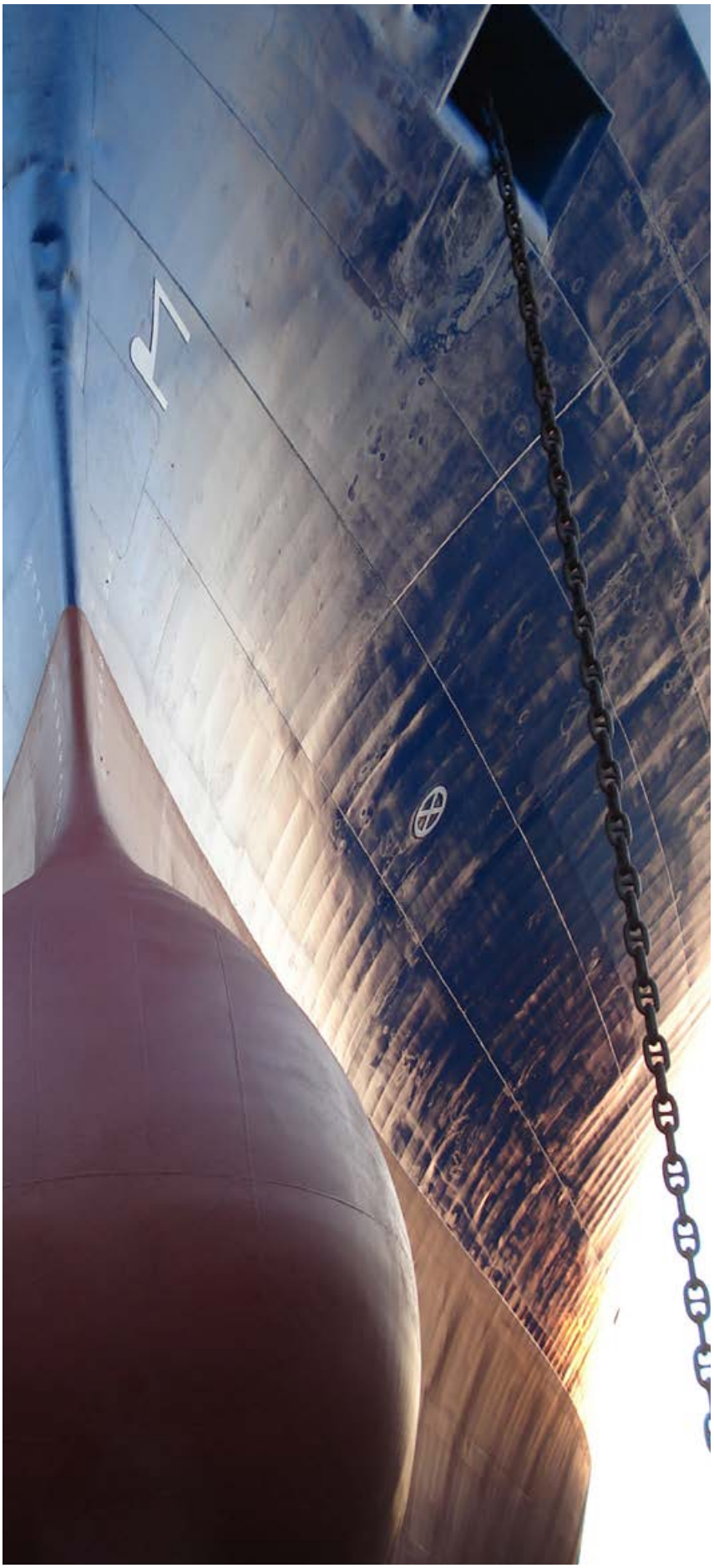
- Optimised channel dredging design and planning
- Under-keel clearance studies
- Horizontal navigation and vessel manoeuvrability studies
- Fast time simulations using SimFlex4 from Force Technology
- Full scale vessel motion measurement and analysis
- Probabilistic analysis and risk assessments
- Operational static UKC management (KeelCheck)
- Measured & forecast environmental data displays (PortWeather)
- Optimisation of Port throughput using our Dynamic Port Capacity Model
- Mooring analysis – deep sea, CBM, conventional and suction pad mooring systems
- Moored vessel motion and mooring line warning systems (Berth Warning System, BerthAlert)
- Hydro/meteo analysis, modelling and forecasting
- Hydro/meteo data processing and quality assurance

The client base of OMC is varied across a range of organisations around the world. Our products and services are provided to Port Authorities, Government Regulatory Bodies, Pilot Organisations, Research Committees and Institutions, Shipping Lines, Terminal Operators and other stakeholders across the maritime and shipping industry.

In recognition of OMC's international standing as the world's leading developer and operator of real-time UKC systems, its founder, Dr. Terry O'Brien, was appointed Chair of PIANC Working Group 54 tasked to develop guidelines for the use of hydro/meteo data to optimise safe waterway access. These guidelines have been published as PIANC Report No 117-2012 – Use of Hydro/Meteo Information for Port Access and Operations. Dr. O'Brien is also a member of PIANC Working Group 49, tasked with determining the new design guideline for navigational channels with regard to horizontal and vertical navigation. These guidelines have been published as PIANC Report No 121-2014 – Harbour Approach Channels Design Guidelines.

