Addendum 1
Goat Island Conservation Management Plan 2011 for the 4-10 Tons Fixed Electric Tower Crane.

Goat Island, Sydney Harbour National Park.

Date: 1 March 2024

Item Name: 4-10 Tons Fixed Electric Tower Crane	
SHR Item No: 00989	HHIMS ID number: 3452
CMP Item No: 009	
Item Type: Built	Historical Phase: The MSB 1936-1992
Significance: Moderate	Materials: Steel frame and trusses
Construction Start Date: 1924	Construction End Date: 1963
Archaeological Potential: None	

Purpose

Goat Island is listed on the State Heritage Register (SHR) No 00989. The 4-10 Tons Fixed Electric Tower Crane is within the SHR boundary of Goat Island.

The June 2011 Goat Island Conservation Management Plan (CMP) Vols 1 to 4 was endorsed 6 April 2011, under S38A of the *Heritage Act 1977.* The CMP records the crane's history and condition known and observed at the time.

This addendum updates the Volume 3 Site Database inventory sheet with new information on the crane's history, physical condition and integrity, rarity and conservation policy.

In the CMP and earlier plans, the crane was described and titled as a hammerhead crane. Sir William Arrol & Company 1924 design drawings for the crane's mechanisms survive in the former Maritime Services Board's plan collection now held by NPWS. The crane is identified on 1924 drawings as the 4-10 Tons Fixed Electric Tower Crane. Accordingly, the Sir William Arrol & Company title for the crane is used in this report.

Authors

This addendum was prepared by the National Parks and Wildlife Service (NPWS) and Paul Connett, Heritage Structural Engineer, Taylor Thompson Whitting (TTW).

Historical Summary

The 4-10 tons Fixed Electric Tower Crane was fabricated in Parkhead, Glasgow in 1924 by the renowned Scottish engineering firm Sir William Arrol & Company, for Mort's Dock & Engineering Company.

Mort's Dock was established at Balmain in 1854 by Thomas Mort and Captain Rowntree. Mort and Rowntree formed the Waterview Bay Dry Dock Company, (later renamed Mort's Dock & Engineering Company) in 1853 and built Australia's first dry dock and patent slip. Mort's Dock & Engineering Company purchased the Arrol Shipyard Crane, described in a 1927 Sir William Arrol & Company catalogue as a tower crane for shipyards, made of various heights and powers to suit varying conditions (Figure 1). The only bespoke feature of Mort's Dock crane was the height of the crane. The crane was shipped in sections from Glasgow and erected on the western side of the company's main dry dock in 1924 to 1925. The crane was commissioned in 1926. The crane's serial number is 2184.

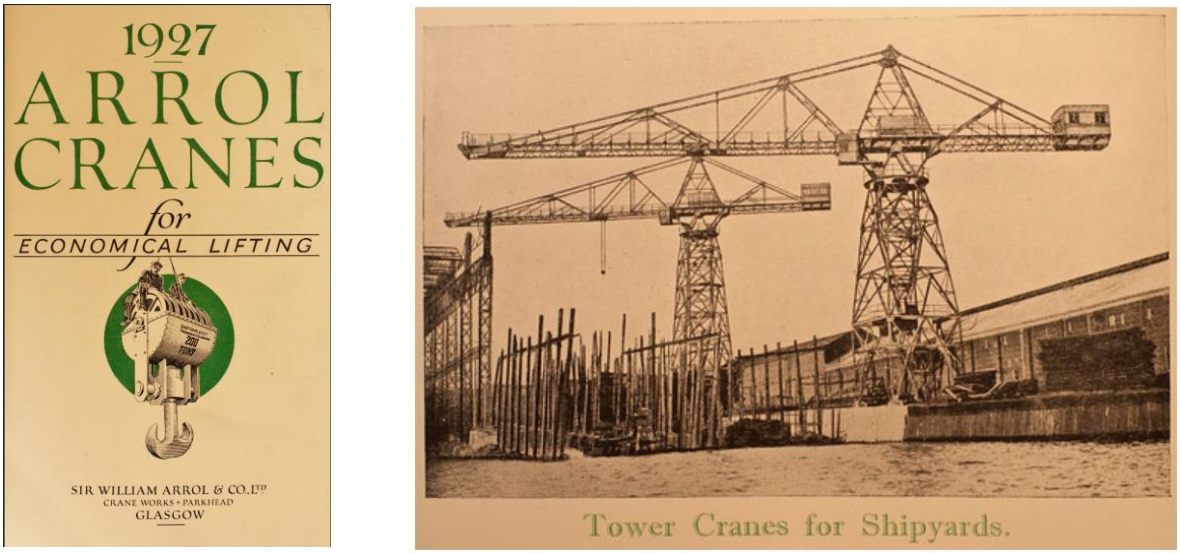

Figure 1: The 1927 Arrol Cranes Catalogue (Source: urbanglasgow.co.uk)

The Arrol crane operated at Mort's Dock from 1926 to 1959. Labour unrest and other factors during the post-World War II recovery led to the closure of Mort's Dock on 12 November 1958. On 16 January 1959, liquidators sold the site with contents and the crane placed on the market. The Maritime Services Board of NSW (MSB) purchased and dismantled the crane in 1962. The MSB used the Royal Australian Navy Floating Titan Crane to move and re-erect the crane at its Goat Island shipyard to supplement use of smaller derrick cranes.

The MSB made minor modifications to dismantle, move and re-erect the Arrol crane such as welded and bolted splice plate connections. Footings for the crane new location were poured in January 1963 and the crane was re-erected and operational by 1964.

By 1992 all MSB operations at Goat Island had been relocated and the MSB Marine Engineering Division had been dismantled. The scaled down marine operations service, MSB's firefighting and oil spill response, was transferred to Walsh Bay. The NSW National Parks and Wildlife Service (NPWS) assumed responsibility for Goat Island in 1992.

In 1998 the shipyard, including the crane, was reactivated by NPWS under a lease between a commercial ship repair operator and NPWS. The several subsequent shipyard leaseholder(s) operated the crane from 1998 until 2010.

