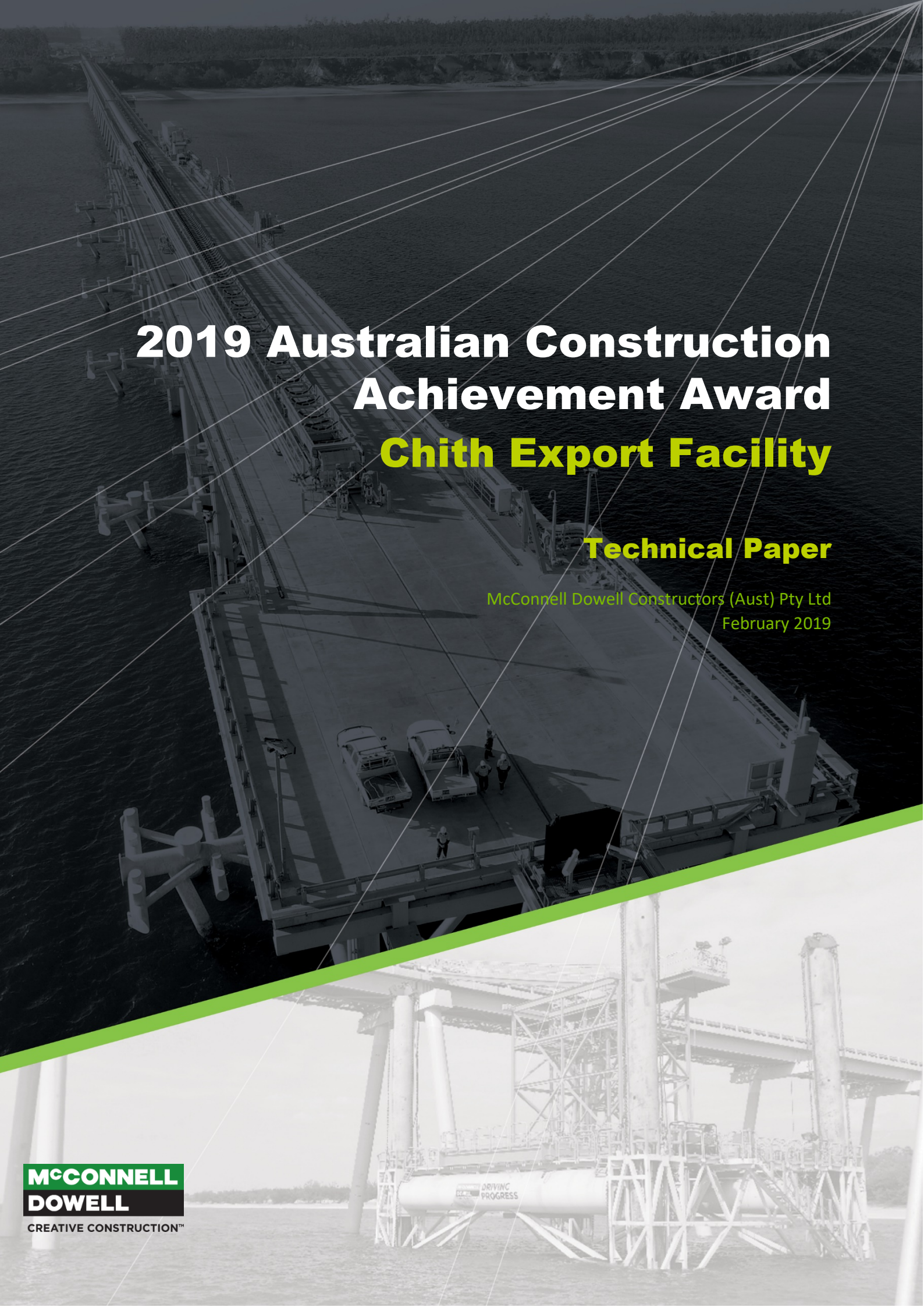




2019 Australian Construction Achievement Award

Chith Export Facility

Technical Paper

McConnell Dowell Constructors (Aust) Pty Ltd
February 2019

Table of Contents

1. Project Details	1
2. Introduction	2
3. Outcomes Achieved.....	3
Workplace health and safety	3
Time	4
Cost	4
Quality.....	5
Environment and heritage	6
Sustainability (in the context of construction)	6
Innovation and new technologies utilised	7
Stakeholder satisfaction.....	10
4. Complexity, Difficulty and Optimisation of the Construction Task	11
Challenging logistics.....	13
5. Collaborative Contracting Model.....	15
6. Leadership and Management of the Project Delivery.....	15
Project team relationships	15
Generating a legacy	17
Entrant's contribution in the design process	17
Health and safety leadership.....	17
Planning and control of construction operations.....	18
Industrial relations.....	18
Training and development initiatives	19
7. Key Organisations and Personnel	20

1. Project Details

Project	Chith Export Facility, part of the Amrun Project
Location	Near Weipa, Far North Queensland
Contract Value	\$170M
Completion	June 2018
Entrant	McConnell Dowell in collaboration with Rio Tinto, Bechtel and Jacobs
Role of entrant	Constructor
Project team	Client Rio Tinto Constructor McConnell Dowell EPCM Bechtel Designer Jacobs
Project fast facts	350m long wharf 7 wharf jackets 28 jacket piles 6 topside modules 650m long jetty 58 jetty piles 26 jetty bents 1,270m of export conveyor 1,400t the heaviest dual crane lift on the project 12,000t of steel fabricated in China and shipped direct to site 270 full time construction roles
Project awards to date	Winner Queensland Civil Contractors' Federation Award for Project Excellence (and in the running for the National award) Winner Queensland Major Contractors' Association Award for Innovation and Excellence Winner Rio Tinto 2018 (Global) Chief Executive Safety Award for Best Contractor Finalist Queensland Mining Awards Finalist Australian Engineering Excellence Awards

2. Introduction

Rio Tinto's Chith Export Facility is a large, complex and remotely located construction project that has revolutionised the design and construction for safe, smart and efficient large scale marine construction.