DUKC® has assisted more than 120 port facilities, terminals, and waterways to safely and efficiently conduct more than 200,000 deep draft transits over the past 30 years. OMC's ship motion modelling has an unrivalled level of full scale validation and testing. Each DUKC® system is validated at each port or waterway using high-precision DGPS survey equipment to accurately measure the movement of vessels in all six degrees of motion while transiting a waterway. The results are compared with the DUKC® predictions of vessel motion and position. OMC has performed over 800 full scale vessel measurements. These validation measurements have been undertaken in a wide range of waterways around the world on a large variety of ship sizes, types and load states.

OMC applies this same technology and experience to channel design, dredge optimisation and port operability studies, achieving significant benefits over the standard methods.



DUKC® Channel Design & Optimisation Capability

The optimisation of waterways is a cost-benefit exercise that balances safety, economics and environmental concerns.

OMC's cutting edge DUKC® technology can be used to minimise dredging volumes and thereby minimise both the capital and maintenance costs of dredging operations and the environmental impacts associated with these operations.

Millions of dollars in extra costs and possible environmental damage have been saved by the conjunctive use of DUKC® optimised dredging and a DUKC® operational system.

Where DUKC® technology is installed, the UKC requirements of each section of a channel transit can be quantified. **This information can then be used to create the channel depth profile which optimally matches the specified channel access criteria.** Increased allowable sailing drafts and tidal windows are delivered at a greatly reduced dredging cost and with minimum possible environmental effects.

Traditional channel design based upon assumptions of static UKC requirements results in unnecessary dredging and a channel profile that does not match operational requirements.

OMC waterway design engineers are world leaders in the development and implementation of channel design and depth optimisation technology. Our unique understanding of port operations, statistical modelling techniques and UKC analysis enables us to present an accurate picture of cost-benefit to the client. Our optimisation methods enable dredging to be targeted, ensuring maximum return on investment and minimum environmental impact.

OMC has carried out a large number of dredge optimisation studies in Australia and abroad and with the conjunctive use of the **DUKC® operational system has reduced capital dredging requirements in the order of 50% in some cases.**

Industry Representation

In addition to serving on two PIANC working groups, OMC International is a member of the following industry bodies:

- PIANC International
- PIANC Australia
- International Harbour Masters' Association (IHMA)
- International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA)
- International Association of Ports and Harbours (IAPH)
- International Maritime Pilots' Associate (IMPA)
- Ports Australia
- Maritime Industry Australia Ltd (MIAL)
- Shipping Australia Ltd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2017 Case Study

PORT HEDLAND – CLIENT: PILBARA PORTS AUTHORITY (PPA)

Port Hedland has utilised DUKC® to determine sailing drafts and windows for all deep draft vessel transits during the past 22 years. The geographic constraints of the long, unidirectional channel, coupled with large tidal ranges and potential exposure to swells provides an especially challenging environment for UKC management. Given the significant potential consequences of any incident within port or channel, the effective management of grounding risk is a high priority.

The Port has experienced significant growth in volumes over recent years, making its operations critical to the economy at both a state and national level. In the 2015/16 financial year, the port exported a record 460.4 million tonnes, and sailed more than one million tonnes on a single tide on more than sixty occasions. **This contributed more than $2.6 billion to state royalties last financial year.**

A key PPA strategy in managing the channel risk has been the $120m WA State government approved CROP (Channel Risk and Optimisation Project). CROP involves the delivery of an emergency passing lane alongside the existing channel, enhancement of an existing refuge zone together with targeted dredging of the existing channel depths to increase the available draft and tonnage for laden outbound vessels, and to extend sailing windows for laden vessels.

PPA's dredging team used DUKC® methodology as the core technology in the CROP design process. The preferred channel profile for CROP resulted in substantial benefits, including an average increase in draft of 0.56m for a high water departure, and an average increase in the sailing window closing time of 33 minutes for an 18m draft vessel. **The DUKC® channel optimisation process resulted in a reduction of the dredged area of ~90,000m2 without any compromise to the benefits.**

The assessment of the potential impact of CROP was taken one step further by simulating the revised channel profiles within OMC's Dynamic Port Capacity Model (DPCM®).

The DPCM® is a discrete event simulation model of the Port of Port Hedland operations that incorporates the DUKC®. The purpose of the DPCM® is to provide a tool to assess the impact on port capacity of changes to variables such as ship loader rates, vessel fleet profiles, cyclones, asset availability (tugs, pilots, etc.). The performance of the DPCM has been validated each year since its development against the actual port throughput.

Analysis undertaken utilising the DPCM® was the basis by which the declared port capacity of Port Hedland was increased by PPA in 2015 by 16 per cent from 495 mtpa to 577mtpa, deferring further the date at which any Outer Harbour development may be needed (at an estimated cost of $20 billion).

The DPCM® analysis highlighted the impact of the CROP on the short-loading of vessels, the benefits of which accrue through both increased tonnages and reduced dead-freight claims for the port's customers. The analysis indicated that CROP would reduce both the occurrence of short-loaded vessels, as well as the amount of short-loading when it does occur.

Using the optimised CROP channel profile, the DUKC® Series 5 resulted in an average increase in draft of 0.63m across all sailing times. Importantly, for vessels sailing at the opening of the tidal window (3-5 hours before high water) when typically they are most draft constrained, the DUKC® provided an average benefit over the static UKC of 0.81m. For this same departure window, the optimal CROP channel profile yielded no benefit when operating under a static UKC rule.