In 2010, following a WorkCover NSW inspection, the shipyard leaseholder commissioned an engineer's inspection, which concluded that the crane was damaged beyond repair and unsafe to operate. On 9 December 2010, WorkCover NSW issued Prohibition Notice No.153358, prohibiting the use of the crane as it was unsafe to operate. The crane was taken out of service

and not used since 2010. Since the crane was taken out of service, safety inspections have been conducted approximately biennially by structural engineers Hyder Consulting and then Arcadis.

Sir William Arrol & Company

Sir William Arrol & Company was a leading Scottish steel fabrication and civil engineering construction business founded by William Arrol in Glasgow. In partnership with other companies it built some of the most recognised bridges in the United Kingdom including the second Tay Bridge, the Forth Bridge and the steel and iron superstructures for Tower Bridge in London. William Arrol & Company also developed specialist equipment for the manufacture and erection of their steel structures, and this is where their expertise in steel fabrication and construction lay. This included hydraulic riveting machines and cranes that were used during the construction of Tower Bridge.

In the mid 1880's Sir William Arrol & Company supplied fabricated steel from their Glasgow Dalmarnock Iron Works for the first Hawkesbury River Railway Bridge and supplied British cement to the project. The bridge design and on-site assembly of the seven span truss bridge was by a different company - the Union Bridge Company of New York. At the time of opening, the bridge was the longest structure to be built in Australia and largest bridge in the Southern Hemisphere. Opened in 1889 the bridge linking Sydney to Newcastle by rail, and in effect the railway systems of the eastern Australian states.

Sir William Arrol & Company's business expanded in the late 19th and early 20th century to incorporate a civil engineering design office, designing bridges, bascule, swing and transport bridges, workshops, ship building facilities, cranes, construction machinery and construction methods. Early notable design and construction projects included the road and tram bridges over the River Nile at Cairo, and the Titan Crane at Clydebank (1907). At the time the Titan was the biggest crane of its type ever built and had a lifting capacity of 160 tonnes.

Sir William Arrol & Company was commissioned to build many ship construction yards in the United Kingdom. At 260m long, 82m wide and 69m high, the Arrol Gantry at the Harland and Wolff Shipyard was one of the largest steel structures built by Sir William Arrol & Company at that time, and an essential part of the infrastructure needed to construct the Olympic-class ocean liners Olympic (1911), Titanic (1912) and Britannic (1914).

In 1910 Sir William Arrol & Company acquired Appleby Crane and Transport Company and their Parkhead Crane Works, which allowed Arrol to not only design and build cranes but also to provide the crane machinery. The Appleby Crane and Transport Company, and its predecessor companies, had constructed the 1883 steam beam engineer pump for Goulburn Waterworks, NSW and the 1899 Jessop and Appleby Brothers steam crane which remains as an artefact at Constitution Dock in Hobart, Tasmania.

Sir William Arrol & Company manufactured hundreds of cranes at the Parkhead Crane Works. Off-the-shelf and bespoke cranes included overhead travelling cranes for workshops, hydraulic wharf cranes on tracks, light derrick cranes with a maximum lift of 5 tons, for shipbuilding and bridge construction, electric tower cranes for shipbuilding, of the type erected at Mort's Dock, with a maximum lift of 10 tons; track-mounted block-setting cranes for wharf and breakwater construction, travelling jib cranes, and very large cantilever cranes able to lift up to 250 tons, both static, travelling and floating.

Sir William Arrol

Sir William Arrol was a pre-eminent 19th century Scottish civil engineer and member of the British parliament. He started work at the age of nine in a cotton mill and at the age of fourteen he was apprenticed to a blacksmith, supplementing his practical education with night school classes and the purchase of books on engineering. In 1868 at the age of 29 he started his own company as a boiler and girder maker in Glasgow. Within 10 years his development of the girder making workshop and innovation of specialist machinery saw him fabricating and constructing railway bridges, at a time when railways were expanding across Britain. He

combined his skills as a good engineer with business acumen, willingness to partner with other companies on large projects, and employment of a well-respected team of engineers and craftsmen to take on new tasks in a period of high world-wide industrial growth. He died in 1913 at the age of 74.

Description

Sir William Arrol & Company 1924 design drawings for the crane's mechanisms describe the crane as the 4-10 Tons Fixed Electric Tower Crane.

The crane was located within the Goat Island shipyard so that it could swing over and serve both the 500T and 150T slipways, the Broadside Wharf 4a and the workshops and storage areas in the former Magazine Precinct.

The crane stands at the head of two slipways, above high-water level. The tower has a square base with four legs connected to concrete footings. The tower measures approximately 6.25m by 6.25m on plan. Each leg has two 63mm diameter holding down (HD) bolts, which provide resistance to overturning.

The crane is 20 metres tall, and the jib is 67m long with 44m long front cantilever and a 23m short rear cantilever. The crane had a 10-ton load capacity at 60 feet and 4-tons at 140 feet.

The crane consists of a fixed tower and a cantilevered rotary jib. The crane is made of steel, predominantly riveted angle and tee-sections, joined by gusset plates to form a rigid trussed structure. In 1962 the MSB formed some bolted and welded joints to re-erect the disassembled crane in the shipyard. The crane tower has a square base with four legs bolted to concrete pads, presumably with deep rock-bolts which provide resistance to overturning. The tower carries a pair of upper and lower bearings which support the rotary jib and allow the jib to rotate, while providing resistance to the overturning moment produced by the cantilevered load at the end of the jib, or by the counterweight at the other end of the jib when there is no load on the hook. The top of the fixed tower tapers inwards to support a large-diameter ring, which acts as the upper bearing for the jib, and as a static horizontal gear ring for controlling the angle of rotation (or slew) of the jib (Figure 2).