The facility comprises a 650m access jetty, a 350m loading wharf and an onshore conveyor system that will service Rio Tinto's Amrun bauxite mine, south of Weipa in remote Far North Queensland.

Innovatively designed by Jacobs (in collaboration with the constructor), constructed in 10 months by McConnell Dowell and with constructability input and oversight from Bechtel; Rio Tinto fostered a best-for-project philosophy across every aspect of the development.

Modularisation was at the heart of the solution, and the project team took it to new levels in scale and breadth, saving 300,000 job-hours and reducing overall build time by 12 months.

The 350m wharf structure was split into seven, first-of-a-kind 'jacket' modules (the substructure) and six topside modules.

Weighing approximately 680 tonnes each and standing 30m high, the jacket modules with integrated dolphins (Jacketed Wharf with integral Dolphins (JWD)) reduced the number of permanent wharf piles required from 100 to just 28, minimising environmental impact to marine life – a core focus for the Chith Export Facility team.

The wharf topside modules, placed on the jackets, ranged from 600 to 1400 tonnes and were fabricated complete with all services, conveyors, concrete roadways and access walkways.

In true 'plug and play' fashion, the JWD modules were delivered and installed by a heavy-lift ship in a safe, clean and efficient operation.

The 650m access jetty was constructed using McConnell Dowell's cantilever traveller frame. Developed for efficiency, repeatability and safety, this method minimised high-risk marine-based construction and saw each complete bent delivered in just three days.



Picture – The completed facility

3. Outcomes Achieved

Workplace health and safety

McConnell Dowell, Rio Tinto, Bechtel and Jacobs share an uncompromising approach to achieving zero harm and this saw **McConnell Dowell achieved a remarkable Total Recordable Incident Frequency Rate (TRIFR) of only 2.40 (one Medical Treatment Injury for 414,000 hours worked), and zero Lost Time Injuries.**

McConnell Dowell fully embraced Rio Tinto's Critical Risk Management (CRM) system on the project, and site safety management was rigorously audited by Rio Tinto. The auditors were highly complementary of McConnell Dowell's performance, with the company meeting or exceeding all of Rio Tinto's key performance indicators.

McConnell Dowell was the first contractor on site to receive 100% on a weekly workplace health, safety and environment audit, and the company went on to achieve numerous 100% results, a very rare feat.

These results and the strong “zero harm” culture nurtured on site saw McConnell Dowell win the Rio Tinto Chief Executive global safety award for ‘Best Contractor’ in 2018.

In announcing the award Rio Tinto CEO, J.S. Jacques, said ...

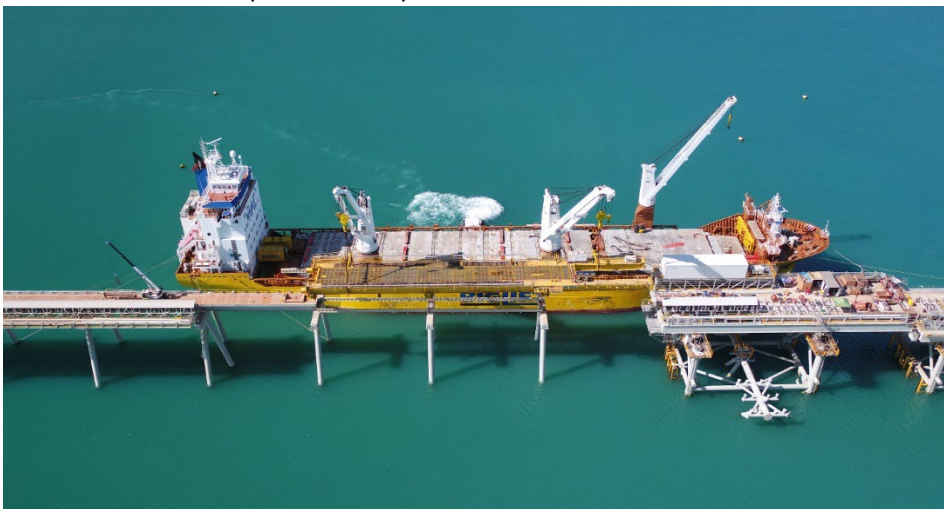
“I personally found it inspiring to see the team prove safety and productivity do go hand-in-hand, with the Chith project delivered ahead of schedule and below cost, alongside an impressive safety record.”

Risk management

Effective risk mitigation and management lay at the heart of these excellent safety results. The team was constantly seeking ways to reduce on site risks through new, different and innovative ways of working.

One example was around demobilising the cantilever traveller, where the project team was able to significantly reduce employee hours and exposure to high-risk activities at height and over water.

Rather than deconstructing the traveller piece by piece, the team made use of a heavy-lift ship returning from another project to lift the traveller in its entirety directly onto the transport ship deck in one go. This resulted in minimal work at height, no scaffold construction, no hot works, no associated risk from cutting large beams and so on. The de-risked process was performed without incident.