This analysis has highlighted two important factors in the operations at the Port of Port Hedland, which in our experience, are replicated across most ports. **Firstly, DUKC® provides a considerable benefit over static UKC rules for the port, allowing vessels to safely transit at deeper drafts, thereby carrying more cargo. Secondly, there are conditions where the port's static rule provides underkeel clearances which do not meet the minimum safety requirements.**

The CROP analysis was shortlisted for the 2017 Dredging and Port Construction Innovation Awards.

Dynamic Moored Vessel Analysis

OMC has extensive experience in modelling the motions of moored ships exposed to various environmental conditions, resulting in unparalleled expertise in mooring design and ship motion modelling. OMC developed the numerical model, SPMS (Simulation Package for the Motions of Ships), for the analysis of various problems associated with the motions of vessels, either moored, towed or free moving along channels or in deep water.

Since development commenced in 1962, it has been extended to solve a wide variety of maritime projects in Australia and overseas. This includes analysis of motions, line tensions and fender forces of bulk carriers, oil tankers, container vessels, frigates, submarines, Ro-Ro vessels, general cargo ships and tugs at a wide variety of berths, including spread moorings, swamp moorings, fendered jetties and single point moorings. The model has also been used for the analysis of the relative motions of a transhipment facility involving ship to barge transfer of bulk cargo.

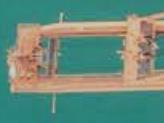
The SPMS numerical model includes the capability to model the slow drift oscillations of moored vessels due to long waves (periods greater than 30 seconds), as well as the wave frequency oscillations caused by sea and swell waves. Long period waves can be the most important driving force on moored vessels exposed to ocean swell because they can excite large amplitude, low frequency oscillations of the moored vessel in the horizontal modes of surge, sway and yaw.

These oscillations occur at frequencies similar to the corresponding natural frequencies of the ship/line/fender system, leading to possible resonance amplification of the moored vessel motions, breakage of mooring lines and damage to berth and fenders - unlike wave frequency motions which are relatively highly damped, low frequency motions are only lightly damped, hence the great danger of resonance amplification arising from any significant long wave excitation.

Major calibration and validation exercises for the SPMS moored ship model have been completed during 1998/99 for two vessels at Port Taranaki on the west coast of New Zealand, during 2005 for two vessels at Geraldton and in 2006 for three vessels at Port Hedland, Western Australia.

These exercises involved DGPS measurement of moored ship motions, direct measurement of line tensions by strain gauges and collection of short and long wave data at the berth. An important outcome of these studies was the full-scale calibration and validation of the low frequency damping forces generated by the SPMS model.

OMC has also carried out full scale measurement validation exercises on over 630 vessels at over 40 different ports globally. This includes all major vessel types with varying depth/draft ratios, stability characteristics and transit speeds, channel configurations, tidal patterns and wave climates. This data is analysed to validate the SPMS numerical model predictions utilising the measured wave, current and tide data against the ship particulars, thereby verifying the moored vessel motions.



The SPMS model is the **only comprehensive ship-modelling package developed in the Southern Hemisphere**, and is one of only a handful in use in the world. It has being extensively used in the Australasia region for moored ship problems where long waves/seiching are prevalent.

Vessel Interaction Expertise

OMC has extensive experience with passing vessel interactions, and was an Industry partner in the Marin Research Institute Research on Passing Effects on Ships (ROPES) research project.

ROPES was a joint industry project and included development and validation of a computer tool to predict the effect of passing vessels for existing and new port and terminal developments. The project included extensive scale model testing and full scale monitoring campaigns in the Port of Rotterdam. Participants in the project included Ports of Rotterdam, Antwerp and Amsterdam, ExxonMobil, Cavotec, KRVE, and Deltares. As a partner OMC holds and has full rights to the developed IP which has used to both validate the OMC passing vessel model and to complement it for ongoing projects.

OMC has undertaken passing vessel mooring studies at Fremantle (2017), Gladstone (2017, 2016), Port Hedland (2014, 2012, 2011, 2010, 2009, 2008, 2006) Newcastle (2011, 20106), Brisbane (2012), and Cape Lambert (2010). For these studies, OMC has used modelling to determine optimum vessel passing speeds and distances given the prevailing environmental conditions, tidal levels and characteristics of both the moored and passing vessels. The Port Hedland study also involved validation of the model against full scale measurements, with excellent correlation between measured data and model outputs.

Berth Warning System

In addition to mooring studies, OMC has also developed the Dynamic Berth Warning System (BWS) to improve port operating safety.

The BWS is a real-time berth warning system designed to provide assistance to terminal operators in making decisions as to the operating safety of berthed vessels. BWS assesses both the vessel motions and the loads placed on moorings, lines and fenders by ocean swells, currents, and wind to provide produce a rating of port operating safety.

The BWS can incorporate wind, wave, and current forecasts from the National Weather Service, or private forecast providers, giving the potential to provide dynamic berth operability forecasts up to a week in advance, improving berth safety and performance.

Oceanographic Instrumentation Data Processing

Metocean data processing services can involve conversion of raw to processed data, quality assurance and control measures, real-time transmission, as well as monitoring of all these aspects. The optimisation of the data processing can be device, location and data use specific, and usually involves a network of different instruments and transmission options. For use in operational real-time applications such as the DUKC®, the efficient and reliable management of all these aspects is particularly important. OMC has developed a data processing capability that is both tailored for real-time use, as well as to the benefits of the many other users of the data.

The closer to a device that OMC can obtain its raw data stream the greater the options and benefits available.

Benefits

The main advantages in using OMC's metocean data processing services are:

1. The data processing and QC is optimised for DUKC® use;
2. The data processing and QC is transparent, best practice and standards based; and
3. They enable OMC to be the single point of contact for all issues metocean and DUKC®.