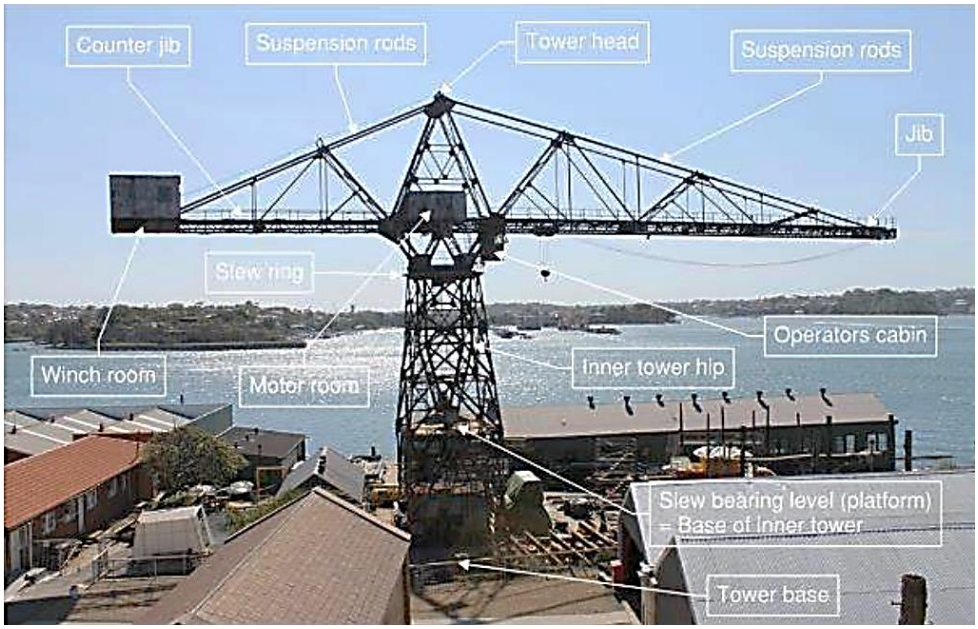

Figure 2: Crane components (TTW Fig 1 p7)

The jib is tee-shaped, with a long horizontal jib as two unequal back-to-back cantilevers, mounted on top of a short vertical pivot member which nests inside the tower and is supported by the upper and lower bearings. The short end of the cantilever jib carries a small corrugated-

iron motor house, holding a pair of motors and winches. The motors and winches act as a fixed counterweight to the hook and load.

At the centre of the rotary jib, above the pivot, is another corrugated iron motor house, which holds a heavier electric motor and winch to raise or lower the hook and its load. There is also a second electric motor and some gearing to drive the pinion which engages the large horizontal gear ring on the tower and controls the rotation/slewing of the jib.

Mounted on one side of the hammerhead jib, close to the tower, there is a small cabin for the crane driver. The cabin has windows looking down onto the area covered by the hook and rotates with the jib so that the driver always has a good view of the hook and load. The cabin also has a chair for the driver, and several electric control handles to control the speed and direction of the various motors driving the winches and gears. The driver gained access to the cabin from ground level by climbing a series of steep narrow steel ladders within the tower and walking along a steel chequer-plate catwalk.

When operating the crane, the driver would be assisted by a crane chaser at ground level. The chaser would use steel rope slings or chains to attach the hook securely to the load, so that the load was balanced and would not tilt and fall out of the sling. The chaser would then use whistle or hand signals to direct the crane driver for lifting and precise placement of the load.

Modifications

MSB made some minor modifications to dismantle, move and re-erect the Arrol crane in the 1960s such as welded and bolted splice plate connections. Footings for the crane new location were poured in January 1963 and the crane was re-erected and operational by 1964. The crane has not been modified since it commenced in service on the island in 1964.

Current Condition

Since the crane was taken out of service in 2010, safety inspections have been conducted approximately biennially by structural engineering firms Hyder Consulting and by Arcadis Pty Ltd. The inspection reports since 2010 have been summarised for this assessment.

The crane structure is heavily corroded, with considerable loss of thickness on some members. There is crevice corrosion at joints and between plates, where rainwater collects, and the integrity of rivets between members has not been assessed.

In recent years, control cabin and winch room windows, and the like, have been removed so that they do not detach in high winds. Additionally, a catch net has been installed beneath the control cabin, and ropes secured across the central motor room as a precaution against elements detaching.

A structural safety inspection by Arcadis in 2021 advised that some handrails and catwalks/floors are now in such an advanced state of corrosion that additional safety latch lines are required to access the crane safely, using fall arrest systems. Nevertheless, the floor to the counter jib winch room is considered too corroded to enter, as there is an absence of structural elements to safely attach a fall arrest system to.

The crane's electrical system and equipment dates from the early 1960s, with some equipment and controls possibly dating from when the crane was commissioned at Mort's Bay in 1926. While localised repairs have been performed to deal with unexpected breakdowns, there are no records of any significant electrical upgrades by MSB or NPWS since 1964. The crane's whole electrical equipment and assembly is more than 60 years old and obsolete.

The jib in 'out-of-service' mode must be allowed to slew freely under prevailing winds to prevent twisting, buckling and damage. This is safest and best practice for tower cranes and is known as out-of-service weathervane mode.

In November 2010, R K Findley's crane engineer inspected the crane and concluded that 'the crane was damaged beyond repair and not in a safe state of operation'. On 9 December 2010 WorkCover NSW issued a notice prohibiting the use of the crane. Subsequently, in accordance

with AS2550.1, clause 6.6, out of service, the crane electric supply was disconnected and isolated.

Under *Work Health and Safety Regulation 2017* Schedule 5, Registration of Plant and Plant Design, Part 1, it is a legislative requirement that the design of tower cranes is registered. Under Schedule 5 Part 2, it is a legislative requirement that the item of plant (tower crane) is also registered. The condition of the crane is so poor that it is irretrievable with no possibility that the crane can be registered in the future. The crane must remain out of service.

A Hazardous Materials Register has been prepared for the crane. There are asbestos containing materials (ACM), and the crane structure is painted with lead-based paint, the remains of which are friable and flaking.

Views and setting

The endorsed CMP identifies significant views for Goat Island (Figure 3). Views of the Tower Crane were identified as being of high significance.

