

RAIL

LONDON *SPECIAL*



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Special



PAUL BIGLAND

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DLR at 30 ■ Crossrail 2 ■ Northern Line Extension

PLUS: Expertise from Bombardier, SNC-Lavalin, Siemens and Taylor Woodrow

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JACK BOSKETT/RAIL.

Welcome

London Mayor Sadiq Khan unveiled his draft *Transport Strategy* in June that firmly places new transport infrastructure as the cornerstone of London's future prosperity and world status. Looking ahead over the next 25 years, it argues that a steady pipeline of enhancements, including extensions to the London Underground and Docklands Light Railway (DLR), will help create 1.2 million more jobs by 2041, while supporting the construction of 50,000 much-needed new homes each year.

That is not to mention providing relief to existing capacity, as London's population is expected to rise from 8.7 million to 10.5 million over the next 25 years.

There is of course much precedent of transport - and rail in particular - enabling this type of significant economic growth, and readers need look no further than the DLR, which has played a crucial role in regenerating long-neglected parts of east London and establishing Canary Wharf as a global financial centre, ever since its first passenger services ran in August 1987.

RAIL looks back at 30 years of operations on DLR, during which time ridership has grown 18-fold from 6.7 million in its first year to 122 million in 2016-17, while speaking to both Transport for London and operator KeolisAmey Docklands about how the DLR has become one of the UK's highest performing railways (p44-51).

To the southwest of the City, another transport scheme is underpinning large-

scale economic growth and regeneration - the £1.2 billion Northern Line Extension to Battersea, where more than £9bn is being invested to convert the previously semi-derelict Battersea Power Station into new flats and offices. *RAIL* is granted rare access to the tunnel face of excavations and the main works site on p68-72.

Next in the pipeline of future enhancements, and most certainly top of the list in terms of both engineering scale and price tag, is Crossrail 2, which could open by 2033 if it gets the go-ahead by Government. For a progress report on how plans for the £30bn-plus project is developing, *RAIL* speaks exclusively to Crossrail 2's Managing Director Michèle Dix on p58-63.

PAUL STEPHEN
Assistant Features Editor, *RAIL*

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A DLR service arrives at Canary Wharf on August 22 2015 in the shadow of global investment bank Citigroup's EMEA headquarters at 25 Canada Square. ANTONY GUPPY.



DLR at 30

Three decades after it carried its first fare-paying passengers, **PAUL STEPHEN** asks Transport for London's Director of DLR **DANNY PRICE** how the Docklands Light Railway plans to maintain its enviable status as one of the UK's highest performing railways

When Her Majesty the Queen officially opened East London's Docklands Light Railway on July 30 1987, few could have imagined the extent to which the network would grow.

Initially just eight miles long, the DLR comprised 15 stations, served by a fleet of 11 single-car electric multiple units, based at a small depot in Poplar. Thirty years later and it has undergone six extensions, and now serves 45 stations on 24 miles of track.

Passenger numbers have also risen considerably, from 6.7 million in DLR's first year of operation to 122 million in 2016-17, served by today's fleet of 56 Bombardier-built and mainly three-car trains. Comprising 149 individual vehicles, the fleet is now based at Poplar, and also at a larger site in Beckton,

which became DLR's primary depot when it opened in 1994.

Well-known for its largely elevated route and fully automated 'driverless' operation, DLR passengers can enjoy uninterrupted views of Dockland's rapidly evolving urban landscape, on a self-contained network with near-perfect punctuality.

Operated and maintained by KeolisAmey Docklands (KAD) on behalf of Transport for London (TfL) since 2014, 99.5% of DLR trains ran on time between May 28-June 24, this year with a moving annual average of 99.2%. Meanwhile, 89% of passengers said they felt satisfied at the end of their journeys in the latest satisfaction survey.

"DLR has a really exciting history, with an extension opened on average every four years up to 2011," says TfL's DLR Director

30 THINGS TO DO BY DLR

To mark the 30th anniversary of DLR, TfL has released a travel guide showing visitor attractions around East London accessible via DLR, including London Docklands Museum, Queen Elizabeth Olympic Park and the Royal Observatory Greenwich.

It can be downloaded by visiting: <http://content.tfl.gov.uk/dlr30-leaflet-and-map.pdf>

Danny Price. "Passenger volume is now 18 times that of its first year, there are 13 times as many trains, and the fact that it's grown with investment [in the areas it serves] makes it an unmitigated success story.

"Of its many successes, its biggest is that it has maintained very high levels of reliability, and really high levels of customer feedback. It's always had good engagement with local users and visitors, while satisfaction scores are high and social media feedback is generally positive. I think the backbone of that throughout has been the 99% performance railway."

The DLR was first conceived in the early 1980s as a catalyst in regenerating parts of the East End of London which had become economically depressed following the closure of the Royal Docks to commercial shipping in 1980.

At the time, Margaret Thatcher's government was actively supporting efforts by newly established quango London Dockland Development Corporation to tempt large companies to relocate to the Docklands area, and it saw the DLR as a cheaper alternative to extending London Underground's Jubilee Line.

A £77m contract was subsequently agreed in August 1982, with a joint venture comprising GEC and Mowlem for



The DLR is opened by Her Majesty the Queen on July 30 1987, aboard DLR 011. The first passenger service would run a month later on August 31. TRANSPORT FOR LONDON.

► construction to begin in 1985 on three routes between Tower Gateway, Island Gardens and Stratford that intersected at Poplar.

By providing direct access between the Government-designated urban enterprise zone at Canary Wharf and central London, the DLR paved the way for construction work to begin on a new financial centre for the capital to complement the Square Mile, and its first major buildings were completed in 1991, including the UK's second tallest building, One Canada Square.

More than 150,000 people now work at Canary Wharf, in two million square metres of office space, where a conglomeration of brokers, investment managers, insurance companies, hedge funds management firms and currency exchanges have turned it into a global command centre for the international trade of financial and professional services.

Canary Wharf is also home to two of the world's largest banks, HSBC and Barclays. It is now also served by the Jubilee Line since its Millennium Extension in 1999, and will soon be served by Crossrail, once a station opens there on its Abbey Wood branch in December 2018.

Transport links were further boosted in June 2012 when the Emirates Air Line cable

COMMENT: FORMER TFL RAIL MD AND DLR CHAIRMAN HOWARD SMITH

"The thing that everyone involved with the DLR talks of is the 'can do' culture, in which it's grown from an embarrassingly underspecified and rather unreliable service at the start to a vital part of the spectacular regeneration of East London. It provides near-faultless service, day in, day out and carried half a million passengers a day as a trusted centrepiece of the 2012 Olympic Games.

"The extensions to Lewisham, London City Airport, Woolwich and Stratford rank as some of the most rapidly developed and cost-effective rail infrastructure anywhere in Europe, delivered by a hugely talented team that ran a 'production line' of projects, from walking the route, through planning, delivery and operation - eventually including a cable car - the

'Docklands Light Ropeway', as it was christened by some!

"In successfully pioneering moving block signalling, near-universal stakeholder support, a record rail market share from a brilliantly located station at City Airport, and its efficient, cost-effective operations, the DLR has taught lessons that go far beyond East London, both in terms of organisational learning and the DLR ethos that has spread throughout the world. A largely self-contained operation divorced from some of the distractions - and occasional madness - of the wider networks has provided a real chance for talented people to show what they can do - and have enormous fun while doing so!

"Happy birthday DLR, and here's to even greater glories - and further expansion - in the coming decades!"



DLR 016 passes DLR 019 at Heron Quays on June 29 1994. The station re-opened approximately 200 metres further south from here in 2002 as part of the DLR capacity enhancement project to facilitate three-car running. PAUL BIGLAND.



car opened from the Greenwich peninsula to Royal Victoria Dock, a project delivered by TfL's DLR team.

Price adds: "There were a far fewer people in Canary Wharf in those days (1987), but success has to be borne from somewhere and DLR delivered. In a way, it was the lifeblood of Canary Wharf, because its workforce relied on it so much at the time.

"Canary Wharf was a real case of 'build it and they will come'. And DLR was in the right place at the right time.

"Today, passenger numbers continue to grow, which raises the threat of overcrowding. Our primary objective is to continue delivering that 99% railway. Plans for some great new rolling stock have now gone out to tender, and we're still adding capacity at stations such as Custom House to make sure that we address crowding levels as they rise."

How DLR will cater for growing demand was outlined in the Mayor of London Sadiq Khan's draft *Transport Strategy* published in June (RAIL 832). It proposed the DLR's first physical expansion since 2011 by extending from Gallions Reach to Thamesmead via a new Thames river crossing, while also confirming a requirement for new rolling stock by 2022.

It says that 43 new trains are needed to enable 33 of DLR's oldest B90 and B92 stock trains to be withdrawn, and to strengthen services across the Royal Docks area, which has been earmarked for 25,000 new homes and 60,000 new jobs.

The trains will have walk-through carriages, which will increase capacity by 30%. The new layout obviates the need for longer trains, which would have required costly upgrades to infrastructure. They'll also feature air conditioning - a first for DLR - plus mobile device charging points and real-time passenger information; the contract is expected to be awarded in summer 2018.

"We're really pleased that the Mayor's draft Transport Strategy shows an extension to Thamesmead. I suppose it's quite a small extension compared to previous ones, but DLR is now quite a significant railway. It's extremely important that we maintain it properly, run it effectively and sustain its exemplary performance.

"New rolling stock will increase capacity by 30%, particularly important in meeting the growing demand for journeys to London City Airport and also the huge number



"In a way, it was the lifeblood of Canary Wharf, because its workforce relied on it so much at the time."

Danny Price, Director of DLR, TfL



Beckton depot opened in March 1994 on the site of the former Beckton Gas Works, and will undergo further expansion to accommodate new rolling stock that will enter traffic in 2022. ANTONY GUPPY.

of developments and thousands of new homes and jobs that are expected. New infrastructure and capacity are very much needed."

Price says that DLR will also be employing other methods of increasing capacity by improving the flow of passengers, and in particular the 25% of people who use DLR for leisure, perhaps experiencing DLR for the first time.

So a new colour-coded map of the DLR has just been launched on trains and station boards to make it easier to find popular destinations, such as the ExCel exhibition centre, and provide clearer interchange information.

Coping with the capacity crunch brings with it two additional challenges, as Price acknowledges the inherent difficulties of replacing elements of the fleet without having any knock-on effect on reliability and current service provision.

How Crossrail will affect DLR is also not fully understood, with interfaces between DLR and Elizabeth Line services at Canary Wharf, Custom House, West India Quay and Stratford.