Having OMC responsible for the data processing can also enable a port to mitigate its risk by having the DUKC® environmental data handling provided by an organisation able to provide certainty of long term supply and 24/7 support. Furthermore, being an end user of the data provides the highest impetus for OMC to deliver a comprehensive service and promote data integrity.

QA/QC

Quality Control (QC) measures of monitoring and automated test procedures rely on effective preventative Quality Assurance (QA) measures. As OMC does not provide any physical handling capability, the QA measures such as maintenance, levelling and calibration need to be managed by the port or through third parties.

The QC software that has been developed for wave, tide and current data is optimised for DUKC® purposes. Benefits for DUKC® users are increased safety, data availability and potentially draft availability depending on the device. For example, a wave buoy's watch circle can be linked to the QC status thus providing an automated DUKC® response to increase safety. Also increased data availability through the processing of raw data to remove errors, while maintaining useful data has been achieved by minimising the effect of transmission and GPS errors in the case of Datawell DWR-G data. Erroneous data from some devices can result in overly conservative wave energy being introduces, which if sustained can result in loss of sailing draft and planning noisiness.

The processing methods employed by OMC are based on the latest international best practice. Quality Assurance of Real Time Oceanographic Devices, or QARTOD, are guidelines developed by instrument manufacturers and their largest US based users. OMC have implemented these for the QC processing of waves and tides at several ports, and will do so also for currents. For further details please refer the technical paper published in Coast and Ports 2017, 'Quality Control Experiences using QARTOD in Australian Ports'.

Continuous Support

OMC's 24/7 support helpdesk objective is to keep a port's DUKC® in operation. A common cause of downtime is an interruption in the real-time environmental data due to IT and transmission issues. In having access to the raw data stream enables a support engineer to more quickly determine if the cause of a data outage is QC or transmission related and so provide a faster diagnosis response.

Physical handling issues will need to be coordinated during business hours through contact with a ports' coordinator.

Displays

The Metocean page of the DUKC® Series 5 system is a proven display solution providing an overview with widgets and time series plots for investigation. If these displays are on the consolidated hosting system, they will be available to anybody with internet access and an account.

Data Archiving and Provision

OMC can also maintain an archive of historical records. A user download facility can be provided through the DUKC® to enable requests for data to be managed directly by the port. This will provide CSV data files.

Experience

Port of Melbourne	Waves and Tides using OMC's DataFilter	since 2005
Torres Strait for Australian Maritime Safety Authority	Waves, Tides and Currents	since 2010
Port Hedland for Pilbara Ports Authority	Nortek AWACS (waves, currents), Datawell DWRGs (waves), VegaPuls (tides) using QARTOD	since 2015
Fremantle Port	Datawell DWR (waves,), Digiquartz pressure gauge (waves and tides) using QARTOD	since 2017
Hay Point for North Queensland Bulk Ports	Aandeera (currents) using QARTOD	planned for Q3 2017

Previous Experience: Channel Design, Dredge Optimisation, UKC Analysis

2022		
	Onslow	Iron ore project UKC & channel optimisation study.
	Hastings	Suezmax tanker UKC decision support.
	Vancouver	Tidal windows study.
	Darwin	Ship lift detailed UKC assessment.
	Port Kemlba	Deep draft vessel accessibility study.
2021		
	Karumba	UKC Study.
	Bell Bay	Navigational feasibility study.
	Sept Iles	UKC assessment.
	Woodside	Inbound tanker UKC assessment.
	Angola	UKC Assessment.
	Saint John	UKC Analysis.
	Associated British Pilots	Channel UKC study for The Humber river ports.
	JNPT	DUKC® benefit study.
2020		
	TangerMed	TangerMed Assessment of UKC requirements for Ultra Large Container Ships at the Port of Tanger Med (TM1)
	Dampier Salt Ltd	Study to evaluate optimum berth pocket depths at Mistaken Island.
	Viva Energy	Dredge optimisation analysis for the deep draft tanker route at Geelong.
	T-Ports	UKC and accessibility assessment for the Lucky Eyre transhipment vessel.
	Confidential	Full scale measurements and squat analysis for a passenger vessel.
2019		
	ExxonMobil PNG	Assessment of UKC requirements for larger tankers and LNG vessels at the Caution Bay terminal in Papua New Guinea.
	T-Ports	Dynamic Port Capacity Modelling of the greenfields Lucky Bay transhipment operation.
	NQBP	Channel depth assessment for Capesized vessels at Weipa.
	Woodside	UKC risk assessment for Woodside's Dampier operations.
	TangerMed	TangerMed Assessment of UKC requirements for Ultra Large Container Ships at the Port of Tanger Med (TM2)
	Pilbara Ports Authority (Port Hedland)	Channel Risk & Optimisation Project (CROP) update.