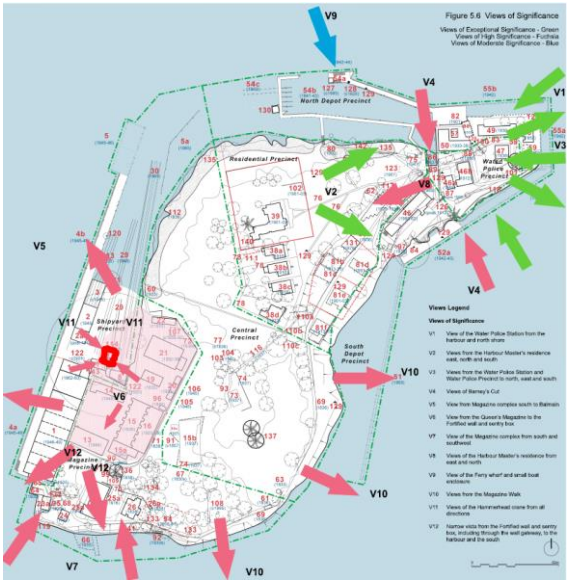

Figure 3: Significant views recorded in the CMP (CMP Volume 1)

The crane is generally not visible from the east, and when seen from northern and western elevated vantage points (e.g., Balls Head) recedes against the island ridge-line vegetation (Figure 4).

Figure 4: The view of Goat Island from Balls Head (R Newton/NPWS)

When seen from waters to the west of the island the crane's profile towers above the shipyard buildings (Figure 5).

Figure 5: The Tower Crane over the Shipyard and Magazine precincts (R Newton/NPWS)

The crane also dominates views looking west from the island's western ridgeline (Figure 6).

Figure 6: The Magazine Precinct viewed from the island's western ridge (R Newton/NPWS)

While presenting a dramatic asymmetrical 'T' shaped silhouette, with its distinctive open steel lattice structure, slew ring, cabins and prominent topmost cable suspension rods, the crane is an equally intrusive element dominating the intact Magazine Precinct and contributing to the obscuration of the complex from the northern and western aspects.

The 2011 CM states;

This structure can be considered as both a landmark feature and as having impact on the appreciation of the natural landscape of the Island and the magazine precinct. (CMP, p.270)

The 2011 CMP does not comment on the visual impact of the crane on the island's Aboriginal cultural heritage values.

Comparative Analysis

Bunbury Jetty Crane

An Arrol designed mobile electric crane stands at Bunbury Harbour Western Australia (Figure 7). The jetty crane was originally erected in 1911 on the Bunbury Timber Jetty and travelled on rails along the jetty. It was decommissioned in 1982 and moved to near the end of the jetty causeway. The crane is identified by its inscribed plate 'Sir William Arrol and Co Ltd Parkhead Glasgow Order 543 Load 3 Tons 1911' (Figure 8).

Figure 7: Arrol designed Bunbury Jetty Crane 1911 (inherit.stateheritage.wa.gov.au)

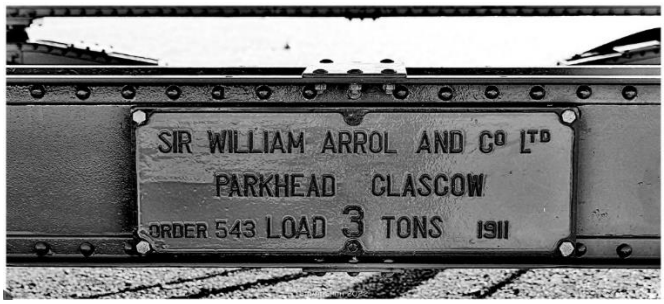

Figure 8: Inscribed plate on jetty crane (inherit.stateheritage.wa.gov.au)

Garden Island cranes

In 1944, the Commonwealth Department of Defence called for tenders for the construction of a giant 250T cantilever crane to operate at the Garden Island dock. The project was awarded to the Sydney Steel Co Pty. Ltd. who were contracted to fabricate and erect the crane to the design of Sir William Arrol with Sir Alexander Gibb and Partners as consultants; with all mechanical and electrical equipment coming from England (Figures 9-10). The crane was commissioned in February 1952 and operated until 1996.

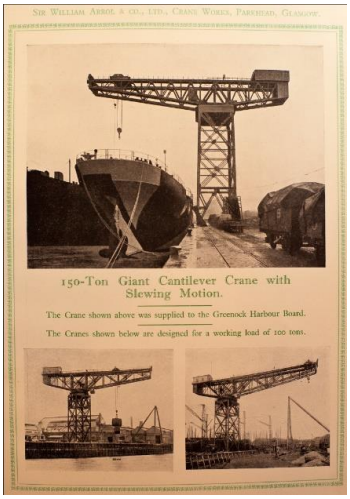

Figure 9: Arrol's 1927 cranes catalogue (urbanglasgow.co.uk)

Figure 10: The Garden Island 250T cantilever crane

The Department of Defence ceased using its crane in 1996 because its heavy lifting requirements were more efficiently and safely fulfilled by mobile cranes. In 2012 the Department of Defence proposed to remove the crane, it being necessary to eliminate safety risk and continue to provide training and logistical support, maintenance facilities and berths for naval shipping. It was estimated that the cost of mothballing was $21million, $31million to

restore and $7.4million to remove. On 17 July 2013, the Commonwealth Government approved the removal of the crane. The crane was dismantled and removed by the end of 2014 and replaced with.

The giant cantilever crane was replaced a new 100-tonne crane and is one of four large operating cranes at Garden Island (Figures 11-12).

Figure 11: One of the four large cranes operating at Garden Island (R Newton/NPWS).

Figure 12: Three of the four large cranes operating at Garden Island (R Newton/NPWS).

17 Cockatoo Island cranes

Nine large steam-powered and electric cranes survive nearby at Cockatoo Island managed by the Sydney Harbour Federation Trust. The cranes were decommissioned in the 1990s and no longer service the island's shipyard and dockside. Two of the steam cranes have been restored to working order by volunteers; the 1890s steam powered No. 2 Travelling Steam Crane and the 1891 Steam Crane constructed at Mort's Dock, which like the Goat Island Tower Crane has a 10-ton lifting capacity (Figures 13-14).

Figure 73: 1890s steam powered Ruby Crane, No.9 (Ed Beebe/NPWS)

Figure 84: 1891 Mort's Dock Steam Crane (Ed Beebe/NPWS)

The island's tall Slipway Travelling Crane survives but its boom (jib) and fixings have been dismantled and placed near the crane as part of make-safe works. The largest Electric Portal Travelling Jib Crane on Cockatoo Island was moved to the island in 1979. Two Electric Travelling Jib Cranes are located on the island southern western side with the Fixed Tower Crane on the island's southern side. The Fixed Tower Crane was manufactured by Favco Industries and was installed at the timber wharf on the southern apron in 1963 as part of a major refit program involving the naval patrol boat fleet (Figure 15-21). Other smaller cranes include the Mobile Crane near the visitor centre, the Stiff Leg Crane near the Harbour View Apartments and the Jib Crane on the upper island.