Picture – Demobilising the cantilever traveller

Time

From mobilisation in March 2017 to construction completion in December 2017, the project set new benchmarks for construction speed and productivity for a marine facility of this size and complexity.

Modularisation of the wharf structure (resulting in less piling, scaffolding and temporary works access platforms, welding, blasting and painting), coupled with the optimised jetty design and high productivity rates of the cantilever traveller for the jetty (three to days per bent), saw the overall construction schedule reduced by 12 months (to just 10 months) in comparison to the original 'stick-build' method. This approach compressed the entire marine construction to within one dry season, lessening exposure to adverse weather, including cyclones.

Cost

Capital expenditure was reduced by \$40M.

The design and construction strategies employed on the Chith Export Facility project reduced site labour-hours by 300,000, lowered the cost of marine plant by two thirds and reduced the number of wharf piles from 100 to 28; while the efficient set-up and weight of McConnell Dowell's jetty cantilever traveller enabled the steel in these piles to be reduced by some 325 tonnes. Flow-on effects of the reduced workforce saw a reduction in environmental, logistical, and resource-intensive impacts of transporting personnel, materials and plant to the very remote site. Accommodating and sustaining fewer site-based employees was also a major cost saver and environmental benefit.

However, the Chith Export Facility still realised a total economic contribution of more than \$150M for Australia. This was spent across engineering, procurement and construction-management services; design consultancies; construction personnel; the balance of material supply; dredging works; and marine services.

In addition to the capital cost savings, the improved quality derived by prefabricating the vast bulk of the facility offsite, in a controlled workshop environment, will contribute positively to wharf durability and reduce ongoing maintenance costs.

Quality

Offsite fabrication typically has a positive impact on quality, but on a project of this scale (12,000 tonnes of fabricated steel) and precision (10mm pile to jacket to topside tolerance), quality control was crucial.

Members of the McConnell Dowell construction team were based at the four fabrication facilities in China to oversee quality and maximise coordination and communication with the site-based team. Bechtel, Rio Tinto and Jacobs also mobilised in China, providing strong cross-organisational quality control and ensuring quality issues could be rapidly identified and resolved through joint discussions with all primary stakeholders.

Fabrication progress was monitored daily by the Planning Manager through the China-based team, which meant that any potential delays to the program could be identified early and resolved with the fabricators. This included identifying and notifying the fabricator where shortages in plant, labour and materials had potential to impact delivery dates. Fabrication was also reported back daily to the on-site construction team to provide transparency across the project.

There was full traceability on Vendor Supplied Equipment, including goods receipt certificates, dilapidation reports, preservation monitoring and compliance.

On-site quality control was just as rigorous and McConnell Dowell had zero rework and an empty punch list on departure from site two months ahead of the shiploader delivery.



Picture – Fabrication of 30m-high jacket modules

Environment

The innovative wharf design and construction meant that the project had considerably less impact on local marine life than a traditional stick-built design. Key initiatives included:

- Reduction in the number of permanent wharf piles required from 100 to 28 resulted in less pile driving and overall site works (welding, blasting, painting). The reduction in piling activities also had the added benefit of less work in an active turtle nesting zone (numerous fresh nests with eggs were identified during construction)
- The majority of fabrication and painting was undertaken in an offsite controlled workshop environment, rather than onsite over/near water
- Fewer marine plant (including barges) operating during construction also played a major role in reducing the environmental impact
- The cantilever traveller had an incorporated blast and paint box for coating the headstock-to-pile connection. This allowed for positive encapsulation during the paint-and-blast process to mitigate garnet from the blasting process and paint overspray entering the environment
- Non-chemical (electrical) stainless-steel passivation methods were used for the wharf launder and sumps. This involved a TIG welding kit and environmentally friendly citric acid
- Final cleaning of the stainless steel components of the facility was done by blasting with food-grade bicarbonate soda, instead of the traditional environmentally harmful and carcinogenic pickling paste chemical.



Picture – Turtle surveys being completed at Amrun by Rio Tinto's Land & Sea team, made up of Wik-Waya Traditional Owners.

Sustainability (in the context of construction)

By reducing the construction period by 12 months and completing the site works in only 10 months, the saving of 300,000 job-hours translated to significant savings in travel costs, accommodation and associated carbon footprint.

Future expandability of the wharf to include an additional berth was incorporated into the design, with the supporting structure for future fenders and mooring hooks included on the jackets. This provided a saving of approximately 42 piles that would have otherwise had to be installed for future expansion.

Innovation and new technologies utilised

Design and construction of the Chith Export Facility used many new and innovative techniques, including:

1. **Dolphin integration into a jacket structure** – Integration of the dolphin structure into the jacket structure (Jacketed Wharf with integral Dolphins (JWD)) is believed to be a world first in jacket design. This innovation was critical in increasing the effectiveness of modularisation by removing the need for separate dolphin structure modules, therefore reducing the quantities of piles, crane lifts, welding, blasting and painting, while dramatically reducing construction duration



Picture – Transport of jacket structure at fabrication facility

2. **Wharf construction using modular construction techniques and offshore fabrication** — The modules, weighing up to 1200 tonnes each, were transported to site by means of a heavy-lift ship and directly placed onto previously driven piles within the jacket structure, using the ship's onboard cranes.