Price is optimistic, because the DLR team have 30 years of predicting and accommodating new passenger flows, plus the experience of the 2012 Olympic Games, during which an unprecedented 12



Canary Wharf station is pictured on December 6 1991, less than a month since opening. The six-platform station was not ready in time for the DLR's official opening in August 1987, after it was realised that demand had been considerably underestimated and station plans would have to be revised. COLOUR RAIL.

► million passengers were carried by DLR. "Reliability and departure to schedule scores are over 99% and we're very proud of that, but there's no complacency there. We have a stock of trains, built in 1992, that need replacing, but we still need to maintain reliability while the old trains are being taken out of service. It takes quite a lot of planning and collaboration with KAD (KeolisAmey Docklands), our operator and maintainer of the system.

"In the short term, with Crossrail, you could look at it from the perspective that some of the passenger volume gets taken away from DLR [as passengers switch to using Elizabeth Line services], but what you get instead is people utilising DLR in a different way. You've got some different dynamic operational challenges there, which we've modelled, and with that there are some station upgrades taking place so we're ready for them.

"The Olympic Games left us with a legacy of planning and applying the right methods to prepare for big events. If you've handled something as big as the Olympics, you can apply that experience to anything."

He adds: "The Olympics aside, we carried out the modelling for the six extensions, so

FROM THE OPERATOR: KEVIN THOMAS, MANAGING DIRECTOR OF KEOLISAMEY DOCKLANDS



"Commencing on December 7 2014, we are now well into our third year as franchise operator and are responsible for the operation of all services, along with the maintenance of rolling stock and infrastructure assets.

"The franchise is very collaborative in nature and we have a strong relationship with Docklands Light Railway Limited, with which we share a joint strategy and vision of delivering service excellence every day.

"We work closely together to ensure customers receive the best service and customer experience possible, and to build upon the reputation of the DLR as a very high-performance railway. With demand rising year on year, we have experienced more than a 10% increase in passenger journeys in our first two years of this franchise. This makes DLR the sixth busiest railway in the UK, carrying over 122 million passengers in 2016-17.

"None of this would be possible without the team of people we have working here - they are a key feature of the DLR success story. There is a real sense of unity with a dedication to the community and railway, which is evidenced by the great levels of passion and pride that I see every day.

"Our team of community ambassadors also play an important role, working with our local communities and helping people to get around on the DLR. They carry out 10,000 accessibility trips each year, hold open days and attend local events to give travel advice and answer questions; all intended

to make the DLR more accessible, providing mobility to more people than ever before.

"Transport for London is one of the largest transport bodies in the world; it is a good client with big aspirations. The DLR is an iconic, high-performance railway and we are very proud to be trusted to run the DLR on its behalf. With Keolis and Amey as the parent companies of this franchise, we can draw on a vast range of expertise within these organisations to share best practice from their global operations.

"This has helped us to deliver exceptional levels of performance, consistently above 99% and achieving beyond 99.5% more recently. We have achieved record levels of customer satisfaction for the DLR and we're introducing new initiatives to improve this even further. Such achievements can only help strengthen the DLR's reputation for excellence and best practice.

"Our experience at the DLR is also helping Keolis and Amey, by sharing best practice from such an iconic railway. Members of our team are able to provide information and experience that contribute to bids for other transport contracts, for example the recent successful bid for the Manchester Metrolink system (KeolisAmey Metrolink), which began in July this year.

"The DLR is at the heart of developments in east London. It plays a key role in the ongoing regeneration of the area, which is contributing to the continuing increase in residential and commercial populations. This shows no sign of slowing down, and long may it continue, together with the benefits for local people.

"The success and expansion of the DLR over the last 30 years has shown how integral transport can be to its communities and the legacy it can provide for an area - and the next 30 years look to be just as exciting. On behalf of the whole KAD team, I wish DLR a very happy 30th birthday."



DLR 04 approaches West India Quay on August 18 1989. It is one of DLR's original 11 single-car trains, known as P86 stock. Built by Linke-Hofmann-Busch (now Alstom), the stock was sold and moved to Essen, Germany, in 1991, as the vehicles did not meet safety regulations needed to run in DLR's newly built tunnelled extension to Bank. D. PYE/COLOUR RAIL.

we've seen lots of trend changes and have reacted to that. Most of those trend changes have been relatively gradual. But, as I said, much of the legacy from 2012 is about planning for things, not reacting to them."

Price says he's confident in the strength of TfL's relationship with KAD, which took over operations and maintenance from Serco in December 2014 in a contract that will run until 2021 at the earliest.

In formal recognition of this partnership

approach, in November 2016 DLR and KAD achieved certification to BS 11000, the British Standard for Collaborative Relationships.

"I think it's absolutely critical that we have been such good partners since December 2014. The two senior teams are completely aligned on agreed objectives to deliver service excellence for our customers on a daily basis.

"That is what completely underpins how DLR delivers for TfL, as opposed to

“ Getting the BS 11000 standard in collaboration was a significant achievement. I don't think many of these were awarded in the rail industry. ”

Danny Price, Director of DLR, TfL



The DLR's Automatic Train Control (ATC) system is controlled from a central control room at Beckton, using moving block signalling. ANTONY GUPPY.

TIMELINE

- JULY 30 1987**
DLR opened by HM The Queen
- AUG 31 1987**
First passenger service runs
- AUG 1988**
6.7 million passengers carried by DLR in its first year
- JUL 29 1991**
Extension opened to Bank
- 1992**
23 B90 units enter service
- MAR 28 1994**
Extension opened between Poplar and Beckton, where new depot opens
- 1995**
47 B92 units enter service
- 1996**
Annual ridership reaches 16m
- APR 6 1997**
Docklands Railway Management Ltd becomes franchise operator, owned by Serco
- NOV 22 1999**
Lewisham extension opened
- 1999**
Annual ridership reaches 29m
- 2002**
24 B2K stock units enter service
- DEC 2 2005**
London City Airport extension opens
- 2006**
Annual ridership reaches 60m
- MAY 2006**
New franchise awarded to Serco Docklands
- 2009**
55 B07 stock units enter service
- JAN 12 2009**
Extension opened to Woolwich Arsenal
- AUG 31 2011**
Extension opened to Stratford International
- JUL 27-AUG 12 2012**
12m passengers carried during London Olympic Games
- DEC 7 2014**
KeolisAmey Docklands becomes franchise operator
- APR 2017**
Annual ridership reaches 122m
- JUN 21 2017**
London Mayor's draft Transport Strategy confirms replacement rolling stock project and extension to Thamesmead

The scene at Prince Regent on August 10, where DLR trains arrive and depart beneath a British Airways plane taking off from London City Airport. To the left, work continues on the approach to Connaught Tunnel beneath the Royal Docks on Crossrail's south-eastern branch to Abbey Wood, due to open in December 2018. ANTONY GUPPY.



► having separate objectives and hoping they align. Getting the BS 11000 standard in collaboration was also quite a significant achievement. I don't think many of these were awarded in the rail industry, and it was certainly a first for TfL, but like any relationship, it requires constant work - particularly in operations, where things won't always be plain sailing, or happen as planned. It's about how quickly you can work together to get things resolved and having an open, honest relationship has certainly underpinned a lot of the good results that have been delivered.

"I chair a joint leadership team between KAD and my team, and I particularly enjoy discussing strategic changes, and listening to the diverse range of viewpoints. Not everyone necessarily agrees with every single point, so you have members of a combined team who genuinely challenge each other. But they're all united in wanting

AUGUST 31 1987 REMEMBERED: ANTHONY SMITH, CHIEF EXECUTIVE OF TRANSPORT FOCUS

"Always keen to try out something new, my friends and I were there 30 years ago on the first day of the DLR. It seemed really futuristic: no driver, a modern feel and new, at a time when much else on Britain's transport systems were groaning with age and wear. Going to Mudchute from Tower Gateway for the first time (I walked through

the tunnel at Greenwich to get home to Catford) made you realise what transport does best: opens up opportunities for work, living and pleasure. Long may the DLR continue to expand and reach more parts of London that used to be hard to get to. Passengers love it and the staff are great - happy birthday!"



to do the right thing - who pays their salaries is almost forgotten about in many meetings. And the results of that approach speak for themselves."

Finally, Price argues that it is DLR's integration within TfL itself that will yield the greatest results, having been handed responsibility and devolved powers for all of London's public transport between 2000-03.

He says that the passenger experience can only be improved further by looking at each of TfL's separate directorates as a whole, where the sum is greater than its parts.

"From my perspective, and considering the fact that DLR sits within TfL, it's very difficult to take the two in isolation. TfL is driving the entire strategy and if you look at the interchanges, including with river

“If you've handled something as big as the Olympics, you can apply that experience to anything.”

Danny Price, *Director of DLR, TfL*

services and many others, that TfL brain is particularly important to the ongoing success of DLR.

"Historically, and prior to TfL's existence, DLR focused on being a single railway serving a particular area. Today, it's about bringing its benefits to London as a whole, via its interchanges with London Underground, heavy rail, cable cars, buses and river services.

"Very few passengers use just one of these services, so making these interfaces work well is crucial, and we're very focused on that." ■

Further reading

- Automatic for the people, *RAIL* 358
- DLR: the first 20 years, *RAIL* 564
- Triumph of the 'toy train', *RAIL* 577
- The secret to Serco's success, *RAIL* 733



DLR 042 departs Canary Wharf as DLR 124 arrives on April 15 in an image that perfectly illustrates the subtle differences between DLR's Bombardier-built B07 stock that entered service in July 2009 (left), and B90 stock (right) which entered service in 1992. DLR 042 will be withdrawn by 2022, when new rolling stock is scheduled to enter service. PAUL BIGLAND.



A DLR three-car train is in operation near Royal Victoria on September 24 2016. PAUL BIGLAND.



A selection of previous DLR coverage in *RAIL*.

SOLVING THE 'MORE FOR LESS' EQUATION

Commitment and innovation are key to the success of Taylor Woodrow's recent Underground feats, the firm's TfL Sector Director JEZ HASKINS tells PAUL STEPHEN

In a city where Transport for London's motto is 'every journey matters', leading civil engineering firm Taylor Woodrow's challenge is to deliver sophisticated infrastructure upgrades while simultaneously keeping Londoners on the move.

Working in joint venture with BAM Nuttall, the team has done just that by completing the recent upgrade of Tottenham Court Road Tube station, closely followed by the upgrade of Victoria Tube station, which is due for completion in 2018.

Both projects are integral to increasing capacity on the London Underground, which is experiencing strong levels of passenger growth year on year.