Figure 95: Northern Slipway Travelling Crane, Crane Number C300, with jib removed since 2019 for safety (Ed Beebe/NPWS)

Figure 106: Southerland Wharf Electric Portal Travelling Jib Crane, Crane Number C277 (NPWS/Ed Beebe Nov 23)

Figure 117: The northern of the two Electric Travelling Jib Cranes, AFD Crane 1, Crane Number C226 (NPWS/Ed Beebe)

Figure 128: The southern of the two Electric Travelling Jib Cranes, AFD Crane 2, Crane Number C227 (Ed Beebe/NPWS)

Figure 139: Patrol Boat Crane, Crane Number C231 (Ed Beebe/NPWS)

Figure 20: Bolt Wharf Jib Crane, Crane Number C302 (NPWS/Ed Beebe)

Figure 214: Cruiser Wharf Travelling Jib Crane, Crane Number C60, with jib removed since 2019 for safety. Source NPWS/Ed Beebe Nov 23

Mobile Block Setting Steam Crane, Port Kembla Breakwater, decommissioned and retained as artefact

This crane was closely involved in the development of Port Kembla. The British company Cowans, Sheidon & Co Ltd established in 1848 was one of the world's leading crane and shovel manufacturers. The Port Kembla Mobile Block Setting Steam Crane is one of their popular 30T steam rail cranes manufactured in the early 1900s. NSW Public Works imported it to quarry the large basalt blocks needed to build the Port Kembla eastern breakwater. Concrete blocks were used later as a more efficient alternative to basalt, so the crane was converted to a tri-leg model to the lift the large blocks on to rail wagons to carry the blocks to the breakwater. The crane was used until 1979 and is now on display as an outdoor artefact (Figures 22-23).

Figure 152: Mobile Block Setting Steam Crane (Wollongong Council)

Figure 163: More recently, the crane in April 2013 (Wollongong Council)

Titan Floating 150T Crane, scuttled and sunk

While not a fixed or rail supported mobile crane, the Titan floating crane was an important part of Sydney's Harbour maritime operations from 1917 until 1991 (Figures 24-25). Titan was fabricated in the United Kingdom by Cowans, Sheldon & Company of Carlisle. The crane was transported to Australia in parts and assembled at Cockatoo Island Dockyard, Sydney. The crane was launched on 5 December 1917 and entered service with the Royal Australian Navy (RAN). Titan's main purpose was to provide heavy lifting services at the Cockatoo Island Dockyard. Initially, the crane was used throughout the entire harbour. Later, poor barge seakeeping made it dangerous to tow the crane

across Sydney Heads and it was restricted to south and west of Bradleys Head. After being declared surplus to requirements by RAN, the crane became the property of Cockatoo Island Dockyard, which operated it until the dockyard's closure in 1991. Titan was sold to a Singaporean company, and authorisation was given to tow her to Singapore in 1992. During the tow, the crane's barge inverted on 24 December, and the crane was scuttled five days later

Figure 174: The Titan Crane at Garden Island in 1988 (Trove).

Figure 185: Titan being towed out of Sydney Harbour on 22 December 1992. (SMH 16 December 2022)

Newington Armory Cranes, decommissioned and retained as artefacts

Two large industrial cranes sit on the water's edge of the Armory's broadside wharf (Figures 26-27). The cranes were built in 1973 and replaced two other cranes from 1929. The cranes lifted stock onto the wharf from concrete lighters

Figure 196: The Newington Armory Western Crane (Ed Beebe/NPWS)

Figure 207: The Newington Armory Eastern Crane (Ed Beebe/NPWS)

Other cranes

Large jib cranes serviced Newcastle Harbour and Port Kembla, but all cranes in these ports were progressively taken down from the 1970s to 1990s. Two Stothert and Pitt cranes worked on Coffs Harbour Jetty erected in 1944 and 1951. They were comparable to the Goat Island Arrol and Co Tower Crane. However, an inspection report in 1977 advised that both cranes were unsafe and should be removed. The cranes were eventually taken down in 1983.

Smaller dockside jibs cranes in NSW include:

- The Campbells Crane at the Museum of Sydney, believed to be the first wharf crane used in Sydney, circa 1842.
- Two small cranes up to 4m tall displayed at Walsh Bay as artefacts.

Statement of Significance

The Goat Island 4-10 tons Fixed Electric Tower Crane is the third oldest amongst a large collection of surviving large dockside/ maritime cranes in NSW. The surviving large dockside/ maritime cranes, mostly on Garden and Cockatoo islands in Sydney Harbour, display a range of configurations, loadings and age. The Tower Crane is the only crane in NSW fabricated by Arrol and Co.

The Goat Island Tower Crane is associated with Sir William Arrol & Co, one of the most recognised 19th and 20th Century British engineering companies which built hundreds of bridges, hydraulic and electric cranes to suit a variety of purposes, docks, hydro-electric and nuclear power stations across Britain, including 125 sites in Scotland alone. In NSW Arrol and Co supplied fabricated steelwork for the first Hawkesbury River Railway Bridge (1889). The Goat Island Tower Crane was not a bespoke Arrol and Co crane, like the 250T Giant Cantilever Crane on Garden Island, but was a standard catalogue item.

Although not in its original location the Tower Crane demonstrates historical significance for its association with maritime activities in Sydney Harbour first at Mort's Dock from 1924 to 1959 and at the Goat Island Shipyard from 1963.

The crane's structure is heavily corroded, with considerable loss of thickness on some key structural members. The crane's whole electrical equipment and assembly is more than 60 years old and obsolete. There are no records of any significant electrical upgrades by MSB since 1964.

Historical Significance

The Goat Island Tower Crane demonstrates historical significance being the largest crane serving Mort's Dock dry dock from 1924 to 1959. The crane demonstrates historical significance for the role it played in the MSB's mid-20th century upgrade of its island shipyard alongside the new 500-ton slipway which both substantially increased the island's shipbuilding and repair capacity from the 1960s to the 1980s.