Picture – Heavy-lift ship placing modules

Maximising off-site fabrication and minimising on-site construction activity – an approach that achieves time, cost and safety benefits. Off-site fabrication occurs in controlled purpose-built fabrication facilities with existing infrastructure as opposed to a one-off process on site. Cranage, paint facilities and preassembly areas are all available in a fabrication shop and quality can be controlled more effectively in a production setting. The capacity to mobilise more manpower to shop fabrication, which extends to sharing the load among multiple facilities, also has the benefits of reducing both risk and overall construction timeframe.

These innovative techniques enabled the project team to reduce the quantity of floating plant and labour required for construction, significantly reducing or eliminating:

- Access risks associated with working from floating plant
- Downtime resulting from sea state or cyclones, providing greater program certainty
- Costs associated with using a significant amount of labour
- Costs and logistical challenges of transporting and accommodating labour in the remote location
- Quality issues when works were conducted in less-controlled environments.

3. **Headstock connections**— A horizontal pile cut resulted in a thicker pile-cap plate at additional cost; however, the connection minimised job-hours on site:

- The horizontal weld provided a better quality outcome as it was easier to complete.
- The painting rectification was simplified, resulting in a better product.
- Permanent design considered the construction load cases. The piles and headstock were designed for the cantilever traveller load, which was the limit for loading through the piles. This led to a best-for-project balance of lowest construction cost versus most efficient permanent works material costs.

The lower construction cost was achieved by maximising over-the-top construction, hydraulically driven structures and repetitious methodologies. McConnell Dowell, Bechtel and Jacobs worked together to minimise the rework associated with rectification of temporary works elements, including the required lifting lugs, tie downs and trunnions. The design considered these and made them permanent, thereby mitigating the cost of removal and remediation.

4. **Smart Temporary works**—From project commencement the Chith team sought ways to reduce on-site labour, mitigate safety risks and reduce the construction program by implementing smart temporary works solutions. For example, the painting platform on the trestle provided a travelling gantry that eliminated the need to work outside of contained areas. Another example of smart temporary works was the trunnion walkways. The lifting trunnions for the heavy-lift ship were more than 25m in the air and access was difficult. Consequently, walkways were designed to be lowered in from the permanent platform out to the trunnions. The walkways were installed in China and were not removed until the units were in position. This meant that there was access to the lifting points at the yard in China for hooking up the heavy-lift ship, unhooking on the heavy-lift ship, access for tie downs, access to hooking up on ship and access in water for unhooking. A further example was the jacking platforms, which were temporary works but left in place in the final product. These platforms can now be used for future bearing replacement. The jacket design was modular and expandable to not only Cape-size vessels but additional berths in the future. Thought was given to how these would be constructed without impacting operations at that time. That is, the berth could be doubled in capacity with the addition of a second set of dolphin jewellery. The team considered how this would be constructed and then incorporated elements and connection in its construction activities. This ultimately means that expansion can be undertaken outside of the operating envelopes in the future.

Stakeholder satisfaction

Client

The project's primary stakeholder was owner Rio Tinto and its General Manager for the project, Marcia Hanrahan, said this...

"Innovations such as these are integral for advancing the future of the mining and metals industry in a safe, cost effective and replicable manner. The collaboration between Rio Tinto, Bechtel, Jacobs Engineering, and McConnell Dowell throughout the design, fabrication, and construction phases of the project has delivered a construction method for wharf building that will pave the way for future projects, not just in Australia, but globally."

Community

With the Chith Export Facility located on traditional lands of the Wik-Waya people, great focus was placed on ensuring that all those involved with the facility understood the significance of the area to Traditional Owners, and consistently demonstrated respect for the land and Elders past and present. This involved all project personnel being welcomed to Country by senior Wik-Waya Traditional Owner Tony Kerindun, undertaking cultural awareness training, and having a detailed understanding of cultural heritage exclusion zones and considerations.

Furthermore, the facility name—Chith—is the Wik-Waya word for the red and white eagle that visits the area surrounding the facility. This name created a great sense of pride and ownership across the construction team, as well.

The deep understanding and personal interaction between the workforce and Traditional Owners brought about many positive outcomes. Firstly, it enhanced the cultural capability of the contracting partners working on the facility, which were required to maintain a rigorous focus and report on local and Indigenous participation. Secondly, it gave individuals the opportunity to gain a personal understanding of local Aboriginal people, their connection to Country and their aspirations for future generations. These things combined helped to build a strong culture of inclusiveness and respect.

From an employment perspective, the peak construction Chith Export Facility construction workforce reached 150 in December 2017, and a total of 270 full time roles throughout the duration of the job. Of this workforce, 16 team members were of Aboriginal or Torres Strait Islander descent, and two were local Aboriginal people.

4. Complexity, Difficulty and Optimisation of the Construction Task

The Chith Export Facility is large, remotely located and marine based – a complex combination to test the ingenuity of any team.

The base-case wharf design, developed in a previous incarnation of the project by others, was a conventional steel-framed, stick-built wharf, with independent dolphin structures, supported on driven steel piles.

This form of construction requires all materials to be transported to the project site, stored in large laydown areas, and then progressively staged to the workfront. Installing the components on site requires mobilisation of marine plant, including pile and crane barges, jack-up barges, storage barges and support vessels. It also involves a lot of temporary works, particularly scaffolding, to provide access and working platforms for construction personnel, as well as temporary supports for permanent structures during installation. To complete this volume of site works requires a large team of construction personnel, including welders, painters, labourers, piling crew, crane operators, barge crews, laydown area crew, management and supervision.