Previous Experience: Channel Design, Dredge Optimisation, UKC Analysis

	TasPorts	Assessment of the static UKC regime for the port of Burnie.
	Teck Resources	Assessment of maximum potential sailing drafts for outbound bulk carriers at the Port of Vancouver.
	Belfast Harbour	Review of UKC requirements for bulk carriers, ferries and cruise ships.
2018		
	South32 / GEMCO	Groote Eylandt UKC analysis.
	North Queensland Bulk Ports	Jessica Point study.
	Rio Tinto	Dredge benefits analysis for Dampier and Cape Lambert.
	Rio Tinto	Dredge volume analysis to accommodate capesize class vessels at a port facility.
	Flinders Ports	Navigational risk assessment for container vessels at Port Adelaide.
	AECOM (Confidential)	Channel accessibility study for container vessels at an existing port.
	WA Port (Confidential)	Channel accessibility and dredge optimisation study to assess the viability of larger vessels.
2017		
	Mid West Ports Authority	Feasibility assessment for new vessel class including full bridge simulations.
	Mid West Ports Authority	Channel design for new vessel class.
	Mid West Ports Authority	Dredging benefits analysis.
	AECOM	Channel accessibility study for the Port of Newcastle.
	Rio Tinto Iron Ore (Dampier)	Post dredge analysis to assess the benefits of the dredging campaign.
	Lyttelton, NZ	Evaluation of channel capacity for a nominated channel profile, and optimisation of the depths to achieve the same throughput.
	WA Port (Confidential)	Channel accessibility and dredge optimisation study to assess the viability of larger vessels.
	Caltex	UKC at berth risk assessment for Kurnell Berth at Port Botany.
	Woodside	UKC risk assessment for Woodside's Dampier operations and development of an operational planning tool.
2016		
	Montreal Port Authority	Optimisation of the dredging requirements for the St Lawrence river between Montreal and Trois-Rivieres.
	Rio Tinto Iron Ore (Cape Lambert)	Progress survey channel analysis to assess the benefits of additional dredging to assist in the management of the dredge campaign and determine the most critical areas to target.
	Rio Tinto Iron Ore (Dampier)	Progress survey channel analysis to determine the benefits of achieving a revised depth target to inform the direction of the dredge campaign.

Previous Experience: Channel Design, Dredge Optimisation, UKC Analysis

	Rio Tinto Iron Ore (Cape Lambert)	Assessment of the impacts on sailing drafts resulting from channel accretion.
	Rio Tinto Iron Ore (Dampier)	Analysis of the expected benefits with respect to sailing windows and maximum drafts for a number of alternative dredged channel profiles.
2015		
	Pilbara Port Authority (Port Hedland)	Assessment of the benefits expected from the Channel Risk and Optimisation (CROP) proposal.
	Aurizon	Evaluation of channel capacity for a nominated channel profile, and optimisation of the depths to achieve the same throughput.
2014		
	Pilbara Port Authority (Port Hedland)	Analysis of expected benefits gained by increasing the depth of the channel.
	Geraldton Port Authority	Vessel motion analysis to assess UKC requirements.
2013		
	Geraldton Port Authority	Channel UKC risk assessment.
	Port of Brisbane Corporation	Dredging impact study to quantify the expected increase in maximum sailing draft gained by increasing the depth of the channel.
	Port of Melbourne Corporation	Tanker Access Study for 14.7m tanker vessels accessing the Port of Melbourne.
	Port Hedland Port Authority	Inner Harbour dredge capacity study for Port Hedland Port Authority to target critical dredging spots considering UKC requirements.
2012		
	Rio Tinto Iron Ore	Assessment of channel width requirements for Cape Lambert, WA.
2011		
	Rio Tinto Iron Ore	Channel design optimisation for maximising vessel utilisation at Cape Lambert, WA.
	Worley Parsons / OPR	Oakajee channel design.
	Fremantle Ports	Channel accessibility study.
	Chevron	LNG vessel motion analysis.
	Port of Townsville	UKC assessment.
2010		
	Rio Tinto Iron Ore	Analysis of current forces on vessels for Cape Lambert berths.
	Rio Tinto Iron Ore	Channel design optimisation for proposed port developments at Cape Lambert, WA.
	JFA Consultants	Oakajee barge motion analysis.

Previous Experience: Channel Design, Dredge Optimisation, UKC Analysis

2009		
	Port Hedland Port Authority	Channel design study to determine dredge requirements to achieve incremental draft gains.
	JFA Consultants	Oakajee channel design.
	Rio Tinto Iron Ore	Channel design optimisation for proposed port developments at Cape Lambert, WA.
	AECOM for API	Channel design optimisation for proposed bulk port at Anketell Point, WA.
	Ports Corporation Queensland (Weipa)	Targeted dredging advice to optimise DUKC®.
2008		
	Port Otago Limited	Channel design optimisation for the Port of Otago for next generation 6,000 & 8,000 TEU container vessels.
	JFA Consultants / Albany Port Authority	Peer review of channel design for approach channel for proposed expansion for Grange resources.
	Gasbridge, NZ	Channel design optimisation for Port Taranaki (NZ) for proposed LNG vessels consistent with the operational DUKC®.
2007		
	Worley Parsons	UKC Sensitivity Study for proposed Oakajee port development, Western Australia.
	Maunsell	UKC Sensitivity Study for proposed Oakajee port development, Western Australia.
2006		
	Worley Parsons	UKC requirements and channel depths for tankers transiting the Dampier channel to be developed for the Woodside Pluto Project.
2005		
	Silver Fern Shipping	Channel design optimisation for the Port of Marsden Point, (NZ) to provide a design that is consistent with the operational DUKC®.
	Ports Corp Queensland	Channel design optimisation for the Port of Hay Point to provide a design that is consistent with the operational DUKC®.
	Westgate Transport	Channel design optimisation for Port Taranaki (NZ) to provide a design that is consistent with the operational DUKC®.
	Flinders Ports	Channel design optimisation for the approaches to the Adelaide Outer Harbour to maximise the yield of their planned capital dredging.
	Fremantle Ports	Channel design optimisation for Fremantle Ports to provide a design that is consistent with the operational DUKC®.
	Newcastle Port Corporation	Channel depth analysis for the Port of Newcastle following the recent implementation of a DUKC® system.