Historical Association

The Goat Island Tower Crane demonstrates significance for its association with the renowned heavy engineering business Sir William Arrol & Co, association with Mort's Dock from 1924-1959 and association with the Goat Island shipyard since 1963.

Aesthetic Significance

The Tower Crane demonstrates aesthetic significance as a prominent maritime industrial landmark on the western side of Sydney Harbour.

Social Significance

The Goat Island Tower Crane demonstrates social significance for its association with the MSB shipyard's social history. The endorsed 2011 CMP advises that the island's social significance is now an historical value as 30 years has elapsed since the Island was a workplace and few of the workers and families remain who had direct associations with the place.

Technical/Research Significance

The Goat Island Tower Crane demonstrates technical/research significance because its structure, electrical systems, plant and equipment provide evidence and information about early 20th century crane and shipyard engineering technology and practices.

Rarity

While there is collection of surviving large dockside/ maritime cranes in Sydney Harbour, the Goat Island Tower Crane is the only Arrol and Co fabricated crane in NSW, though not the only one in Australia. The surviving cranes evidence a range of functions, configurations, loadings and age, but most have been progressively decommissioned and mothballed from the 1980s to the 1990s because they were redundant, no longer safe to operate and their specific shipyard and dockside uses changed or ended.

Representativeness

Despite its poor structural condition and the condition of its deteriorated electrics, plant and equipment, the Goat Island Tower Crane is an informative representative example of a large 20th

century shipyard crane. Its structure, electrical systems, plant and equipment still provide accurate information about early 20th century crane and shipyard engineering technology and practices.

Conservation policies and actions

Condition, conservation and maintenance

The crane is at the end of its service life and there is no possibility of repair for return to service. The integrity of the tower crane is poor. Elements of the crane have corroded to the extent that it is not possible to access the crane for purpose of undertaking routine condition inspections.

The crane could be repaired and retained as a non-operating crane at considerable expense but will also require considerable ongoing resources, expertise, work and money to keep the crane safe and minimise risk to life and property. If repaired as a non-operating crane, on-going maintenance would include:

- Annual inspections.
- Regular maintenance of the crane cantilever jib suspension system (jib and suspension rods).
- Regular maintenance of the slew mechanism, ensuring that the jib can rotate freely.
- NDT weld inspections and ultrasonic testing of rivets and bolts every 10 years with repair/replacement/augmentation as required and re-coating of any repairs.

Relationship to other buildings and structures

The 2011 endorsed CMP advised that the Goat Island Arrol and Co Tower Crane is important as a part of MSB's shipyard upgrade in the 1960s. The 2011 CMP also indicates that the crane has a negative impact on the Magazine Precinct, as the crane is an incongruous feature, oversailing the intact Powder Magazine complex and negatively affects views within the mostly intact precinct.

The 2011 CMP states;

Removal of structures, elements and buildings of lower significance than the colonial buildings (which have exceptional significance) may take place to recover aspects of that exceptional significance of high significance including the setting of the precincts (Uses Policy 5, p.252).

Furthermore, the need to ensure that the crane swings freely on its slew with the wind means that the crane jib routinely swings over elements of exceptional significance, including the Queens Magazine and Cooperage with risk of falling debris causing irreversible damage to these buildings. The Magazine and Shipyard precincts will also remain unavailable for public access as the risk to public safety cannot be eliminated while the crane continues to rotate over these areas. This risk also affects any future uses of these precincts.

Figure 21: The radius of the jib rotation (Nearmap, 2024)

The 2011 CMP states;

Removal would be considered acceptable if:

The slipways cease permanent operation and/or the crane becomes a hazard to public safety or to other buildings (Enhancing significance policy V7).

Use

The 2011 endorsed CMP advised that the crane's continuing use as part of an operational shipyard is important for its conservation, however, the crane can no longer be safely or legally operated and the crane can never be returned to service.

The 2011 CMP advised that the crane could be relocated if it becomes redundant. The crane is now redundant. Relocation of the crane to its original location in Balmain would not be feasible as this is now a public reserve and would require exclusive of public access and the installation and maintenance costs would be excessive. Relocation of the crane to another location would not address the safety risks associated with failing structural elements, nor enable the crane to be returned to any form of use. Relocation is unlikely to be a viable or welcome conservation outcome.

Removal and disposal of the crane is acceptable as it is the only option which can fully eliminate the risk to public safety and other buildings of exceptional significance and allow safe public access to these areas.

Interpretation

The 2011 CMP advised that the Goat Island Arrol and Co Tower Crane should be interpreted as part of the shipyard. The 2011 CMP also states on-site signs and information panels are to be discrete in location and appearance. (Interpretation, policy 5).

If the crane is removed the crane should be photographed and digitally recorded. Digital interpretation, such as a 3D model, or physical signage can be used to interpret the history of the site.

If the crane is removed the manufacturer's plaque should be retained and used on-site to interpret the crane's history. Other elements of the crane could also be retained for purpose of interpreting the crane, providing these can be easily conserved and don't create a risk to visitors.