It's expected that Tottenham Court Road will accommodate up to 200,000 passengers a day as a key interchange station with the Elizabeth Line (Crossrail) coming into use in December 2018, and perhaps Crossrail 2 in the future. The team has built a new ticket hall that is six times larger than the original, and provided step-free access from street to platform by installing eight new escalators and six new lifts.

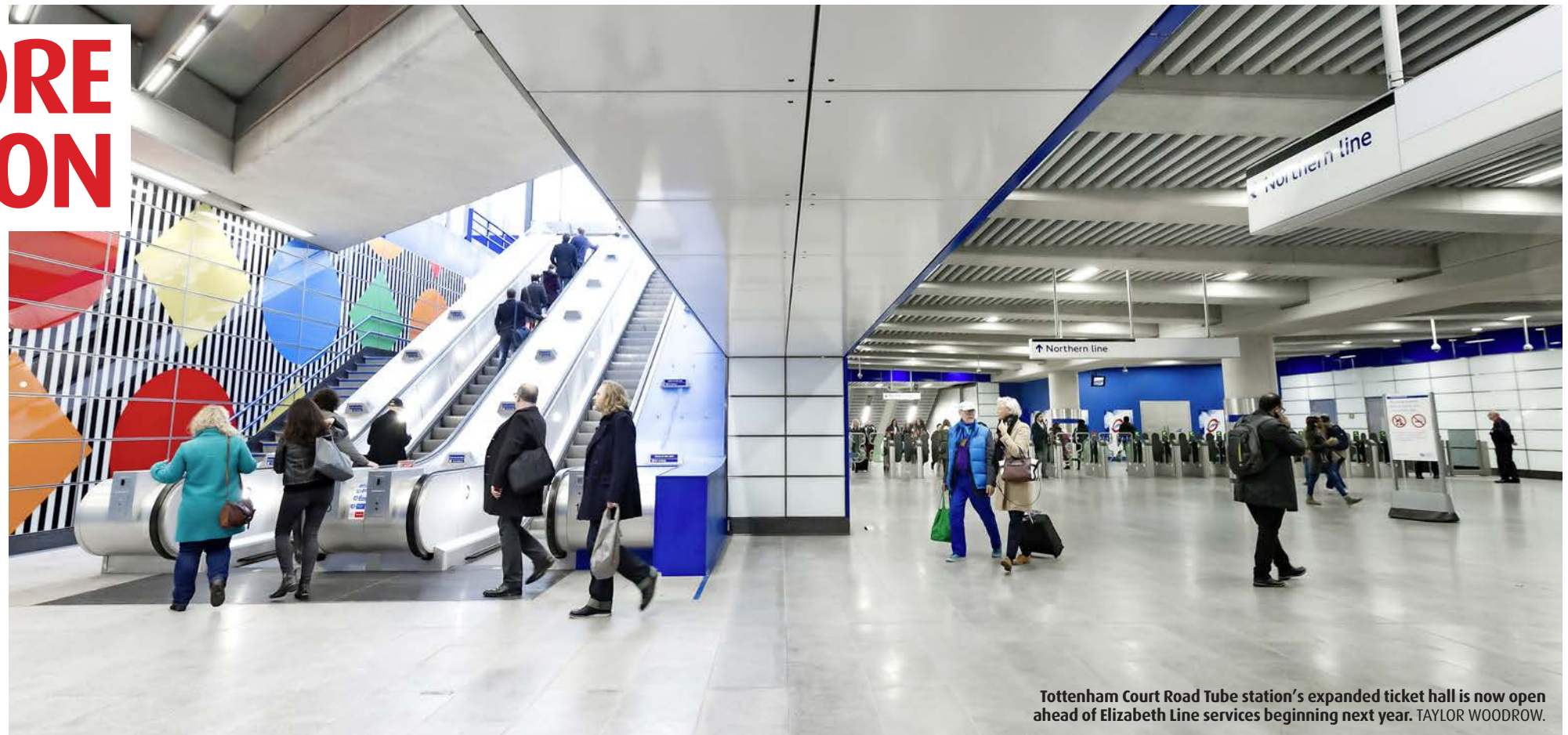
All works have been conducted while maintaining the operation of the station below ground, and the road network above ground; this includes one of the busiest road junctions in Central London.

Says Haskins: "A focus on detail, respect, innovation and relationships is at the heart of our approach. The scale of these upgrades means that disruption is inevitable. Our job is to come up with solutions that not only deliver the best value for our customer, but make the whole process easier on passengers, traffic, residents and businesses wherever we can."

The importance of the road network around Tottenham Court Road Station meant that many complex traffic management arrangements were needed to keep traffic moving throughout the various stages of the project. The team developed and maintained close relationships with stakeholders, undertaking detailed collaborative planning that would take everyone's needs into account. It's an area undergoing major development, and which also relies on maintaining footfall to its retail outlets. Not disrupting their operations was, therefore, of primary importance to the team.

Below the surface, two new overbridges were constructed above the existing Central Line platform tunnels to expand capacity for pedestrian access from a new Central Line passenger tunnel.

The scale of the challenge was enormous but, undaunted, the team rose to it by carefully devising an innovative and bespoke solution.



Tottenham Court Road Tube station's expanded ticket hall is now open ahead of Elizabeth Line services beginning next year. TAYLOR WOODROW.

Haskins explains: "The existing platform tunnels are twin bores with cast iron segmental linings, located one metre below and adjacent to a large Victorian brick sewer. The sewer could not be moved or disturbed without risking leakage. The solution included driving over 90 horizontal steel piles of up to 20m in length from the adjacent Royal Mail Rail tunnel that is no longer in service to form a support raft beneath the sewer."

"In the original design, the overbridge tunnel was to be driven using traditional timber handworks, a slow and manual process. However, the team worked with civil engineering firms OTB, Halcrow and Dr Sauer & Partners to develop an alternative design. This involved a machine-excavated shotcrete cavern spanning over the crown of the platform tunnels, which enabled London Underground to continue operating a full service on the Central Line below."

"As well as being the first project to install a shotcrete cavern over a live operational railway, the team also had to cut out the crown of the Central Line tunnel and install the permanent overbridge beams during two 52-hour possessions. While the works required exceptionally detailed and meticulous planning by all involved, in the end it proved simpler, quicker and safer than alternative traditional techniques, and meant less ground movement."

Meanwhile, over at Victoria, the station serves more passengers than Heathrow Airport each year and is located at the centre of a major transport interchange, woven around a dense population of residents and stakeholders, including two of the capital's long-standing and Grade 2-listed theatres.

The team are providing step-free access while almost doubling the size of the existing Southern ticket hall. They have already opened a new Northern ticket hall and constructed approximately 300m of concrete-lined link tunnels between the two halls.

Over the seven-year project (which commenced in 2011), they will have safely accommodated approximately 595 million passengers and 61 million vehicles through their worksites while transforming this vital node in the transport network.

Within the station, the District and Circle lines (D&C) underpass was integral to the project as it essentially linked the extended South ticket hall to the new North ticket hall. However, the dimension from the top of the running rails to the top of the underpass roof slab was just 0.6m, so innovative thinking was needed to give enough clearance for construction while maintaining the London Underground Standard requirements of a 'step free' tunnel.

The original solution was to support the D&C tracks with concrete walls perpendicular to the track, and segmentally

underpin large sections of the tunnel walls in six segments to form supporting beams. This would be primarily constructed from within the D&C tunnel, and would require a minimum of 17 weekend track closures of the D&C line. This was unacceptable to the team, due to the level of disruption and risk of overrun due to the nature of the work.

A propped slab was developed that moved the focus of construction from the operational D&C tunnel and into the adjacent new link tunnels below, thereby reducing the requirement to close the railway to passenger traffic.

This change in the construction approach meant that the propped slab could be constructed in a six-day blockade over the Christmas period, which was already scheduled for track work shared with other

“ The team were the first to work on a sprayed concrete cavern directly above a live platform during traffic hours. ”

Jez Haskins, TfL Sector Director, Taylor Woodrow

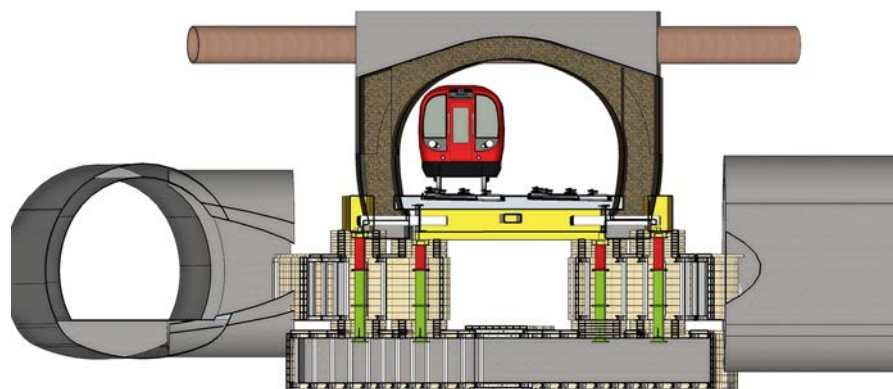
parties. It reduced delivery costs, mitigated risk, and significantly reduced passenger disruption.

The upgrade's design also involved six points at which the new tunnels would break into the existing station tunnels. The team successfully incorporated 'propless' connections in the design to remove the need for any temporary support in the station at these points, maximising operational space throughout the works.

Haskins concludes: "With the London population growing at a rate of twice that of the rest of the UK, the demand for constant and efficient transport is high. Upgrades such as Tottenham Court Road and Victoria are essential in meeting this growth."

"TfL aspires to deliver more for less, as funding for major capital projects becomes harder to secure and ever more projects compete for the available investment. So ensuring that we apply the lessons learnt from projects such as Tottenham Court Road and Victoria will be essential. Projects such as these, delivered by committed teams over seven or more years now set the new minimum level of expectation from which future projects can build upon to introduce the next level of innovation, collaborative working and delivery efficiencies."

"Exciting times are ahead and we are very much looking forward to being involved in future challenging major projects to support London's future growth." ■



Victoria station upgrade's propped slab, just 0.6 metres below the running rails of the District and Circle Lines. TAYLOR WOODROW.

Open access

TfL's smart and simple solutions are making London's Underground an option for a lot of people who would otherwise be unable to use it, writes **STEFANIE FOSTER**

When you are on the Tube, pressed up against your fellow commuters in the heat, it is perhaps not uncommon to feel uneasy at times, especially when the train enters the dark, enclosed tunnels deep under central London. But for some, this feeling is not just simple uneasiness, it is an intense and excessive fear of becoming trapped, of not being able to breathe, and it can cause that person to panic.