Previous Experience: Channel Design, Dredge Optimisation, UKC Analysis

2003		
	TranzRail and Beca Carter Hollings and Ferner	Desk top study to determine optimum channel depths for a proposed rail ferry terminal at exposed site at Clifford Bay, South Island, NZ.
	Hamersley Iron	Study to determine depth increases and locations to achieve optimum yield increase, Port of Dampier, WA.
2002		
	Geraldton Port Authority	Navigation study to determine minimum depths required for the specified wave conditions to provide the required UKC for the specified design vessel for the Geraldton Port Enhancement Project, WA.
2001		
	Geraldton Port Authority	Navigation study to assess dredging options of North and South Channels, Geraldton Port, WA.
	Ports of Auckland Limited	Review of channel design and UKC requirements for the deepening of the port approach channels.
2000		
	Port Authority of New York/New Jersey	Desk study of dredging options for Kill Van Kull and Newark Channels, New York Harbour, USA.
	Victorian Channels Authority	Deepening study of Port Phillip Channels, Melbourne, Vic.
1998		
	Townsville Port Authority	Study into ship-bank interaction to assess the optimum dredging required to reduce the existing bank effect by 50%. Included full-scale and model-scale measurements of bank effect forces and moments as well as numerical modelling of the bank effect being experienced at Townsville, Qld.
1992		
	Ports Corporation of Queensland	Development of a transit/UKC simulation model for the Port of Weipa, Qld, to investigate various options related to dredged bed level profiles, gross under-keel clearance allowances, vessel scheduling and variation of vessel engine speed along the transit through the harbour and South Channel.

Previous Experience: Dynamic Moored Vessel Analysis

2023		
	Port Hedland Port Authority	Dynamic mooring analysis study at Port Hedland berths 1 and 2
	Dalrymple Bay Coal Terminal	Dynamic mooring analysis including the effect of vessel trim at DBCT berths
	Aurecon	Dynamic mooring analysis of ammonia tankers at DBT berths
	Ampol	Post incident mooring analysis, including the impact of Brisbane river currents during flood
	Aurecon	Dynamic moored vessel analysis at Hay Point including shiploader interaction assessment
	PANSW	Cruise ship mooring safety at the Port of Eden
	Samarco	Dynamic mooring analysis for vessels at berth at Ponta Ubu, Brazil
	Wallbridge Gilbert Aztec	Dynamic mooring analysis for greenfield berths at Darwin
2022		
	Wallbridge Gilbert Aztec	Dynamic mooring analysis for greenfield berths at Darwin
	Gladstone Ports Corporation	Moored vessel risk analysis.
	Pilbara Ports Authority	Dynamic moored vessel analysis including the impact of passing vessels.
	BHP	Comprehensive dynamic moored vessel analysis to ensure safe mooring practices.
	Antofagasta Minerals	Dynamic moored vessel analysis for vessels at Puerto Punta Chungo, Chile, including the impact of long period waves.
	NQBP	Optimisation of mooring arrangements for multiple vessel classes at each berth.
	Lyttelton Port Corporation	Mooring analysis to evaluate expected operability and downtime for a berth expansion project, considering both traditional and active mooring systems.
2021		
	Alcoa	Analysis of moored vessel motions and mooring line forces.
	Eastland Port	Dynamic moored vessel analysis at Gisborne, including infra-gravity waves.
2020		
	Antofagasta Minerals	Dynamic moored vessel analysis for vessels at Puerto Punta Chungo, Chile, including the impact of long period waves.
	Pilbara Ports Authority	Assessment of alternative mooring arrangements for the Dampier Cargo Wharf.
	Maritime Constructions	Dynamic mooring analysis for the Smith Bay Floating Wharf study at Kangaroo Island.
	NQBP	Dynamic mooring analysis for the Hay Point berths.
	Flinders Ports	Dynamic mooring analysis for Port Adelaide Outer Harbour berths.