Other images

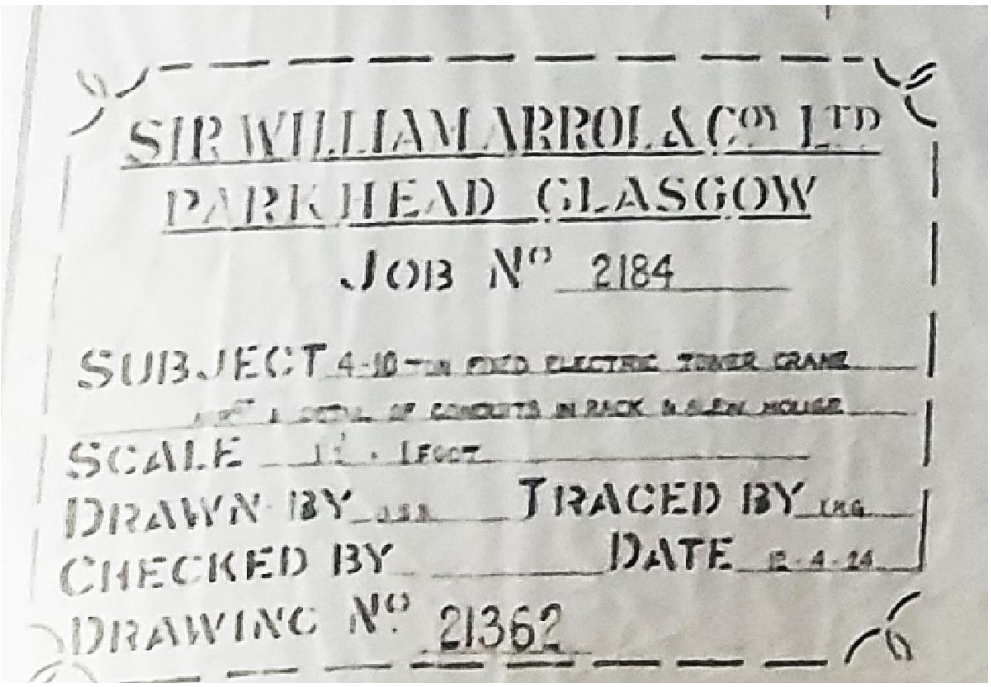

Figure 227 Title Block from an April 1924 Arrol & Co detailed engineering drawing describing the crane as a 4-10 Tons Fixed Electric Tower Crane. (NPWS collection)

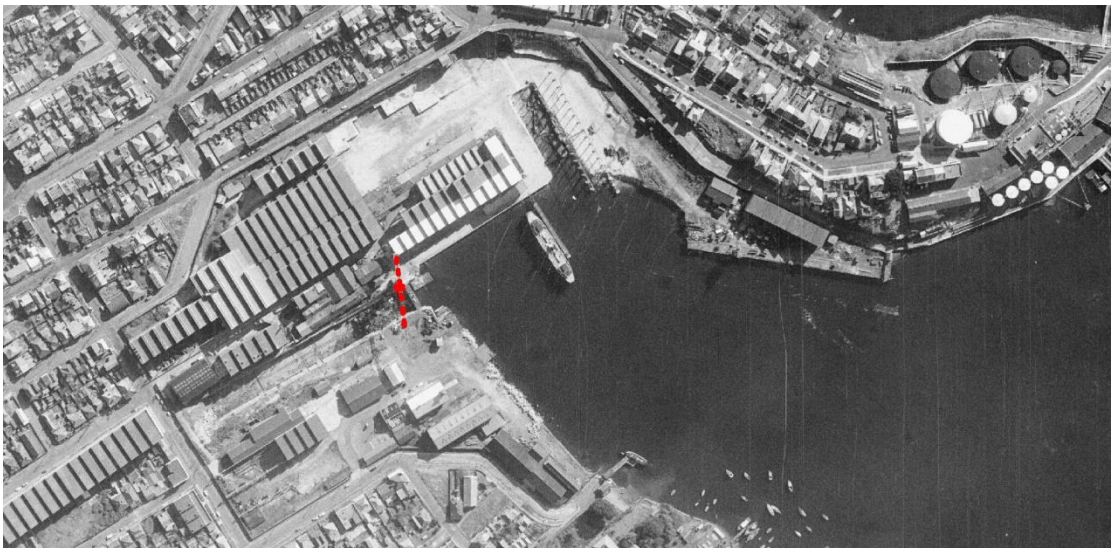

Figure 238: Annotated June 1960 aerial photograph of the western half of the former Mort's Dock, showing the crane still in place, highlighted alongside the dry dock before it was purchased by the MSB. (portal.spatial.nsw.gov.au/download/historic/1068/1068_33_015.jp2.jpeg

Figure 29: Mort's Dock 1930s looking south east showing the Arrol crane operational by 1926 (National Library, PIC/15611/16907 LOC Cold store PIC/15611/nla.obj-163236024)

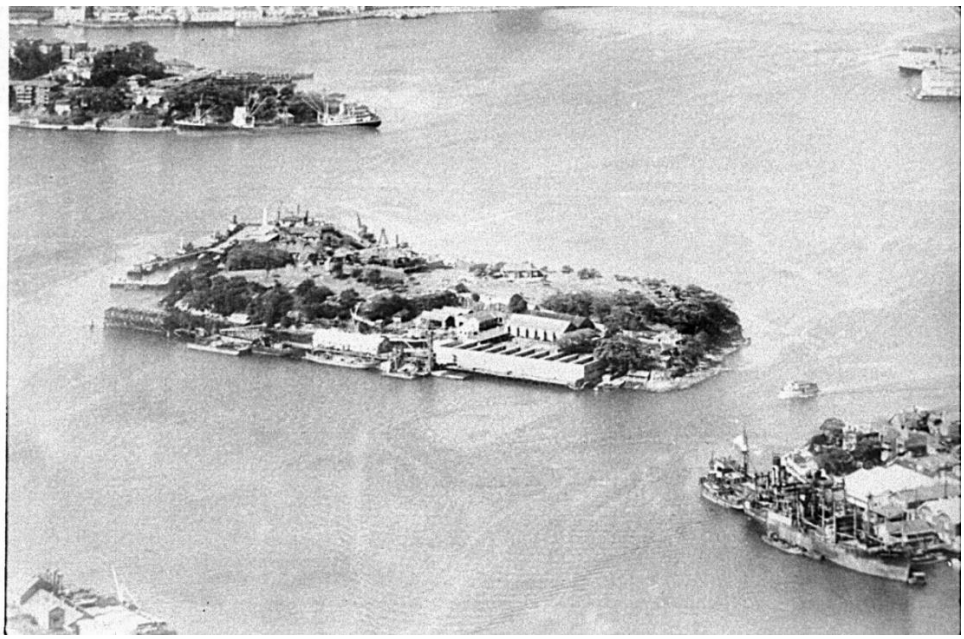

Figure 240: 1950s aerial photograph of Goat Island looking northeast over the shipyard, prior to the crane's arrival (Former MSB Archives File 1072-11)

Figure 251: 1950s, looking northeast over the shipyard prior to the crane's arrival. The MSB used derrick cranes prior to the tower crane's arrival (Former MSB Archives 777009)

Figure 262: 1960s, looking south over the shipyard towards East Balmain prior to the relocation of the crane in 1962. (Former MSB Archives MSBL1425)