Claustrophobia affects around 5% of the population and more general feelings of anxiety affect significantly more people over their lifetimes. It would be easy to dismiss those facts for someone unaffected by these difficulties, but they can have a serious impact on a person's ability to lead a normal life, including travelling on the Tube network.

The name of the Underground alone conjures up images of an entirely subterranean network but, in reality, of the 270 stations, more than half of them are above ground. Only the Victoria, and Waterloo and City lines are completely underground, and much of the outer reaches of the network are much like main line railways.

In recognition that this misunderstanding (or the uncertainty about which parts of the network are in tunnels) might be a barrier to travel for some people, Transport for London last month launched a modified version of

its iconic map to help passengers navigate the Underground network while avoiding areas with large stretches of tunnel. The new map features a grey overlay to show which stations or sections of track are underground, including which London Overground, Docklands Light Railway and TfL Rail sections are in tunnels.

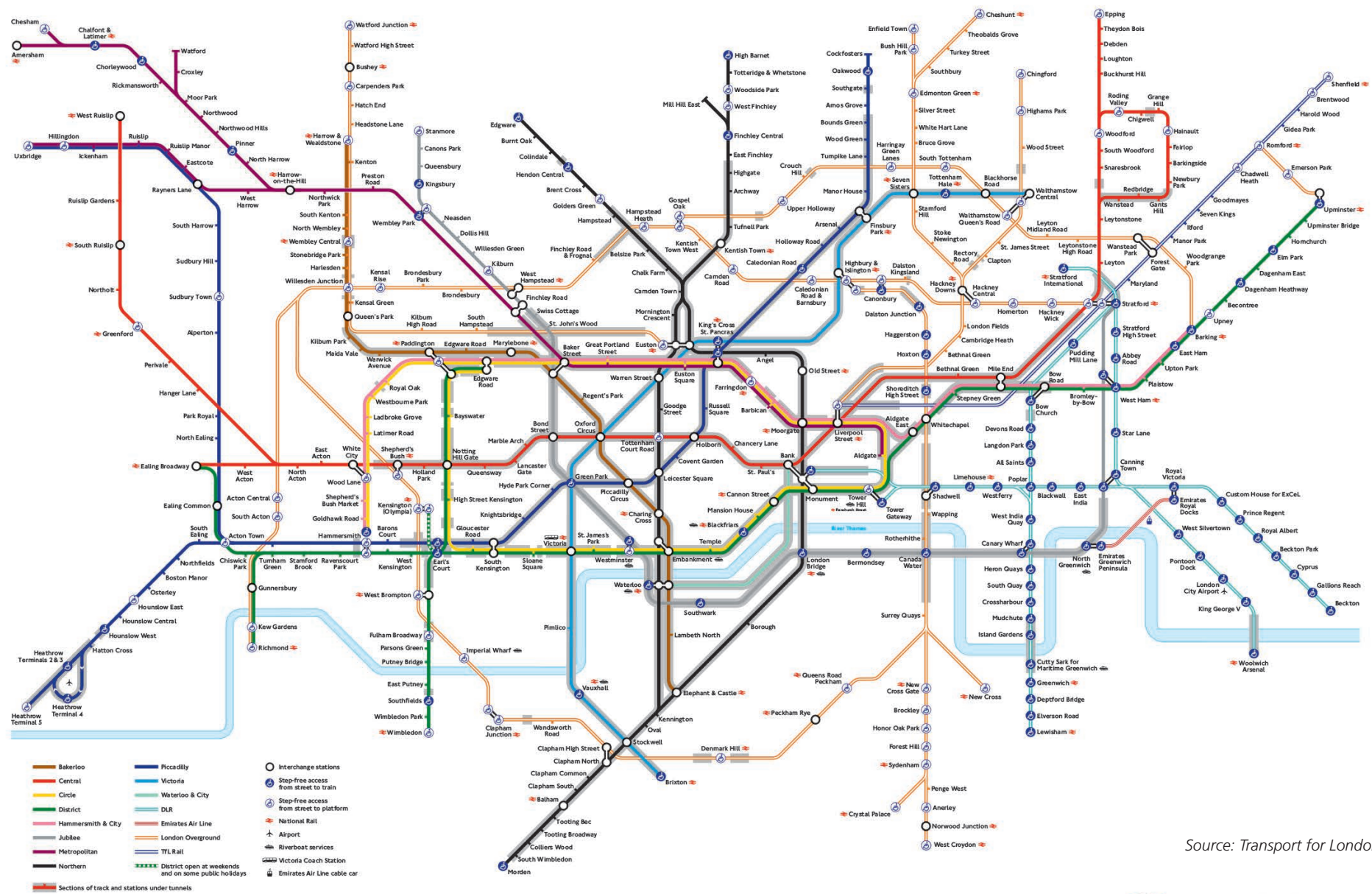
"Making the Tube network accessible for everyone is one of our top priorities," TfL's Director of Customer Strategy Mark Evers said. "This new map is just one of the tools we have created in response to feedback from our customers on how we can make the transport network more accessible, making travelling easier and more comfortable for all our customers."

The move has been a popular one with charity Anxiety UK. Chief Executive Nicky Lidbetter said: "For those with anxiety conditions such as panic attacks and claustrophobia, we know that travel by the Underground can be problematic and challenging. This new map is an excellent resource for those wishing to avoid journeys where there are tunnels, serving as a great pre-journey planning aid and increasing access to public transport. I sincerely hope that the map will encourage those with claustrophobia and/or panic attacks, who have previously avoided this form of public transport out of fear, to reconsider using the Tube".

The idea came about following suggestions from passengers living with claustrophobia or other types of anxiety conditions, who find it difficult to use the Tube. It is just one of many ways that TfL has been listening to its customers and trying to ensure that the Tube network is accessible to as many people as possible. A range of Accessibility guides is available from <https://tfl.gov.uk/forms/12387.aspx> that offer advice on avoiding stairs and finding toilets, as well as large print and audio versions of the map for those with sight or hearing difficulties.

There really does seem to be a map for everyone to make everyday problems just that little bit easier to overcome.

Tube map showing tunnels



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Source: Transport for London.

UNDERGROUND FACTS

45% of the London Underground is in tunnel.

The deepest station on the network is Hampstead on the Northern Line - it's 58½ metres underground at its deepest point.

The Central Line has the most Tube stations with no surface buildings (Bank, Bethnal Green, Chancery Lane, Gants Hill and Notting Hill Gate).

It's not just about maps, either. Last autumn, TfL conducted a trial to see whether a new badge bearing the words 'Please offer me a seat' would help people who find it difficult to stand on public transport, such as those suffering from conditions with invisible symptoms, to obtain a seat.

More than 1,000 people took part in the trial, with 72% of journeys being made easier by using it. Ninety-eight per cent of the participants said they would recommend it. During the trial, TfL used social media and customer information on the network to encourage passengers to offer their seats to

someone with the badge. It is similar to the already very popular 'Baby on Board' badge launched for pregnant women in 2005 - TfL now issues around 310,000 of these every year.

James McNaught, who previously developed a 'cancer on board' badge and also took part in the 'Please offer me a seat' trial, said: "This is a brilliant scheme and I am very glad that it is being introduced. The anxiety of needing a seat but being unsure whether you will get one can rob people of the confidence to use public transport, and this simple initiative will make a huge

difference to the lives of many people."

The badge and an accompanying card has now been rolled out and can be used on

“ Making the Tube network accessible for everyone is one of our top priorities. ”

Mark Evers, Director of Customer Strategy, TfL

all TfL services, including London buses, trams and river services, as well as on station platforms and waiting areas. They are both available at <https://tfl.gov.uk/transport-accessibility/please-offer-me-a-seat>

All of these initiatives are part of TfL's Action on Equality commitments, based on the vision that 'every person matters in keeping London moving, working and growing'. These seemingly simple schemes could make a real difference in breaking down the barriers that prevent some people from making the most of London's comprehensive transport network. ■

KEEP YOUR CUSTOMERS CLOSE, AND YOUR STAFF CLOSER

SNC-Lavalin has gone from strength to strength, and its services are in increasing demand with TfL. Commercial Manager HUGH FRASER tells STEFANIE FOSTER how the firm is supporting the many changes to London's transport

Having your offices at the centre of your client base brings obvious advantages. In 2002, SNC-Lavalin (then Interfleet) recognised the need to diversify its client base from what was, largely, companies formed at the time of privatisation. The firm had set its sights on working with Transport for London, and the only way to do that effectively was to establish a base in the capital.

Hugh Fraser, SNCL's commercial manager, joined the London office 13 years ago. At that point, there were only four employees.

"We based ourselves in Canary Wharf

to be closest to the biggest client, as we saw it [about 500 yards from London Underground's divisional offices] and we developed very good relationships with all of the operating units for TfL."

SNCL has since moved to offices in Devonshire Square, near Liverpool Street station.

"LU was going through PPP [Public Private Partnership] at the time, so there was a lot of reallocation of responsibilities. Within two years we grew to about 30 people at the London office, and we were specifically recruiting people with knowledge of LU."

At that time, SNCL was not on any of the TfL framework agreements, but after qualifying ten years ago on the rolling stock side, the company has been on them ever since, covering more areas as the expertise within SNCL has grown and diversified.

Says Fraser: "Our London office used to be very rolling stock-orientated, but now we cover infrastructure, signalling, project management and transport advisory services as well."

In addition to supporting TfL's rolling stock projects, the team has also played a key role delivering new signalling and systems within London Underground, London Overground and Crossrail. This has included providing a wide variety of technical specialisms and engineering leadership to the Four Line Modernisation Programme, the Deep Tube Programme, and the Victoria Line Upgrade Programme.

Starting with TfL as a direct client, over the years SNCL has provided consultancy services for all of TfL's constituent parts, including LU, Docklands Light Railway, London Tramlink and London Overground,



SNC-Lavalin is firmly rooted in the capital and supports all the constituent parts of Transport for London, as well as many of its suppliers. SHUTTERSTOCK.

while quickly diversifying to support the entire supply base, too.

"We now support all the subsidiaries of TfL, and probably all the suppliers to TfL in some shape or form, whether that be a concessionaire like KeolisAmey Docklands or MTR Crossrail. Our services go all the way through the supply chain. That's because TfL is an integrated railway. Elsewhere, signalling is split out with infrastructure in Network Rail, but TfL manages everything itself, which means that we can provide services throughout the whole system." SNCL's recent acquisition of Atkins will increase the firm's range of abilities.

SNCL has been instrumental in projects that have made a significant difference to London's transport. A recent example is the introduction of a 'black box' to the DLR's rolling stock, to improve reliability and availability. The remote condition-monitoring system allows DLR operators to see vehicle performance in real time, and initiate mitigation measures for smarter maintenance.