Previous Experience: Dynamic Moored Vessel Analysis

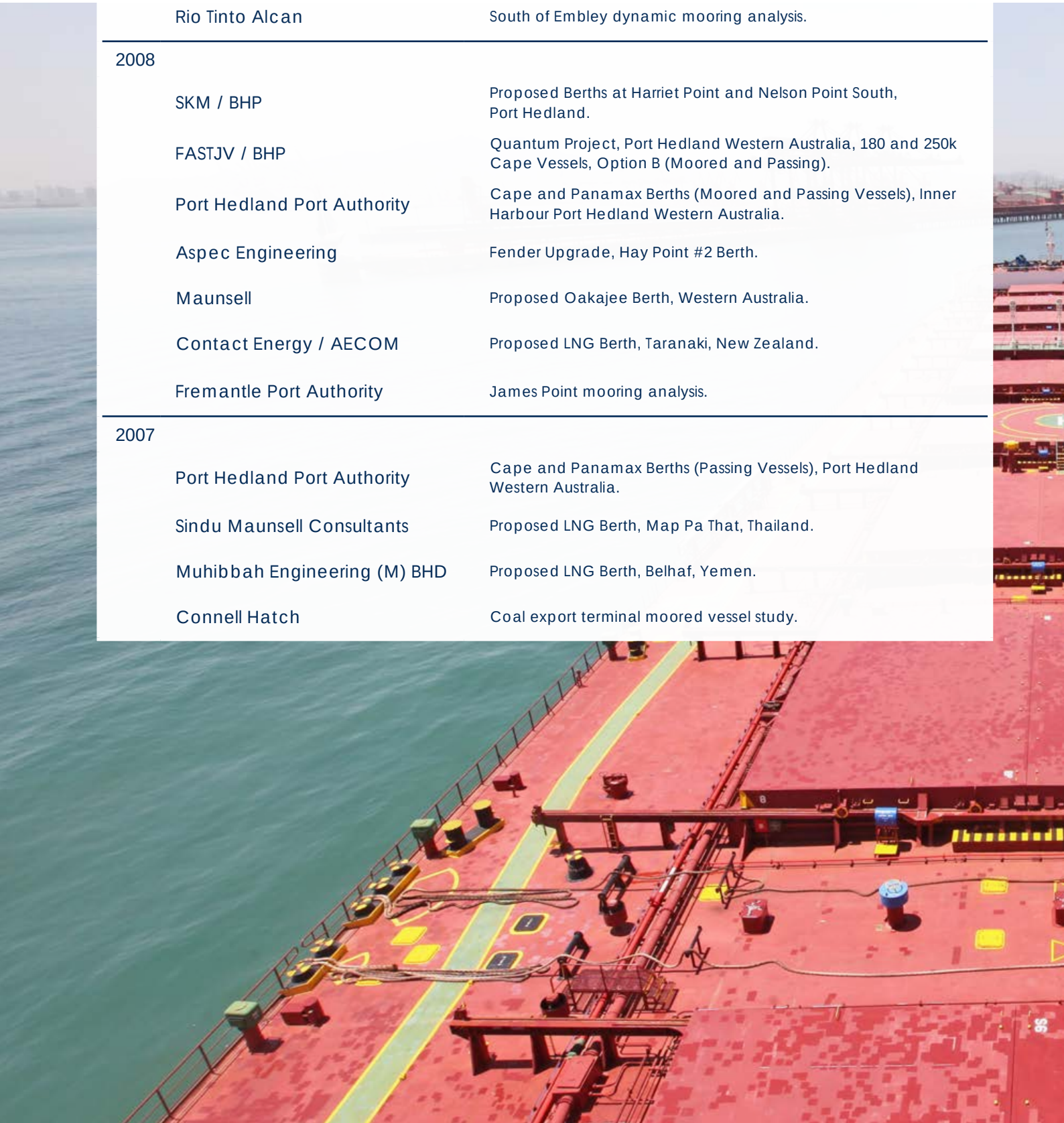
	Gladstone Ports Corporation	Passing vessel interaction study for RG Tanna berths.
	Rio Tinto	Assessment of alternative mooring configurations.
	Port Hedland	Dynamic mooring analysis including passing vessels.
2019		
	PrimePorts	Dynamic mooring analysis in support of a new wharf design at Evans Bay, Timaru.
	Port Hedland	Dynamic mooring analysis including passing vessels for Utah Point berth with Cavotec MoorMaster units.
	Fremantle Ports	Dynamic mooring analysis examining motions of moored vessels in the Inner Harbour.
	Fremantle Ports / Alcoa	Dynamic moored vessel analysis including analysis of infragravity (long period) waves.
	Rio Tinto	Post incident mooring analysis, including an assessments of alternative mooring configurations.
	Port of Napier	Dynamic moored vessel analysis for Cavotec MoorMaster system.
2018		
	Caltex	Passing vessel interaction study at the Port of Brisbane.
	Caltex	Dynamic moored vessel response analysis for MR and LR1 tankers at the Port of Mackay.
2017		
	AECOM / BP	Tangguh LNG project.
	Caltex Australia	Barney Point moored vessel response analysis for passing vessel interactions, Gladstone.
	Fremantle Ports	Moored vessel response analysis for passing vessel interactions.
	Rio Tinto	VLOC mooring analysis for Cape Lambert.
2016		
	Viva Energy	Mooring analysis for LR1 tankers at Dampier.
	Wallbridge Gilbert Aztec	Kangaroo Island floating wharf mooring analysis.
	Gladstone Ports Corporation	Clinton vessel interaction study assuming Cavotec MoorMaster.
	Jacobs	Moored vessel analysis for Amrun project.
	Pilbara Ports Authority	Passing vessel interaction study for MoorMaster moorings at Utah Point, Port Hedland.
2015		
	Rio Tinto	Assessment of alternative mooring configurations for iron ore berths at Dampier.

