

## FORRESTFIELD AIRPORT LINK SPECIALISED EQUIPMENT SOLUTION

### BACKGROUND

The Australian and WA government proposed a rail service to create an alternate mode of transport to the airports that would connect locals and tourists to the Perth City. Estimated to cost approximately \$1.86 billion, the Forrestfield Airport Link project will comprise of three stations and will be delivered late 2021. For this project two 7m diameter Tunnel Boring Machines (TBM) would need to be purchased to tunnel a total distance of 8km.

The project was awarded to a joint venture between Salini Impregilo – NRW. They were tasked with designing, constructing and maintaining the twin rail lines from Forrestfield station to Bayswater Junction. Being one of the industry leaders with an excellent reputation of project delivery in West Australia, Tutt Bryant Heavy Lift & Shift (TBHL&S) was approached to provide lifting and transport solution with the assembling and lowering of the two TBMs, Grace and Sandy, within the Forrestfield Station dive structure, located approximately 20km east of Perth City.

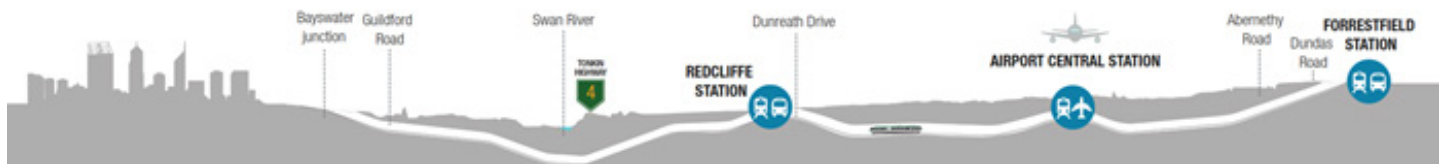


Figure 1: Forrestfield-Airport Link Project overview (FAL Factsheet March 2018)

### A NEW ADDITION TO PERTH'S SKYLINE

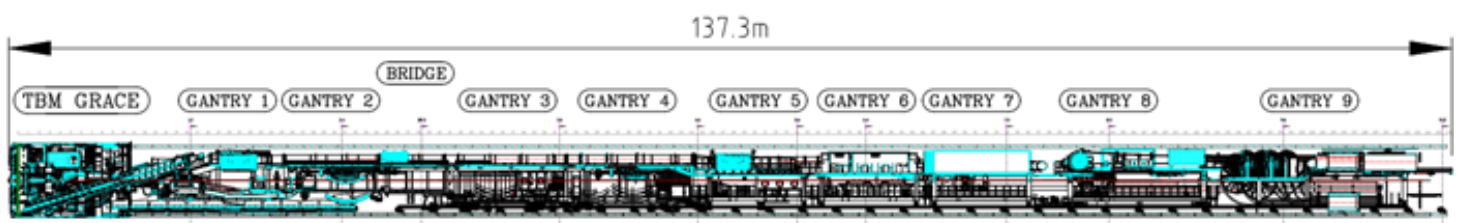
To provide a lifting and transport solution to assemble and lower two \$20 million tunnel boring machines into the Dive site at the proposed Forrestfield Station off Dundas Road.

- Unpack, Dress and Assemble all TBM components at Laydown Area
- Transport Components from laydown yard to Forrestfield Dive site
- Lift and lower components into 15m deep Dive site
- Providing all associated engineering and supervision required for critical lifts and movements

The overall dimension of each TBM were 7.0m x 137.3m and weighed an approximate total of 1017 tonnes. It comprised of a total of 11 sub-modules as detailed below.

#### Tunnel Boring Machine (TBM) Main Components

• Cutterhead	= 75t
• Front Shield	= 170t
• Middle Shield	= 145t
• Tail Skin	= 45t
• Gantry 1	= 93t
• Gantry 2	= 70t
• Bridge Unit	= 40t
• Gantry 3	= 75t
• Gantry 4	= 40t
• Gantry 5	= 40t
• Gantry 6	= 55t
• Gantry 7	= 45t
• Gantry 8 Front	= 20t
• Gantry 8 Rear	= 42t
• Gantry 9 Front	= 20t
• Gantry 9 Rear	= 42t
<b>Total Mass</b>	<b>= 1,017t</b>





Left: Sourced from: <https://www.metronet.wa.gov.au/projects/forrestfield-airport-link>; Right: TBHL&S SPT crew moving TBM Sandy's Front Shield Unit

## SOLUTION AND EQUIPMENT

Tutt Bryant Heavy Lift & Shift proposed to utilise 6 specialised equipment consisting of an all-terrain mobile crane, a self-propelled trailer and four crawler cranes on site to carry-out all task from the proposed scope. With each equipment TBHL&S were required to provide labour and at project peak in July 2017, there were a total of 21 personnel on-site.

### Nicolas MDE Self-Propelled Trailer (12 Axle Lines)

The Self-Propeller trailer was configured with 12 axle lines and had a maximum off-road transport capacity of 360t. This trailer was used to transport all the TBM components from the assembly area to the dive site which was located approximately 1.5km away one way. Over 40 moves were carried out over two month safely over the busy Dundas Road crossing and swiftly through WA's winter weather.

### GROVE 300t All-Terrain Mobile Crane (GMK6300L)

Tasked to assist with the assembly of the TBM modules at the assembly yard. This comprised of dual crane lift to upend the TBM shield units to loading out all the fully dressed gantry modules onto the SP trailer.