The trains can be monitored the whole time they are in service, anywhere on the DLR network, with information taking less than three seconds to reach control staff.

They'll be able to see whether doors are open or shut, the performance of the traction control system, and oversee brake pressures - a total of 270 different items of data.

On a system which carries about 117 million passengers every year, this remote condition monitoring system (a collaboration with lead contractor Arrowvale Electronics and communication supplier Nomad Digital) has made a significant improvement to performance.

But it's not all about performance - some of SNCL's work is on a far more personal level. In April, the firm was awarded two design contracts to help LU improve rail vehicle accessibility for persons with reduced mobility and visual impairments. These cover the Bakerloo Line's 36-train fleet, the Central Line's 85-train fleet and the Waterloo & City Line's five-train fleet. SNCL's modifications are also aimed at improving the passenger experience in general with new information systems, emergency alarms, CCTV and lighting, as well as designated wheelchair and pushchair zones.

The benefit to LU is that these upgrades will extend the life of the fleets and result in long-term cost savings.

SNCL has led the way on many rolling

stock areas for LU and DLR, including reviews of maintenance and support for new vehicle provision. It's had ample involvement in this area, with LU's New Tube for London project to procure 250 new trains for the Piccadilly, Bakerloo, Central and Waterloo & City lines, the first of which is due to enter service on the Piccadilly Line in 2023.

SNCL has supported train builders in their vehicle designs and bids for this major contract by helping them understand how best to fulfil contractual requirements, defining a suitable vehicle solution and writing the final bids.

Says Fraser: "We're looking forward to NTfL and the new DLR vehicles contracts, and then the delivery of those vehicles into service. We have worked with suppliers in the development of their offers for NTfL and look forward to supporting them in the

“ Our services go all the way through the supply chain. ”

Hugh Fraser,
Commercial Manager, SNC-Lavalin

delivery phases."

SNCL's legacy with TfL runs deep - they supported London Tram in bringing vehicle and infrastructure maintenance back in-house, facilitated the introduction of the Class 378 vehicles to the Overground, and advised bidders on the letting of recent concessions for the DLR and Overground. The list goes on...

These achievements would not be possible without SNCL's commitment to its staff.

Regional Director Michael Grace tells RAIL: "We want to carry on growing and strengthening our team. One of the biggest challenges is the availability of people. The market is very busy, and there's a lot of competition for the same good people. Our solution to that is to develop our own."

"We've brought in more than 85 people in the past 12 months. In 2018 we're taking on 22 graduates and four or five technicians, plus some apprentices. Since 1998, we've taken on more than 150 graduates."

Testament to SNCL's staff engagement programme is that just under 70% of those graduates have stayed with the company.

Grace continues: "Retaining good people is paramount, so staff engagement is our number one priority." ■

OLYMPIC CHALLENGE

SNCL played an important role in the London 2012 Olympic Games. It was tasked by DLR and Serco Docklands with a particularly challenging request: to increase the level of service vehicles availability to 96%, or 144 out of the 150-train fleet. Doing this meant working out what pre-emptive work could be performed on the vehicles to ensure that the trains would not need maintenance during the events. In normal operation, maintenance tasks would need to be carried out every day, week or month, so it was not an easy problem to solve.

The contract proved to be serendipitous - their client at London 2012 was Richard George, who is now SNCL's group managing director, having joined the company shortly after the Olympics.

Crossrail 2: true north or going south?

There's been a prolonged radio silence about the future direction of Crossrail 2, London's next great infrastructure project. Finally, Secretary of State for Transport Chris Grayling spoke to the nation last month (July). But few were any the wiser about its details.

With the Government ditching its promises to electrify, among others, the line from Cardiff to Swansea, people could be forgiven for wondering what might be next to bite the dust. Scrapping C2 would have stunned almost everyone, yet it's hard to tell what a new government and a new man running the railways might do, given the prevailing neurosis about expenditure.

Different rules, however, apply to London: it's almost a city state, growing ever more complex and congested. It's where people in power live and work. If the capital is throttled by congested tubes, trains and roads, it will suffer economically. Everyone can see that.

Crossrail (The Elizabeth Line), running from Reading to Shenfield, is expected to deal with the west to east problem. But the commuter belt south of London is crying out for an increase in capacity, and welcomes the ambition shown in Crossrail 2 - of running up to 30 trains hourly once fully operational after 2033.

Yet the route, conceived to run from Cheshunt and - possibly - New Southgate through Alexandra Palace in the north to Wimbledon in the south (and maybe to one or more of Chessington, Shepperton and/or Epsom) currently comes at a price of £31.2 billion. Or so we're told.

With the plans as they stand, C2 would feature a twin 24-mile tunnelled section between Wimbledon and Tottenham Hale and New Southgate, connecting to existing National Rail routes in Surrey and Hertfordshire, and connecting with the Elizabeth Line at Tottenham Court Road interchange.

One of C2's great selling points is that it

At this fragile, embryonic stage, nobody dares breathe a word about Crossrail 2. And money is, as ever, a little too tight to mention. **ANDREW MOURANT** talks to C2 Managing Director **MICHÈLE DIX**

would bypass terminal stations, relieving, for instance, pressure on Waterloo from the south-west. C2 would greatly improve connectivity in the Upper Lea Valley "creating the right conditions for new opportunities and thousands of new homes."

Space would be freed up on the South Western Main Line for around 20 more trains at morning peak hours, and there'd be a similar benefit on the West Anglia Main Line. There'd also be scope to run extra trains to Cambridge, Stansted Airport, Portsmouth, Southampton and Basingstoke.

It's long been agreed that construction costs should be split equally between London and the private sector, with developers given scope to build around new stations. Yet there's been unease about how all this might actually work.

Last month's joint statement from Grayling and C2's co-sponsor, London Mayor Sadiq Khan, told us little because the Department for Transport (DfT) is still evaluating the revised business case. If the communique had any purpose, it was to remind the public that C2 remains alive.

"Given its price tag, we have to ensure that we get this right," Grayling said. "The Mayor and I have agreed... to develop plans that are as strong as possible, so the public gets an affordable scheme that is fair to the UK taxpayer."

"Following a successful outcome... I'm keen to launch a fresh public consultation to help... improve the scheme and clarify the position around the safeguarded route."

So what does that mean? 'Affordable' appears to mean striving to save £4bn - that much was signalled by the National

Infrastructure Commission (NIC) in March last year. As for the latest pricing, the £32.6bn of March 2016 has shrunk to £31.2bn. According to Transport for London (TfL), more than £10bn of that is an allowance for risk.

NIC suggested a delay in building the north western branch running beyond Alexandra Palace to New Southgate. "This would also provide the opportunity to consider an eastern branch from Hackney as

an alternative," said NIC. "More work should also be done on the costs and benefits of individual central London stations."

Might one or more be sacrificed? By chance, the day after Grayling's intervention, RAIL was booked in to interview Transport for London's Michèle Dix, managing director of Crossrail 2. Dix attended the meeting between Grayling and Khan, after which the Secretary of State issued his statement. But she declined to share details of the revised business case for C2 with RAIL because the DfT is still chewing them over.

Dix insists that Grayling still thinks C2 is a good project, and right for London's housing and transport needs. "With commitment to other schemes there's pressure to get this under way," she says. "London has said we can fund half, but most of that money

will only come on stream after we've built it - through fares and the business rates supplement, which we can't use until 2033." (after it's finished contributing to the Elizabeth Line).

Last March Dix told RAIL that the supplement could run another 30 years. Meanwhile, she adds, money should start to trickle in after 2019, via the mayor's Community Infrastructure Levy - "about 16% [of London's share]. We do need help contributing to the cost."

The project is being jointly developed by TfL and Network Rail. It has a Programme Board, chaired by former NIC chairman Lord Adonis, whose job is to make recommendations to Grayling and Khan. There have already been three consultations since 2013 on C2's design and development,

but none since 2015. "The Secretary of State didn't want us to undertake another until he'd seen the revised business case," said Dix.

Political upheaval has held things up. The Government didn't start its review process sooner because of the general election, Dix points out. "We won't now get a decision this side of the summer recess."

The project will require passing a Parliamentary hybrid bill to kick-start things. "Originally, we made plans based on having that bill by 2019. Because of the election, our plan now is that we want it in 2020."

"A hybrid bill is about getting the balance between a railway - building it - and acknowledging that local areas want to have a role. The Secretary of State and the Mayor will decide [its contents] as a result of



Crossrail (pictured here under construction through the Thames Tunnel) will help relieve London's rail capacity crunch from east to west when it fully opens in December 2019. Crossrail 2 is designed to do the same on a north-south axis from 2033, should it secure government approval. CROSSRAIL.



“How can we make it more affordable for the UK government, given other challenges in Wales and the North? How can London contribute more?”

Michèle Dix, Managing Director, Crossrail 2

► output from the Programme Board. It's about balance - what do you want these powers for? The more you put into a bill, the harder it is to get it through."

Dix appears unfazed by the delay. Theoretically, this parliament could run until 2022, which will give more time. By then she hopes the bill will have advanced to a second reading and be on the home straight. She doesn't think recent events will affect the timetable: construction to start in the early 2020s; the first C2 services running in 2033. But, given the political landscape, few people would bet on this parliament running its full five years.

In TfL's revised business case for C2, there is, says Dix, a section about paring down costs ... "how can we make it more affordable for the UK government, given other challenges in Wales and the North? How can London contribute more?"

The stream of private money depends heavily on developers paying to exploit prime sites en route, especially near central London. Unsurprisingly, given London's top-end prices, home builders and property industry leaders are champing at the bit - more than 60 have written a joint letter to the Government, claiming that Crossrail 2 is



“ Following a successful outcome... I'm keen to launch a fresh public consultation to help... improve the scheme and clarify the position around the safeguarded route ”

Chris Grayling, Transport Secretary

"vital to fix the housing crisis".

The revised business case describes how C2 will deliver 200,000 new homes along the route - a lot of them at its northern end, in the Lea Valley. Work has been done to ensure the route aligns with the availability of strategic housing land.

A Parliamentary briefing report in April, shortly before Theresa May's ill-fated dash for the polls, suggested setting up 'one or more' development corporations to lead the master planning.

"For housing provision to be a success across the whole route, the deal for Crossrail 2 will need buy-in from the Greater London

Authority (GLA) and boroughs along the route," it said. That suggests a lot of complex negotiation.

Also in April, a report by property companies suggested London could fund half of C2's cost simply through more commercial development in the West End - "the creation of great, much-needed new places in the country's most economically productive district... [can] help pay for Crossrail 2 through development taxes or local retention."