Figure 273: 1960s, birds eye view looking southwest over the northern end of the island. The crane is visible on the western side of the island. (Former MSB Archives 777009)

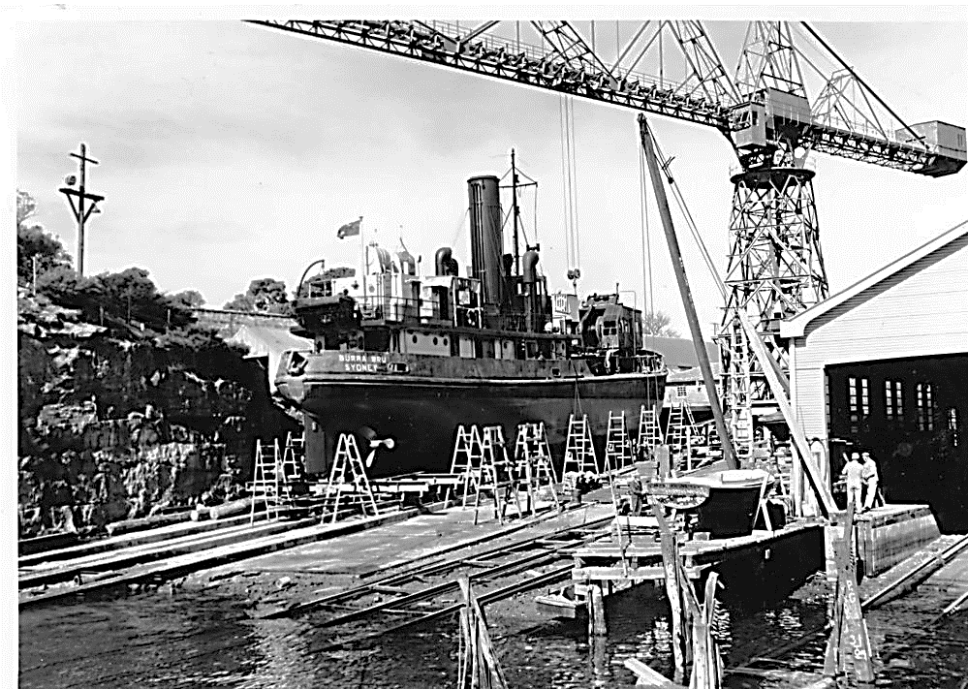

Figure 284: Looking south to the shipyard and the crane over the MSB Dredge BURRA BRU on the Goat Island 500T slip early 1960s not long after the crane was purchased and re-erected by the MSB. (City Sydney Item 785704)

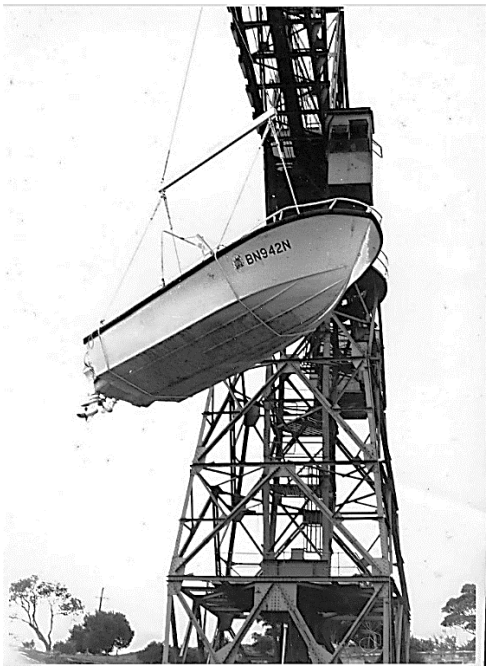

Figure 295 Photo title, 'Goat Island dockside tower crane with a patrol boat circa 1980'. Source City of Sydney Archives -00075441

Figure 306 Current photograph looking from the southwest showing the shipyard and its Broadside wharf, the 2008 pontoon, the Shipyard slipways, the crane and 1940s workshops and ancillary buildings in the foreground. The 1830s Magazine within its compound wall is beyond the shipyard. (NPWS May 2022)

Figure 37 The Tower Crane over-sailing the Powder magazine Cooperage (NPWS 2022)

Figure 3831. Looking up to the slew ring under the jib showing extensive corrosion. (TTW, June 2022)

Figure 39. Looking up to the underside of the motor room showing extensive corrosion. (TTW, June 2022)

Figure 320. Looking up to the underside of the operator cabin under the jib showing extensive corrosion (TTW, June 2022)

Figure 331. Looking up to the underside of the winch room at the short end of the jib showing extensive corrosion. (TTW, June 2022)

Figure 342. Looking up a tower leg (TTW, June 2022)

Figure 353. The manufacture's plaque bolted to the tower. (TTW, June 2022)

Figure 44. Looking along the jib when the crane was last climbed by an engineer showing extensive corrosion and paint loss (Arcadis, July 2021)

Figure 436. Looking at the slew ring mechanism when the crane was last climbed by an engineer showing corrosion. (Arcadis, July 2021)

Figure 46. Looking at the bottom of the rotating mechanism when the crane was last climbed by an engineer showing extensive corrosion (Arcadis July 2021)

Figure 47. Looking onto the Level 1 Platform when the crane was last climbed by an engineer showing extensive corrosion (Arcadis, July 2021)

References

OEH, *Goat Island Conservation Management Plan* Vols 1 to 4 June 2011, endorsed 6 April 2011.

DECC/NPWS. *Goat Island, A Contextual History*, December 2007.

Sir William Arrol and Company Ltd Bridges, *Structural Steel Work and Mechanical Engineering Productions*, 472 pages, published for private circulation by Engineering Ltd., London, 1909.

Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS), *The Sir William Arrol Collection, a Guide to the Scottish Material held in the National Monuments Record of Scotland* (NMRS), 52 pages, published RCAHMS 1998

Grace's Guide to British Industrial History, https://www.gracesguide.co.uk/William_Arrol_and_Co

Mott MacDonald, *Cockatoo Island External Cranes Conservation Management Plan* prepared by for Sydney Harbour Federation Trust, November 2023 (inventory sheets only)

NSW State Heritage Inventory, Hawkesbury River Rail Bridge and Long Island Group, listing number 01140.