The conventional base-case wharf construction had numerous cost, schedule and risk challenges, including:

- Safety risks associated with working at height and over water
- Logistical difficulties in accommodating personnel and transporting construction plant, equipment and materials to the remote site
- Impact of high seas and winds during the wet season, when on average one to two cyclones are experienced (as exemplified during Cyclone Nora in early 2018), making traditional construction methods impractical
- 30-month build from contract award to mechanical completion, spanning more than two wet seasons on site
- Highest cost facility on the project
- Wharf and jetty on the project critical path.

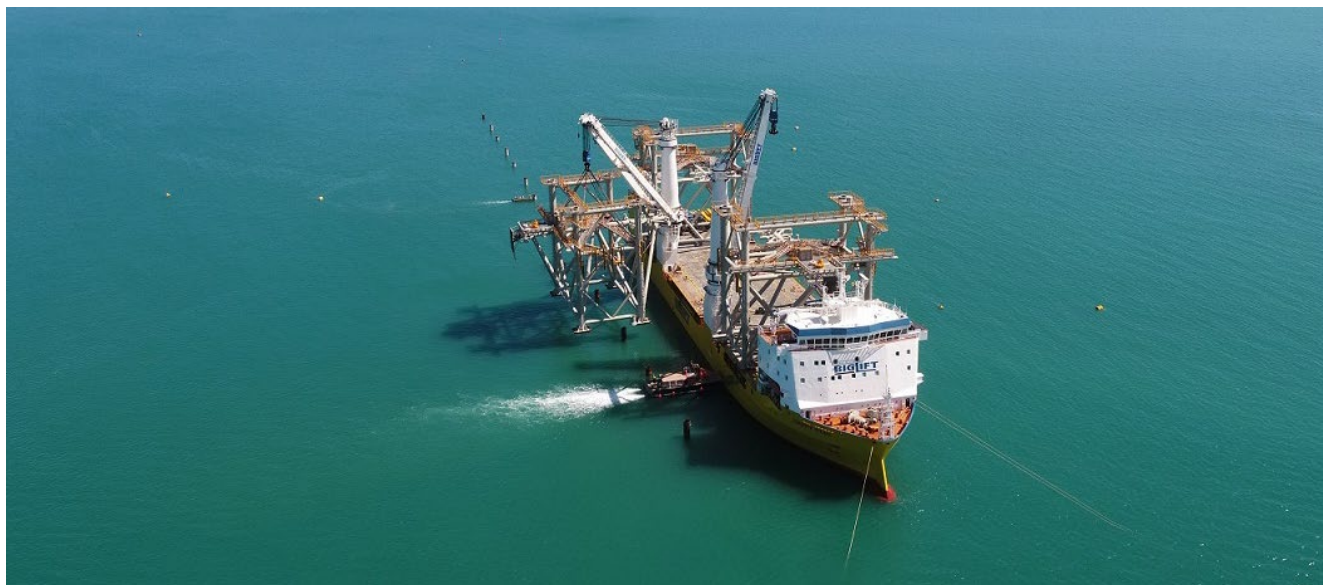
The team looked at the proposed methodology through a series of constructability workshops prior to contract award, factoring in design, fabrication and construction requirements, which lead to three key findings that presented the greatest opportunity for improvement:

- Construction of wharf and dolphins would take 65 per cent of direct labour hours and would require most marine plant and vessels
- Wharf and dolphins attract the highest cost, schedule and health, safety and environment risks
- The biggest challenge was logistics in a remote location.

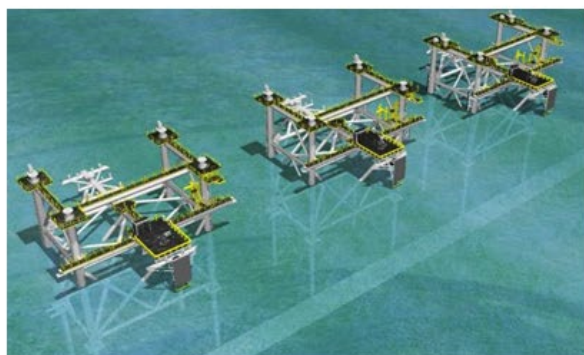
Armed with this information, the team looked at what had been achieved elsewhere, particularly in the strategy to modularise the deck of the wharf, and proven construction methods used at Rio Tinto's Pilbara ports. This saw the design evolve to include all secondary steel, concrete deck, conveyor, piping, electrical services and substations into a modularised structure to transfer all pre-assembly work of the top side of the wharf to an offsite location.

The success of this collaboration prompted the project team to stretch its ingenuity further. The team continued to explore how the bottom side of the facility might also be modularised. This work resulted in integration of the dolphins and wharf substructure into a prefabricated jacket, which was favourable to the geotechnical conditions on the site.

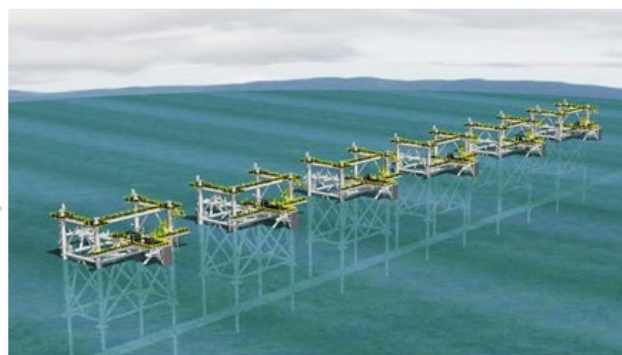
At the heart of this innovation was the unique integration of temporary works into the permanent wharf design, which was critical for all but eliminating the need for scaffolding as part of the on-site assembly works when splicing the main beams of the deck module together. This result was a direct outcome of having constructability input from all parties into the final design. This constructability input achieved a first-of-a-kind type construction, incorporating 13 pre-assemblies made up of seven wharf jackets with integrated dolphin structures fixed with driven piles through sleeves, and six topside modules complete with concrete deck and mechanical installations.