But isn't the West End already developed to the hilt?

"You must be joking!" says Dix. OK, but

might not C2 spawn grotesque tower blocks, of which the capital already has a surfeit? Dix does appear mindful of that - she recalls a recent trip to Japan, staying almost 30 floors up in a skyscraper hotel so surrounded with similar buildings "that there was no horizon."

Yet she sees no reason why the West End should suffer that fate.

"The London borough with the most density of population is Kensington and Chelsea, but so much of the housing is mansion blocks of five or six storeys."

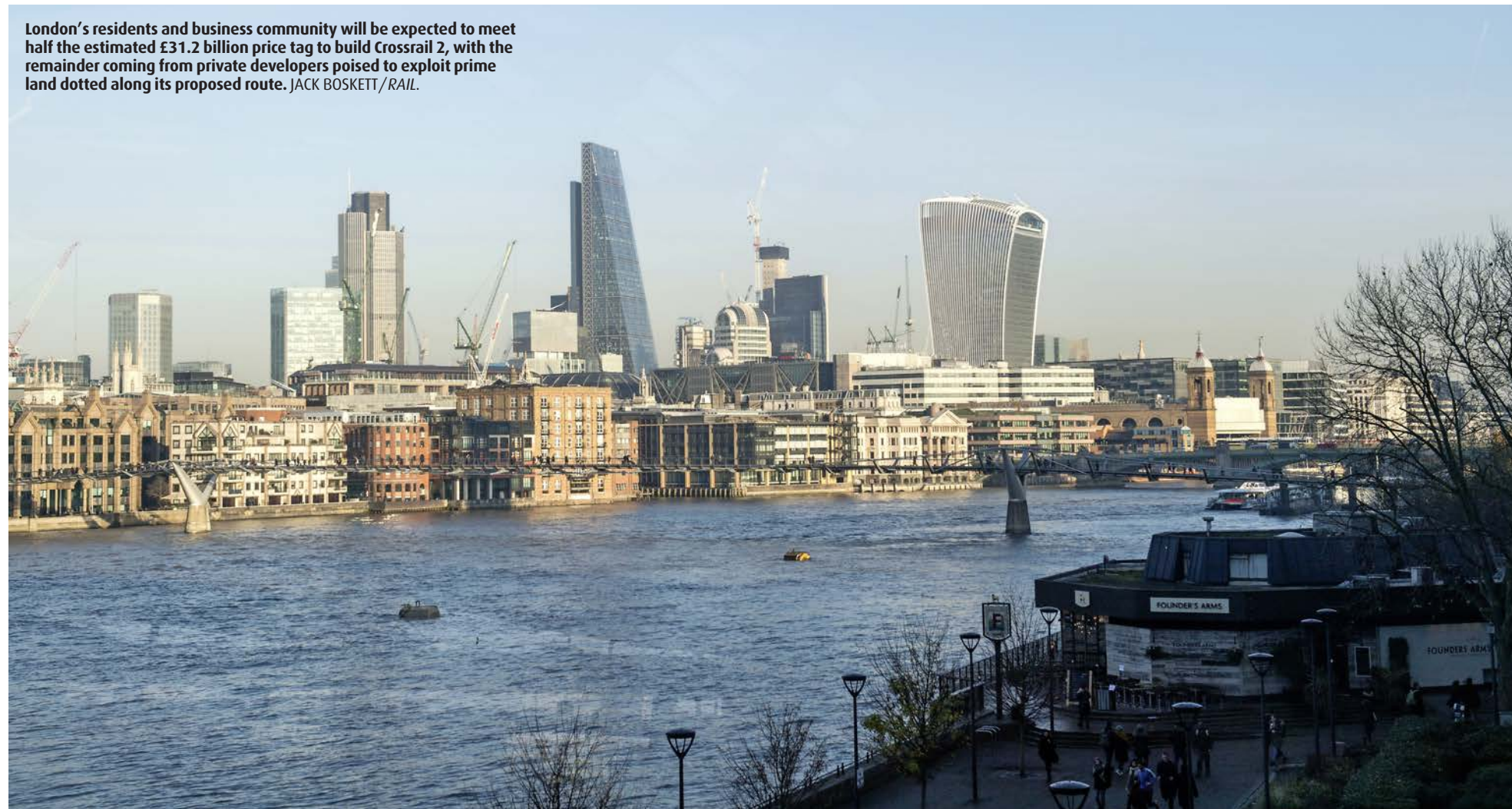
'Densification' need not mean the borough losing its character, she adds. She's keen to avoid the prospect of housing going up "on greenfield sites elsewhere."

So much relies on projections that show the capital's housing soaring in value. Given that the eager lobbying of the Government by developers is very recent, one assumes they're taking a long-term view, unmoved by what the next few years may hold economically and the great unknown of Brexit.

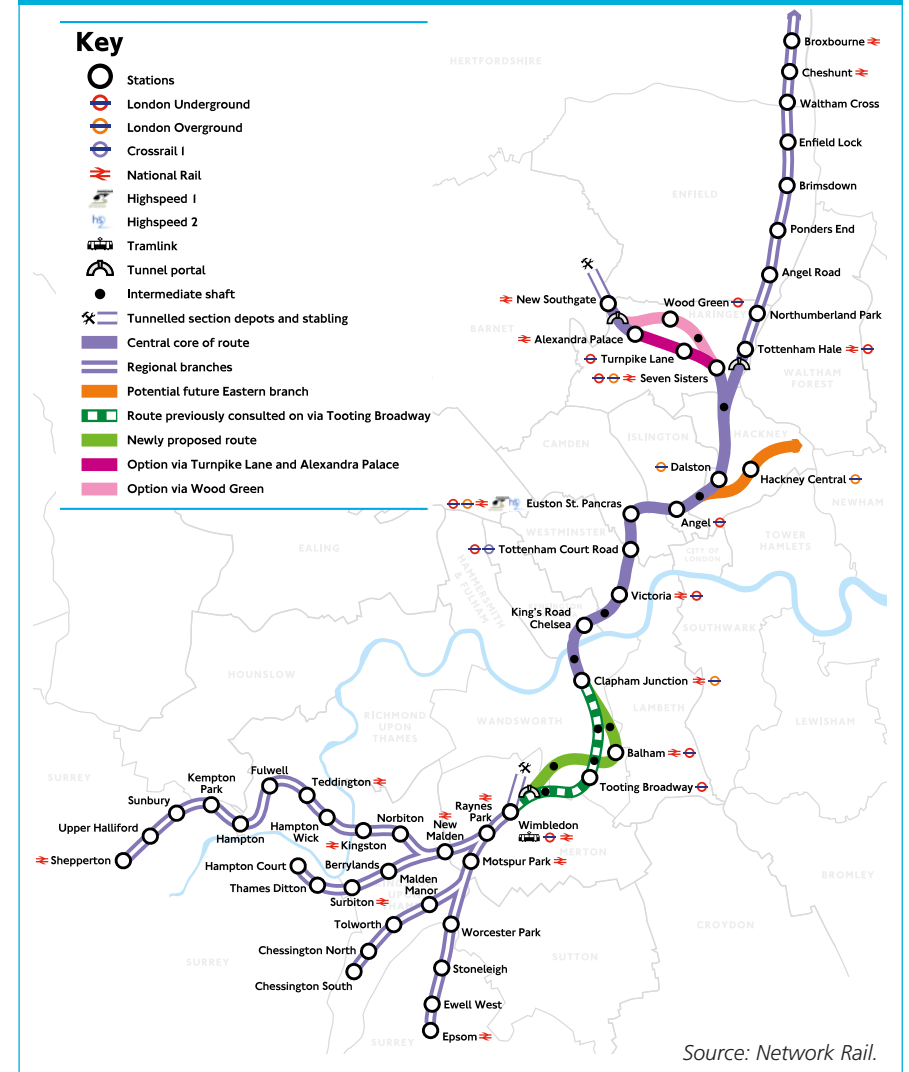
Nobody expects an everlasting ice age when (or if) the UK finally withdraws from Europe, least of all in London.

But some fear that a downturn could be

London's residents and business community will be expected to meet half the estimated £31.2 billion price tag to build Crossrail 2, with the remainder coming from private developers poised to exploit prime land dotted along its proposed route. JACK BOSKETT/RAIL.



CROSSRAIL 2 ROUTE (AUTUMN 2015)



approaching. As RAIL emerged from Dix's office above St James' Park Tube station, the London *Evening Standard* contained a cautionary story. It was that Virgin Money had become wary about making new loans in the capital for fear of borrowers overstretching and ending up in negative equity. Estate agents report that in some boroughs, prices are dropping for the first time in years, the LES added.

Stephen Hammond, MP for Wimbledon, C2's south-western outpost, believes the DfT wants to test London's funding commitment "to obliteration." Hammond favours the scheme - with reservations, but doubts there'll be any consultation on the revised business case until early 2018. "The fact that the department is taking such a long time suggests to me there's a problem," he told RAIL.

SURFACE TENSION

Most of the battles about new stations, and where they might be built, are being fought south of the river.

As RAIL reported last year, the choice of King's Road, Chelsea, has been especially divisive. But there's also anxiety at Wimbledon, where the proposed C2 tunnel would begin, and the tension between expense and practicality surrounding options at Tooting and Balham.

Here we take a closer look at some of those disputes and discussions.

WIMBLEDON

The prospect of a tunnel entrance at Wimbledon has mobilised residents. MP Stephen Hammond has been campaigning for a rethink. He welcomes the business and employment opportunities C2 could bring but says the only option consulted on in 2015 would be "immensely damaging."

Hammond was also concerned about the impact in and around Raynes Park. "C2 didn't make clear how much Raynes Park station would need to change, or how building a large site near Dundonald Road enabling trains to reverse might affect residential property," he said. There

► would, he added, be “huge disruption” in Wimbledon Park, caused by the construction of a tunnel portal at Gap Road.

“What wouldn’t be acceptable is seven years of disruption in Wimbledon town centre,” he told *RAIL*.

“Some of the original plans had unrealistic elements - they were looking at knocking down two office blocks and a listed public house. I suggested they consider tunnelling between Raynes Park and Wimbledon. A box station could go beneath the existing station.

“Originally, C2 said a tunnel couldn’t be put in place because of a gradient problem, but engineers have since conceded they could do it.” Yet that solution would come at a price, as Hammond admits. “Last time C2 was asked, the extra cost of this was about £1bn.”

“I understand they’re looking at other possibilities. One is a refinement of the existing town centre scheme, but much more phased. Another is building a few more District Line platforms pushed to the north side of the station, freeing up lines for C2. That could work but it brings other problems - it would involve taking out residential property and also extra land, including the site of the magistrates’ court.”