### Hitachi Sumitomo 150t Crawler Crane (SCX1500-2)

Tasked to support on-going civil works with the construction of the dive structure and due to space constraints on-site was used for assembling the TBM support pipes during night-shift.

### SANY 300t Crawler Crane (SCC8300)

Used at the dive site to lower the gantry modules into the dive structure and assist with the assembly process required for the commissioning of the TBMs.

### Manitowoc 400t Crawler Crane (M16000)

Mobilised to the assembly area to upend the TBM shield units, assemble and load-out the shield units onto the SP trailer for delivery to the dive site.

### Manitowoc 700t Crawler Crane (MLC650 VPC MAX)

Mobilised to dive site to lift and lower the main TBM shield units within the dive structure.



Above: TBHL&S Self-Propelled Trailer transporting TBM Grace's Middle Shield to the dive site in Forrestfield



Above: TBHL&S 300t Mobile loading-out 91t Gantry 1 onto the SP trailer

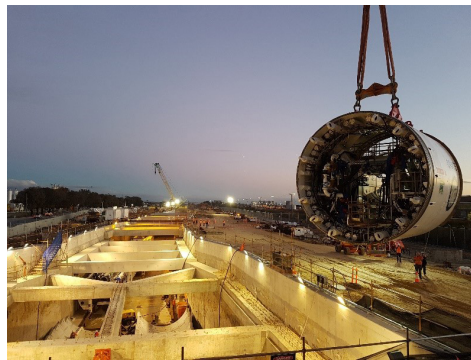
## LIFTS AT THE TBM ASSEMBLY YARD

Dual crane lifts to upend the Front & Middle Shield units using the 300t All-Terrain and 400t crawler cranes.

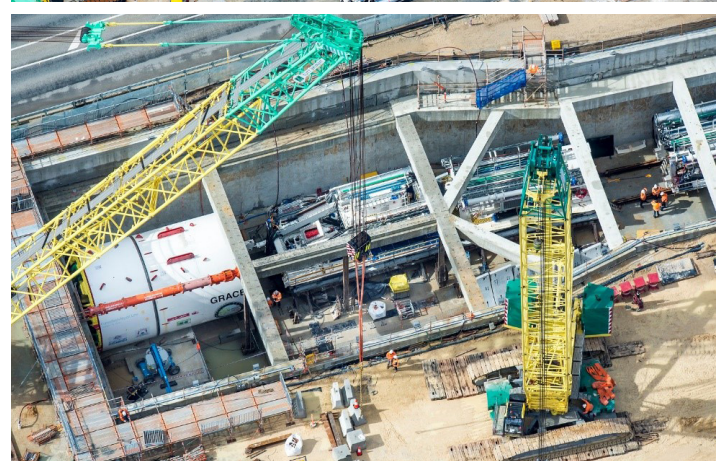


## LIFTS AT THE TBM DIVE SITE

TBHL&S MLC650 VPC MAX S3 50mB carrying out 81% lift of the TBM Grace's Middle Shield, 220t at 32m radius (left). Grace's Middle Shield unit getting lifted and installed within the dive structure (right)



400t Crawler Crane rigged up and ready to lift the TBM Sandy's 220t Middle Shield (left); Aerial Shots of the Dive site with the TBHL&S 700t and 300t crawler cranes working to assemble TBM Grace and Sandy (right)





## PROJECT CHALLENGES

### SPACE

As with any construction site, space is always treasured on-site and when multiple work groups are on-site working on various stages of the project, there can be issues if on-site movements are not managed properly. Hence, with on-going civil works at the dive site taking priority on-site, all TBHL&S crane mobilisations and TBM movements were discussed and planned in detail SI-NRW JV site management to avoid delays or issues.

### TIME

With the critical part of the project leading into late Autumn/early winter, the weather caused a few delays with the civil work and the arrival of the TBM Sandy into Fremantle port, time had to be recovered and space created to ensure the project remains on schedule. Plans to move the gantry units from the assembly yard to the dive site were proposed and with the initial lowering portal's base slab not constructed, an alternate portal was suggested by SI-NRW JV. However, this portal did not have sufficient space to undertake the install as standard rigging arrangements would foul with the concrete braces of the dive structure. TBHL&S assessed the boundaries and engineered a solution to reduce the rigging spread within the short timeline. The clearances were small requiring precise rigging restrictions and careful operation of the crane.

### GROUND

The allowable Ground Bearing Pressure (GBP) on-site was 300kPa and to abide with this TBHL&S mobilised a combination of 3m wide timber and 5m steel mats for the 300t and 700t crawler respectively. Despite this, working near a 3m deep excavation and carrying out 220t lifts requires careful assessment of the ground, ground compaction, water content, soil materials and strength of the concrete dive structure. All these topics were addressed with SI-NRW JV & PTA prior to mobilisation of the 700t crawler.

Despite the challenges faced throughout the project, they were overcome through clever engineering, meticulous planning and well communicated meetings between TBHL&S, SI-NRW JV and Perth Transport Authority (PTA).

## CURRENT STATUS

The project is currently well underway with almost 19 months into the project. TBHL&S has two crawler cranes working, with a 200t crawler crane at Airport Central and a 275t crawler crane at Redcliffe station. Both cranes are being used to carry-out ancillary lifts for civil work, feed tunnel segments onto Multi-Service Vehicles (MSV) within and carryout maintenance work on the TBM. The next station breakthrough is scheduled at Redcliffe station for late March 2019.