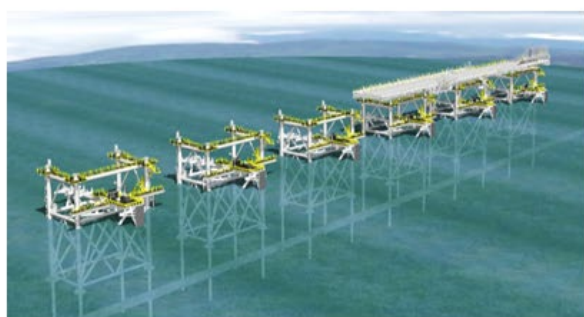
Picture: Heavy-lift vessel lifts the first jacket in place on site



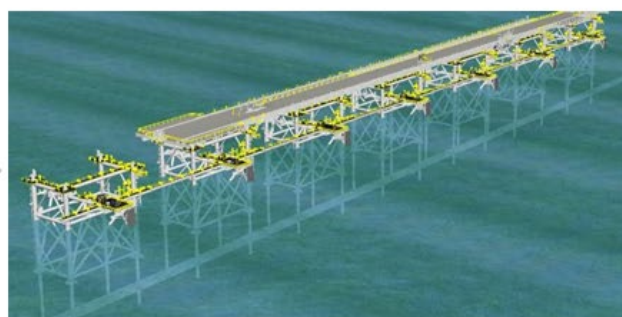
Delivery 1 – land Jackets 1, 2 and 3 (August 2017)
Drive permanent piles through jacket sleeves and grout.



Delivery 2 – land Jackets 4, 5 and 6 (September 2017)



Delivery 2 – land topside modules 1, 2 and 3
(September 2017)



Delivery 3 – land Jacket 7 and topside modules 4, 5 and 6
(October 2017)

The jetty structure also benefitted substantially from constructability input and collaboration between McConnell Dowell and Jacobs. Due to early involvement, configuration of the piles, headstock, deck and

conveyor trusses was optimised to suit McConnell Dowell's cantilever traveller and construction method, enabling a reduction in the construction cycle. The headstock also had every item associated with the temporary works incorporated, avoiding any add-ons or removals during the construction process with the consequent requirement for blast and paint touch-up removed.

An improvement on jetty structure construction from all previous and similar access jetties was addressing the blasting and painting activities that must be carried out below the headstock at the pile/headstock interface. While the welding takes place from the access provided by the traveller and directly after the piling operation, the blast and painting activities follow behind as a separate and generally independent operation. This then generally falls way behind traveller production and becomes an item that delays overall completion, with associated cost blow-outs due to difficult access, once the main construction front passes. To avoid this situation, the team devoted time to design fully enclosed special access structures to safely support personnel and equipment. These could be easily moved forward and enabled a production cycle that matched that of the main traveller. It enabled a high standard of workmanship while ensuring this critical activity progressed with the traveller. The team's new design concept worked extremely well, augmenting overall jetty construction efficiency.

Challenging logistics

McConnell Dowell drew on its proven international logistics expertise to provide a seamless and integrated logistics-management process that was tailored to the unique design restraints. One of the keys to optimising shipping time and site deliveries was incorporating Australian Customs inspections, both at the Chinese port facility and in Weipa. This approach provided the team with certainty that goods would be shipped and received as required. Drawing on this same philosophy, the project's Fabrication Manager was the single point of contact in developing the stowage plan for each shipment, in consultation with and in line with site construction activities. Interface between the China fabrication team and on-site management team started as weekly meetings, increasing to bi-weekly and ultimately, daily meetings as the ship departure date moved closer.

The sheer scale of the wharf jackets and topside wharf modules posed significant challenges through the preparation and planning phase and again during execution. The height of the jackets limited shipping options to the *Happy Star*, which has the highest vertical lift capacity of any heavy-lift ship in the world. The added benefit of this vessel meant that the project could also ship three topside modules in the hold of the ship with three jackets on the weather deck.

Shipments and components

Heavy lift vehicle 1

- Three jackets
- 28 foundation piles
- Small packages and loose items.

Heavy lift vehicle 2

- Three jackets
- Three topside modules
- Small packages and loose items.

Heavy lift vehicle 2

- One jacket
- Three topside modules
- Small packages and loose items.

The downside of the large volume of items able to be shipped at one time was the pressure this applied to not only fabrication but to on-site activities. The project team was required to be across many fronts simultaneously, as it had to complete a number of activities in the same timeframe. The challenge was storing extremely large items, while allowing access to move them in a logical sequence that aligned with the stowage and discharge plan for each shipment. Additionally, at the receiving end there was limited storage and all lifting had to be carried out in open water – either by lifting an 800-tonne jacket over and onto two guide piles while compensating for wind and sea swell or by ship-to-barge transfer also compensating for the same conditions.

“The Chith Export Facility is not only impressive in its sheer scale, complexity and logistics, but also because the project delivery team embraced modular design and construction and took this to a new level.

“This proponent went against the grain of the traditional design and logistics, leading to exceptional outcomes in regard to programme, safety and environment.