Residents are worried that overbearing new buildings will be the price they must pay for C2. “We’ve seen a surge in developers wanting to replace existing buildings with taller ones, which residents don’t support,” Hammond said. “They want higher quality designs. There’s a strong preference for the Victorian style.”

TOOTING VERSUS BALHAM

Last year, when speaking with C2 Managing Director Michèle Dix, *RAIL* came away with the impression that C2’s preference had swung towards a new station at Balham, despite the stronger case to be made for Tooting, further south down the Northern Line. Now, it would appear, things have changed.

The well-documented problem with Tooting is geological. Lying on the Wimbledon fault line (Balham doesn’t), far below ground lies, as Dix describes it, ‘wet pebbly muck.’ “Tooting is the major problem in the whole project... building would take longer... it would be more like open heart surgery as opposed (in Balham’s case) to keyhole surgery. Balham would give us most of the benefits... but be less disruptive; so we’ve planned to build there instead.”

There are hints of a shift 16 months later. “Tooting will be more costly but the potential benefits will outweigh the costs,” Dix tells *RAIL*. “We’ve done more boreholes to get a better understanding of the soil conditions. We identified Tooting Broadway as the best place because of the relief it would give to the Northern Line. Everyone seems to want Tooting... it would help regeneration and serve St George’s Hospital better.”

But caveats remain, chiefly that construction will be far more disruptive and costly because of all that muck and the high water levels.

“Also, there are concerns around Tooting Market - people there think [building a station] will have an [adverse] effect,” she adds. “The market is doing much better than in 2013 (when the first C2 consultations took place). We’ll have to hear what they say. With new stations we don’t just say ‘plonk it there, end of.’”

So consultation is a serious exercise that can change things? Not, says Dix, if it simply amounts to people saying “we don’t like it here, put it somewhere else - that isn’t a reason to move it. But if someone says ‘go somewhere else’ and there’s proper input... then we’d consider it.”

With NIC urging savings, is it realistic to expect backing for Tooting, estimated last year to cost £500m more than Balham and take two to three years longer to build? One thing’s clear - there seems very little appetite for it in Balham. None, in fact, according to Siobhain McDonagh, MP for Mitcham and Morden, who’s long campaigned for a station at Tooting Broadway.

“People fear a Crossrail station at Balham could destroy much of the high street, including Waitrose. And people living around Wandsworth Common don’t like the idea of having air vent shafts there,” she said.

A Tooting Broadway station would relieve the huge overcrowding that’s worst between Tooting Bec and Stockwell. The ‘Clapham Squeeze’ means this stretch of line is practically unusable between 08.00 and 09.00 each weekday morning. Trains heading north are now usually full at Colliers Wood, the third station up.

“This would be hugely eased by giving commuters a choice of travelling on Crossrail 2 to Victoria, Euston or other central destinations,” says McDonagh. “Balham is already well connected - via Southern, people can get to London Victoria directly, besides the rest of South London.”



Tunnelling beneath central London from Wimbledon is expected to release much-needed capacity on the South West Main Line into Britain’s busiest station, London Waterloo, for up to 20 trains per hour. JACK BOSKETT/*RAIL*.



“The fact that the department is taking such a long time suggests to me there’s a problem”

Stephen Hammond, MP for Wimbledon

She says that the better access offered by a C2 station at Tooting would also pull in investment to Mitcham and Morden because transport links are much better than to Balham. Once at Tooting, commuters could reach Clapham Junction in four minutes and Euston/King’s Cross St Pancras in 20.

Yet cost and Tooting’s tricky terrain could be a sticking point.

“You can’t do mechanical extraction there - it’s all gravel and water,” says McDonagh. “And they don’t know how deep it goes, or where it starts.”

KING’S ROAD, CHELSEA

Some local residents think it’s all over - that the idea for a station at King’s Road Chelsea is a dead duck, given the pressure on C2 to save money. As *RAIL* reported last year, the campaign against has been vociferous and high-profile.

According to the Chelsea Society, TfL’s updated business case ‘gives due consideration’ to removing King’s Road station. It’s been condemned by the pressure group nocrossrailchelsea.com as “a complete waste of more than £1bn of public money, lacking any transport justification or financial basis, and fails to meet the criteria upon which Crossrail 2 is based.”

Last November the society was told by the then leader of Kensington and Chelsea Borough Council, Nicholas Paget-Brown, that there wouldn’t be any large buildings either around or above the station entrance. “That served to make any funding for the project even less viable,” the society says. Paget-Brown also said that KCBC wouldn’t provide any funding for the project.

The Chelsea Society has an armoury of objections: overcrowding; the threat of subsidence; that the locality’s ‘village

character’ will be spoilt. They also argued that Chelsea is well enough connected already, with most of it already within 800m of a station.

Regeneration arguments don’t apply to Chelsea, they say. Moreover, locals share the fears of protesters in Wimbledon - that their council might lose powers to control the height and scale of new buildings under a hybrid Act of Parliament “which could overrule everybody.”

The voices have been loud and many. Jason Pearson, a spokesman for nocrossrailchelsea.com, told *RAIL*, “Our sense is that the station is dead. There have been reports about cost-cutting, and that the current proposal is for the Victoria to Clapham stage to go direct. People we’ve spoken to at City Hall have all said privately that King’s Road isn’t going to happen.”

Dix, however, wouldn’t be drawn on the

matter. Moreover, she points out, opposition to King’s Road isn’t universal. “There’s also a quieter ‘yes’ from people living to the West, who feel that public transport in the area isn’t as good as it could be - and also, increasingly, a business lobby,” she said.

Hammond agrees that the station should be kept. In Chelsea there is, he thinks, an element of nimbyism. “In 20 years’ time, people might wonder why on earth we didn’t put a station in there.” ■

ABOUT THE AUTHOR

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Andrew Maurant is a freelance journalist specialising in education, business and the rail industry.



DEVOTED TO DLR

PAUL STEPHEN speaks to MARTIN RENNOLDSON, Bombardier's Group Account Director for TfL, about the role the company's rolling stock has had in shaping the Docklands Light Railway, and could play in its future

Few companies can claim to have contributed so heavily to the 30-year success story of the Docklands Light Railway as Bombardier, which has manufactured each of the 155 purpose-built electric multiple unit (EMU) vehicles that are currently in operation on the network.

This relationship is made all the more remarkable by its endurance, with Bombardier consistently chosen to provide successive orders of rolling stock to help DLR keep pace with booming demand, and to serve physical extensions to its network.

The first order was for B90 stock which Bombardier built in 1991 to replace the DLR's original P86 and P89 stock that ran in single cars, and therefore became increasingly unsuitable for the heavier passenger loadings being experienced on the network prior to their withdrawal in 1991 and 1995.

The 23 B90 vehicles from Bombardier were not only technically superior with increased acceleration, but they also enabled DLR to convert to two-car operation, and were shortly bolstered by an order for 47 near-identical B92 stock vehicles that were built between 1993-95.

Fully automated, the stock quickly established itself as a firm favourite with users, thanks to its capacious interior, large panoramic windows and striking red livery.

By the turn of the millennium there was a requirement for additional capacity as Canary Wharf continued to cement its status as a global financial centre, and an extension was opened to Lewisham in 1999. DLR once again turned to Bombardier for a solution, and 24 vehicles were built between 2001-

2002. Known as B2K, they were an updated version of existing stock.

DLR's fleet was finally brought up to its current level just a few years later, when 24 B07 stock vehicles were ordered in 2005, which was increased by a further 31 vehicles in 2006.

Those vehicles were needed for the network extensions serving London City Airport, Woolwich Arsenal and Stratford International. Meanwhile, the DLR was also being converted to three-car operation ahead of the 2012 Olympic Games, during which the network carried an unprecedented 12 million visitors.

Bombardier's TfL Group Account Director Martin Rennoldson says: "Our relationship with DLR started in the early 1990s when we began delivering the B90 stock, and that relationship has gone from strength to strength to tie in with the dramatic increase in the size of the network.

"We were asked to design something sufficiently robust for this particular environment, which is not really light rail or metro but heavy light rail, and we were given a lot of scope in the interior and exterior design and technical performance in order to meet DLR's business aspirations.

"We like to think that we've played our part in DLR's growth over the last 25 years as its long-term rolling stock partner. It has changed phenomenally in that time, not just in the physical growth of the network but in that part of London, which has been opened up to large-scale development.

"It's helped make Canary Wharf the global financial powerhouse it is now, and connects



Built by Bombardier, DLR 069 approaches West Silvertown on February 20 2015. PAUL BIGLAND.

with Stratford, which was the primary venue of the 2012 Olympics, and is now a key development area. It also serves London City Airport, which is an increasingly attractive airport to fly from."

Demands on the fleet continue to rise with 122 million passenger journeys recorded in 2016-17, a 10% increase from just two years previously. At the same time, reliability remains consistently high, and the moving annual average for fleet reliability (scheduled services that operate) stood at 99.2% at the end of June.

The stock is maintained by DLR operator Keolis Amey, but Bombardier provides technical assistance and supplies spares. This hard-working fleet sustains an impressive performance, more than 25 years since the first vehicles emerged from Bombardier's Derby Litchurch Lane facility.

The company is now hoping that this means it will be well-placed to fulfil the next order for DLR rolling stock, as was confirmed in the Mayor of London's draft Transport Strategy published in June.

It stipulates that 43 new vehicles are needed from 2022 to enable 33 of the oldest B90/92 vehicles to be withdrawn, and to strengthen services across the Royal Docks area where 25,000 new homes and 60,000

new jobs are planned.

Although the new trains will be the same length as existing two and three-car trains, they will be run in fixed formation and feature walk-through carriages to add 30% capacity, resembling the 192 S-Stock trains built by Bombardier for London Underground's sub-surface lines between 2009-17.

The new trains will have air-conditioning, power sockets for mobile devices and onboard real-time information, while Bexton Depot will be expanded to accommodate them.

Transport for London has also indicated that it will seek improved reliability by specifying a mean distance of 50,000km between service-affecting failures, while any new stock will be powered by the network's 750V DC third rail and have automatic operation technology compatible with DLR's moving block signalling system.

An Invitation to Tender is expected to be issued later this year, and a winning bidder announced in 2018.

Bombardier should be in strong contention, as Rennoldson points to the intimate knowledge that its designers already possess of DLR from winning previous bids, and designing rolling stock that fulfils the network's unique requirements.

This has bred a familiarity with the demanding performance required from rolling stock on track well known for its weight restrictions, extremely tight curve radii and inclines as steep as 1-in-6.