Previous Experience: Dynamic Moored Vessel Analysis

2014		
	Rio Tinto	Numerical modelling study of vessel motions, mooring line tensions and fender deflections for Ehoala berth, Madagascar.
	Rio Tinto	Moored vessel analysis for Cape Lambert operational Berth Warning System.
	AECOM	Moored vessel analysis for Geraldton Berth 7.
2013		
	Jacobs	Moored vessel analysis for Amrun project.
2012		
	GHB / Arrow Head	Dynamic vessel mooring study for Gladstone LNG jetty.
	AECOM	Numerical modelling study of vessel motions, mooring line tensions and fender deflections for proposed Port Kembla Outer Harbour development.
	FASTJV / BHP	Quantum Project, Port Hedland Western Australia.
2011		
	SKM	Passing vessel interaction study for Port of Newcastle.
	KLH / James Price Port	Dynamic vessel mooring study for proposed LNG Berth at James Price Point.
	AECOM	Numerical modelling study of vessel motions, mooring line tensions and fender deflections for proposed Port Kembla Outer Harbour development.
	AECOM	Dynamic vessel mooring study for Port Hedland's FMG3 berth.
	SKM / BHP	Dynamic vessel mooring study for Port Hedland's AP4 and AP5 berths including MoorMaster units.
	Aztec Analysis	Numerical moored vessel study for a Land Helicopter Dock (LHD) vessel at BAE site.
	Beca	Mooring study for Clifford Bay including MoorMaster units.
2010		
	AECOM	Dynamic vessel mooring study for Geraldton #7 Berth including MoorMaster units.
	SKM / Rio Tinto	Mooring analysis for proposed Cape Lambert Port B berths.
	Aspec Engineering	Mooring analysis for Hay Point upgrade.
	Cavotec	MoorMaster mooring analyses for Hay Point.
	Geraldton Port Authority	Dynamic vessel mooring study for Geraldton #3, 4 & 5 Berths.
	PHPA	Utah Point Port Moorings Analysis including MoorMaster units, Port Hedland.

Previous Experience: Dynamic Moored Vessel Analysis

2009		
	SKM / Damper Port Authority	Dampier Fuel Wharf Moorings Analysis including MoorMaster units, Dampier.
	AECOM / Port Kembla Port Authority	Proposed Port Kembla Outer Harbour Development, Port Kembla.
	JFA Consultants / Chevron	Proposed Ro Ro and Module Carrier Berth for the LNG Gorgon Project, Barrow Island.
	Rio Tinto Alcan	South of Embley dynamic mooring analysis.
2008		
	SKM / BHP	Proposed Berths at Harriet Point and Nelson Point South, Port Hedland.
	FASTJV / BHP	Quantum Project, Port Hedland Western Australia, 180 and 250k Cape Vessels, Option B (Moored and Passing).
	Port Hedland Port Authority	Cape and Panamax Berths (Moored and Passing Vessels), Inner Harbour Port Hedland Western Australia.
	Aspec Engineering	Fender Upgrade, Hay Point #2 Berth.
	Maunsell	Proposed Oakajee Berth, Western Australia.
	Contact Energy / AECOM	Proposed LNG Berth, Taranaki, New Zealand.
	Fremantle Port Authority	James Point mooring analysis.
2007		
	Port Hedland Port Authority	Cape and Panamax Berths (Passing Vessels), Port Hedland Western Australia.
	Sindu Maunsell Consultants	Proposed LNG Berth, Map Pa That, Thailand.
	Muhibbah Engineering (M) BHD	Proposed LNG Berth, Belhaf, Yemen.
	Connell Hatch	Coal export terminal moored vessel study.



Previous Experience: Full Scale Vessel Motion Analysis

2023
- Geraldton
- Botany Bay
- Savannah

2022
- Cape Preston
- Bremerhaven
- Wellington
- Ponta Ubu

2021
- Ponta Ubu
- Wellington
- Abbot Point
- Botany Bay
- Columbia River Bar

2020
- Wellington
- Napier
- Columbia River Bar
- Melbourne

2019
- Newcastle
- Itaguai
- Melbourne
- Torres Strait
- Cape Lambert
- Dampier
- Torres Strait
- Bunbury
- Belfast

2018
- Newcastle
- Melbourne
- Gisborne
- Geelong
- Lyttelton
- St Lawrence
- Torres Strait

2017
- Gladstone
- Melbourne
- Mundra
- Whyalla
- San Francisco
- Torres Strait
- Weipa

2016
- Brisbane
- Hobart
- Gladstone
- Torres Strait
- Weipa
- San Francisco
- Halifax
- Melbourne
- Geelong

2015
- San Francisco
- Spencer Gulf
- Brisbane
- Napier
- Melbourne

2014
- Port Hedland
- Melbourne
- Napier

2013
- Fraser River
- Port Hedland
- Gerladton
- Fremantle
- Cape Cuvier
- Ocean
- Brisbane
- Columbia River Bar

2012
- Singapore
- Newcastle
- Ocean
- Bass Strait
- Melbourne
- Columbia River Bar

2011
- Geelong
- Bass Strait
- Columbia River Bar
- Melbourne
- Port Phillip Bay
- Vancouver

2010
- Torres Strait
- Cape Lambert

2009
- Newcaslte
- Townsville
- Weser River

2008
- Weipa
- Port Kembla
- Weser River
- Torres Strait

2007
- Marsden Point
- Hay Point
- Brisbane
- Weser River
- Melbourne

2006
- Singapore
- Newcastle
- Marsden Point
- Lisbon
- Gladstone
- Geraldton
- Dampier
- Gisborne

2005
- Marsden Point
- Mackay
- Geraldton
- Fremantle
- Brisbane
- Weser River

2004
- Port Hedland
- Marsden Point
- Geelong

2003
- Napier
- Weser River

2002
- Weser River

2001
- Geelong
- Melbourne

2000
- Weser River
- New York
- Geelong

1999
- Weipa
- Karumba
- Weser River
- Geelong

1998
- Townsville
- Melbourne
- Weser River
- Geelong

1997
- Fremantle
- Dampier
- Port Hedland

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- **MetOcean Data Measurement and Forecasting**
- **Capital and Maintenance Dredging Optimisation**
- **Channel Siltation and Maintenance**
- **Dynamic Port Capacity Modelling**
- **Ship Motion Analysis**
- **Mooring Design and Berth Warning Systems**
- **Ship Simulation**

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