“The construction methodology directly led to lowering personal risk and had a significantly reduced impact on the environment when compared to traditional design and construction methods. Repetition in design and construction was used to optimise the solution.

“In order to make this innovation happen, this team had to back themselves, taking on a higher level of logistical risk. Innovation does not exist without risk.”

Judges' comments
Queensland Major Contractors' Association Awards
5 October 2018

5. Collaborative Contracting Model

Chith Export Facility project delivery was founded on openness and transparency with a shared understanding of risk. The contract apportioned risk according to who best could manage it. For example, the off-site works were lump sum as they were entirely controlled by McConnell Dowell and the level of transparency for Rio Tinto was limited. On-site works were reimbursable with fixed cost elements. Consequently, the on-site works were allocated to those best positioned to manage the risk or to minimise administrative burden. For example, small tools and consumables were at a fixed rate per job-hour to a cap. Small tools and consumables can represent up to 70% of invoicing numbers. By agreeing the rate, less work was required to vet costs. Third party and labour costs were part of the reimbursable. Marine fleet resources were provided by Bechtel and shared across the project. This approach drove better efficiencies of marine fleet usage and therefore, better cost outcomes for Rio Tinto. The project's open and transparent contract model also recognised the change required as the design was issued for construction.

6. Leadership and Management of the Project Delivery

Project team relationships

The Chith Export Facility project is an excellent case study in collaboration, showcasing the benefits of open and respectful relationships between owner, project manager, designer and contractor.

Rio Tinto purposely chose an Early Contractor Involvement approach for the project and this structured and focused engagement on design constructability was key to driving the innovations.

The revised design and construction strategy was not without its risks; however, the ability to leverage the vast experience and technical acumen from those around the table resulted in clear accountabilities for how the team would work together to design, fabricate and construct the project.



Under McConnell Dowell Project Director Graeme Brown's leadership, the Construction Management Team (CMT) aligned itself around a number of core behaviours that were paramount to the project's successful construction. These behaviours were:

- **Collaborate** – a shared commitment and loyalty to each other and the project, exhibited through a 'can do' approach
- **Trust** – to lead by example, take ownership and be open and honest with each other
- **Actively care** – complement our teammates, look for opportunity to help others, engage with all members of the team and provide context behind why we do things
- **Be visible safety and environmental leaders** – drive continuous improvement through active and visible safety and environmental leadership. "Courage to Lead" was an important project principle and motto.
- **Be accountable and compliant** – hold one another accountable for individual compliance to tasks

- **Show perseverance and resilience** – be motivated, passionate and strive for excellence
- **Celebrate milestones and acknowledge success** – celebrate milestones and successes along the journey.

Enshrined in a Team Charter, the CMT lived and breathed these behaviours. The team continually challenged each other and referenced the charter when behaviours were not aligned.

The project's organisation chart was simple and clear. Everyone knew to whom they reported and understood both their own and everyone else's accountability. All personnel coming onto the project were inducted and received a position description outlining their responsibilities and objectives. Regular reviews were held to reinforce accountability and individual performance.

Graeme Brown led the Chith Export facility with integrity, poise and courage.

His leadership style fostered an openness that was manifest in the broader project team. Continually leading from the front, with honesty and genuine caring in his day to day dealings with both internal and client stakeholders, Graeme inspired his peers to strive for better outcomes.

As the client representative, I was approached with an integrity rarely seen on projects, in an environment that helped the broader team commit to excellence.

Any adversity during the project execution phase was dealt with in cooperation and full disclosure to provide an environment that allowed trust and respect to be the drivers for finding a best for project outcome.

Graeme was always straight and never sugar-coated problems and dealt with issues resolutely and expediently.

The projects motto was "courage to lead" a sentiment and value that Graeme espoused at each opportunity, driving his team to be better than they may have thought they could be.

Genuine, honest, fair and uncompromising.

David Gwilliam, Manager Construction Bechtel

Generating a legacy

While wharf modularisation is not new, the Chith Export Facility team took it to the next level with its first-of-a-kind jacket design for the wharf substructure. The jacket structures:

- Reduced over-water access and construction risk
- Massively increased on-site productivity
- Increased quality and productivity, as fabrication took place in a factory environment
- Decreased the learning curve through repetitious design.

When coupled with the traditional topside modules, these designs and construction methods have the potential to revolutionise wharf construction around the world.

Entrant's contribution in the design process

As stated earlier, Rio Tinto purposely chose an Early Contractor Involvement approach for the project and this structured and focused engagement on constructability during the design phase was the key to driving the innovations that resulted.

Instead of the construction team focusing on traditional cost savings in materials and labour, the collective focus was shifted to design optimisation, assessing construction methods, reviewing plant and equipment options, and developing safe, smart temporary works solutions.

Health and safety leadership

Visible leadership in the field was a significant part of our overall success. McConnell Dowell's Project Manager, Graeme Brown, attended every toolbox meeting (when at site) to listen directly to safety issues from the workforce, as well as to impart his knowledge and experience from previous projects. He also consistently undertook three walks a day, engaging with the workforce on a personal level and talking about safety. Additionally, all safety team members conducted at least one field walk per day each.

"Graeme created an environment where all employees' opinions were valued, thereby promoting a safe and successful project outcome."

Gerard Kunde
Offshore Superintendent

A central focus of the site safety strategy was to foster an open and diligent reporting culture, while the hierarchy of communication ensured a consistent safety message was relayed throughout the project team in a timely manner. Communications included:

- Quarterly health and safety representative meetings
- Monthly site leadership team meetings
- Monthly Zero Incident Team Meeting involving all contractors
- Weekly interface meetings with client
- Weekly health and safety leads meeting with the client
- Weekly toolbox meetings
- Daily prestart meetings

These were augmented by less formal but equally important communications processes such as the Visiting Manager Reports.

Strong safety culture

From project commencement, the project leadership team fostered the development of a healthy competition between key work groups (civil, yard/transport logistics, jetty, marine, electrical and support services), with team progress reported weekly at a toolbox meeting. This promoted full transparency among the teams and put any non-performing areas on notice, whereby the following week they would lift their performance. This friendly rivalry ultimately pushed all teams to do their best from week to week, with the overall outcome being that the teams set a high standard for the project. Other examples of the Amrun Chith Export Facility project's strong safety culture include:

- A leadership team that openly encouraged construction personnel to stop potential unsafe activities and take corrective action, regardless of their role (this may have been as simple as performing a new start card, engaging with supervision or seeking expert advice from the health, safety and environment team and management)
- A reward and recognition program that made sure employees were acknowledged for a job well done, which ultimately resulted in high employee morale for the life of the project
- Leadership commitment to creating a fun place to work where personnel were encouraged to interact with all levels of the project hierarchy. The Chith Export Facility project presented a challenging climate during the build up to the wet season, which at times was truly oppressive. However, the work environment made up for it, which translated to very few industrial relations or human resources issues and minimal sick leave.

"We're all in this together. Let's make it work, let's look out for each other, let's set the benchmark for the site and let's do it safely."

Chith Export Facility project team culture

Planning and control of construction operations

McConnell Dowell's Integrated Management System (MMS) was used as the procedural framework to plan and control every aspect of the project's construction.

At a project level, the Management System took the form of a Project Execution Plan (PEP) which was customised to address the specific requirements of each major phase of the project and incorporated specific sub-plans for the management of quality, safety, environment, traffic and other elements requiring control. Accountability was clearly defined throughout the PEP.

Industrial relations

A respectful and productive relationship was developed and nurtured with all employees to support the successful execution of the project.

The Industrial Relations management approach was consistent and collaborative, and all direct-hired personnel and subcontractors were treated equally. Central to the goodwill developed, the Project Management Team ensured full compliance with relevant IR legislation, awards, agreements and codes of practice.

A fair and equitable environment was created, with well communicated processes for responding to and resolving matters raised by employees. There was also a constant focus on maximizing employee input and cooperation and improving work practices through continuous consultation and training.

Training and development initiatives

The training and development initiatives deployed on the project responded to the unique site challenges and construction methods deployed. These included:

- Comprehensive marine operation safety training to ingrain knowledge and awareness of the region's inherent risks
- In-depth inductions with a specific focus on modularised construction and big-lift operations to build a workforce that understood their roles
- Interactive weekly toolbox meetings with a strong emphasis on safety and returning 'home without harm' and 'What Safety Means to Me' – Home, Family, Lifestyle and Dreams.
- Simulation training and drills for scaffolding, work at heights, retrieval and rescue scenarios with a scaffold tower built on site.
- Inductions and Training for the traveller system including detailed graphics simulating the segmented phases of the operation with this unique piece of equipment
- Extensive environmental training encompassing knowledge of the unique flora and fauna present on site and equipping the team with innovative construction methods, skills and equipment to enhance environmental protection outcomes
- Extremes of climate training including heat stress and dealing with cyclones – mandatory for all.
- Comprehensive cultural awareness training to give individuals the opportunity to gain a personal understanding of their connection to Country and their aspirations for future generations. These things combined helped to build a strong culture of inclusiveness and respect throughout staff and the workforce.

Underpinning the integrity and effectiveness of the full suite of training programs was the engagement of registered training providers to ensure any licensed Verification of Competency or Training was industry accredited and certified both before and after project mobilisation.

7. Key Organisations and Personnel

Organisation	Project Role	Key Personnel
Rio Tinto	Owner and Project Principal	Marcia Hanrahan – General Manager Amrun Project Alex Li – Area Project Manager
Bechtel	EPCM	David Gwilliam – Manager Construction Bechtel Phil Newsome – Project Manager Grant Linder – Construction Manager
Jacobs	Designer	Ross Dunkley – Lead Designer Lance Menzies – Senior Structural Designer Steven Gaul – Senior Structural Designer
McConnell Dowell Australia	Constructor	Graeme Brown – Project Manager Steve Woods – Construction Manager Marc Ryder – Safety Manager Franky Portelli – Quality Manager Nick Bernie – Environmental Manager
COSCO Heavy Industry; SCK, Kawasaki; Keda Heavy Industry; Third Harbour Engineering Construction	Module Fabricators	Mr Zhao Zengshan – Vice President COSCO Mr Liu Xuming – General Manager SCK Ms Li Yan – Chairperson KDHI Peter McGeehin – Operations Manager (McConnell Dowell China)
Big Lift Shipping	Heavy lift ship operator	Gem Wender – Project Manager Jeanot Boulet – Captain (Happy Star) Johannes van der Mark – Chief Mate (Happy Star)
Bhagwan and Toll	Marine services, transport and logistics	Ben Wall – Project Manager
Goodline	Camp builder and operator	John Kennedy – Senior Sponsor
CSE	Remote communications/inter net specialists	Aron Ostrofski – Project Manager
Remondis	Waste management	Craig Flesser – Site Superintendent