Rennoldson adds: "We have always been aware of these challenges and can bring our previous experience to bear - and our unique insights. We understand DLR in terms of its standards and procedures and its demands in reliability and acceptance standards. TfL certainly set the standards very high.

"There's nothing else like the DLR in the UK, and when we built the '92s' they were very much a bespoke solution. It's a special case and you have to get to know DLR quite well to really understand its requirements."

Should Bombardier be tasked with delivering the next generation of DLR rolling stock, it will be just the latest in a long production line of trains it has built, or is building, for the wider London area in recent years, and on networks which face a similar capacity challenge.

As well as building the S-Stock for London Underground, the firm is building 70 Class 345 Aventras for Crossrail, with the first entering service between Liverpool Street and Shenfield in June. It also has a fleet of 45 Class 710 Aventras under construction for

London Overground.

Looking to the future, Bombardier has entered into a joint venture with Hitachi to bid for the Deep Tube Upgrade Programme, due to be awarded next May, as well as entering into the pre-qualification process for the DLR rolling stock replacement project.

Rennoldson concludes: "The existing DLR stock is iconic in its own right, but there's room to bring it more into the 21st century and to emulate that ride comfort, capacity and interior ambience of newer trains we have built for London, such as the S-Stock.

"We need to focus on reliability, but also build on ridership, internal capacity and ambience so it's still an attractive and comfortable environment to travel in.

"I know DLR anticipates ridership to level off a bit when Crossrail opens [to Abbey Wood and Shenfield in December 2018], but then rise again strongly, so it needs to make sure that every square centimetre of its new rolling stock is used intelligently and effectively, while integrating with the rest of the TfL network.

"Since 1992, we've been delivering about 20 trains a year on average for TfL. It is one of our top ten global customers, and we'd like to maintain that with a strong UK-based approach." ■



“It's a special case and you have to get to know DLR quite well to really understand its requirements.”

Martin Rennoldson,
TfL Group Account Director, Bombardier

A VERY COMPATIBLE UPGRADE

Siemens Rail Automation's Delivery Director for Mass Transit and International ADRIAN STUBBS gives PAUL STEPHEN the lowdown on how Siemens helped transform London Underground's Victoria Line into one of the highest-capacity lines in Europe



On May 22, London Underground introduced its highest ever frequency timetable, with 36 trains per hour (tph) timetabled on the Victoria Line during peak hours. This equates to one train calling at each station every 100 seconds, enabling 3,000 more passengers to travel each hour at peak times. The introduction of this new timetable crowned the end of an ambitious £10 billion upgrade programme, work on which began in 2003 to deliver extra capacity and efficiency to the then 35-year-old line.

As part of the upgrade programme, the Victoria Line's entire signalling system was replaced and a new fleet of trains introduced for the benefit of the 200 million passengers who currently use it each year. Siemens was appointed to re-signal and re-control the 13-mile line, and to carry out a carefully planned and phased migration from the old Automatic Train Operation (ATO) system installed in the 1960s. This added to the complexity of the programme, with the new system having to be installed with the old one still in situ in

order to facilitate the gradual replacement of the rolling stock fleet without causing any disruption to normal running. Says Stubbs: "Bringing the line up to the excellent standard it is now, with 36tph operation, certainly wasn't easy. But the programme demonstrated the vast experience that we have as a business - not only of signalling new greenfield lines such as on the Crossrail project, but also resignalling pre-existing and challenging brownfield sites such as this." While maintaining performance

throughout, Siemens was involved in every element of resignalling the railway, providing its ATO and Automatic Train Protection (ATP) technology, in conjunction with radio-based signalling, in what is believed to be the world's first ATO-on-ATO upgrade. These new systems were overlaid onto the existing signalling, largely during night-time possessions, every one of which was successfully completed on time. As a result, the first new train entered operational service in July 2009, three years

The Victoria Line has employed Automatic Train Operation technology since it opened in 1968. This has now been completely renewed by Siemens to facilitate an increased frequency of up to 36 trains per hour. JACK BOSKETT/RAIL.

ahead of the final project completion. As the new trains progressively came into service, the existing and new systems operated together until the last of the 1967-Stock trains made its final journey on June 30 2011. During the mixed-fleet phase, the new signalling control centre at Osborne House in London was also opened and entered operation, taking control of the legacy interlockings. The next stage of the programme featured the complete phasing out of the old system. This involved stripping out the entire legacy system's infrastructure and installing new signals, track circuits and platform equipment. Through a series of key commissionings, the new system was fully introduced - increasing the service from 28tph to 33tph. A key milestone for the programme was the London Olympic Games in July 2012, with the programme planned to ensure an optimum and reliable service was provided to support the Games.

London Underground then initiated the Victoria Line Upgrade 2 (VLU2) project as part of its further capacity improvement programme, with the five-year programme involving extensive signalling, rolling stock, power, cooling and infrastructure upgrades. During the final stage, Siemens upgraded signalling and rolling stock systems to reflect the extensive VLU2 infrastructure changes, with comprehensive installation, testing, principles testing and test-train running successfully completed. Says Stubbs: "We had 23 short commissionings as part of VLU2 in a 12-month period, culminating in a closure at Easter 2017 to update the train fleet. It was an intense programme of work, but these are the sort of challenges we enjoy and rise to. It's not in the nature of our business to shy away from these more difficult projects."

Stubbs also applauds the collaborative approach that Transport for London (TfL) and London Underground took with Siemens throughout both upgrade programmes, which he says heavily contributed to the seamless introduction of the new control systems. "Our two organisation's delivery teams

collaborated extremely closely throughout the project, effectively working as a single team to deliver the upgrade programmes. Without that level of collaboration, we simply wouldn't have achieved such a successful outcome.

"We've done our utmost to test to extremes the new technology we were installing and to stress-test the software. Of course, we were able to do some of that on a test rig, but there are still limitations with that approach compared with testing on a live railway.

"London Underground recognised this and provided night-time train testing. Obviously, during all this, Night Tube for London also started running at weekends, which meant less time for testing because time for regular maintenance now also has to be found during week nights."

With the new system comfortably exceeding expectations, Stubbs says that the next area for Siemens to explore in partnership with TfL is in making optimum use of the data diagnostics generated by the new technology to the benefit of every aspect of London Underground's operations.

He adds: "London Underground already embraces the Digital Railway concept, and the challenge now is how to share information from different systems and different parts of the organisation to maximise the operation and reliability of the railway.

"Recognising the power of joining data to create valuable information, Siemens has developed a powerful solution - Siemens Railigent - which does just that.

"Along with much of the industry supply chain, we are also working very closely with Network Rail on its Digital Railway strategy, with our Digital Railway Operations Director Mark Ferrer engaging with David Waboso [Network Rail's Digital Railway managing director] and his team to share expertise and ideas to support the overall future strategy.

"We're learning a lot from our digital signalling work on the Thameslink programme, which will again be a technological first for the industry, with the project demonstrating not only how we can add value in congested areas of the network, but also how the cost-to-benefit ratios might work on the wider network."

Stubbs concludes: "This is an exciting time for the industry in general and for Siemens in particular, as we work collaboratively with operators to address the ever-increasing demands on our railways and to look at holistic solutions that use technology to maximum advantage." ■



“It's not in the nature of our business to shy away from these more difficult projects.”

Adrian Stubbs, Delivery Director for Mass Transit and International, Siemens Rail Automation

At the root of regeneration

PAUL STEPHEN is given rare access to the tunnel face during excavations for London Underground's Northern Line Extension

All RAIL photography: **PAUL STEPHEN**

For visitors to the Northern Line Extension's main works site on Battersea Park Road, it's difficult to know where to look.

With the great looming hulk of Battersea Power Station rising majestically above a crane-laden skyscape, there's abundant evidence in all directions of the huge regeneration project currently being undertaken in Battersea, and the neighbouring districts of Nine Elms and Vauxhall.

The area has become home to an emerging diplomatic quarter in which a large new American Embassy approaches completion, while the famous Grade 2-listed power station is itself subject to a £9 billion conversion to residential and office use, more than 30 years since its generators fell silent for the final time.





1

1. A high angle conveyor belt rises out of the launch shaft to take more than 300,000 tonnes of excavated earth to barges on the River Thames. Its final destination is Goshems Farm, near East Tilbury in Essex.

2. The trailing end of one of NLE's 100m TBMs. The machines will be extracted once their job is complete and sold back to French manufacturer NFM Technologies for redeployment on another project.

3. The TBMs are kept supplied with precast concrete segments by a fleet of six locomotives that run on 2ft 6in-gauge track.

4. Excavation continues for Battersea station box where fit-out will begin in 2019 ahead of completion a year later. The running tunnels will extend for another 20m or so beyond the station box and up to the boundary of Battersea Dogs and Cats Home in the distance.

3

5. Inside the NLE's northern tunnel. The large yellow pipe is for ventilation. To its right is a conveyor belt to remove spoil while, to the left, are pipes bringing clean water to the TBM and removing dirty water to the surface. A mixing agent is also piped to the TBM which is mixed with the soil to make it more workable and easier to excavate while the cable carries an 11,000V electricity supply. A laser reflector can also be seen on the right-hand wall of the tunnel for engineers to accurately keep the TBM on course.

6. TfL calculates that removing 300,000 tonnes of spoil from the NLE excavations by barge will eliminate 40,000 lorry journeys. Each barge can transport 1,600 tonnes of material. TRANSPORT FOR LONDON.

4

“ Nearby construction projects restrict FLO to relying on Just-In-Time delivery of material.”

Surrounded by construction on a scale not seen in the Capital since the build-up to the 2012 Olympic Games, RAIL forgets for a moment that it is here to look at developments below the ground, not above. That is because underpinning the gentrification of this post-industrial landscape is a £1.2bn extension of the London Underground's Northern Line, due for completion by 2020.

Rubber-stamped by the coalition Government in 2014, progress has been swift in actualising plans for the 3.2km extension between Battersea and Kennington - the southern interchange for the Northern Line's Bank and Charing Cross branches.

An innovative funding formula was also found that requires Transport for London to foot much of the bill up-front through loans that will be largely repaid through contributions from local developers. It's another example of a growing trend - of making those who commercially benefit most from infrastructure investment pay a proportionate share of the costs.

A joint venture comprising Ferrovial Agroman and Laing O'Rourke (FLO) was duly handed the main contract to bore twin running tunnels and build new stations at Battersea and Nine Elms. Ventilation shafts will also need to be constructed at both Kennington Park and Kennington Green.

Having mobilised its main works site in Battersea, the FLO's two tunnel boring machines (TBMs) were lowered into a 20m-deep launch shaft in April to begin their subterranean journeys to Kennington in the east.

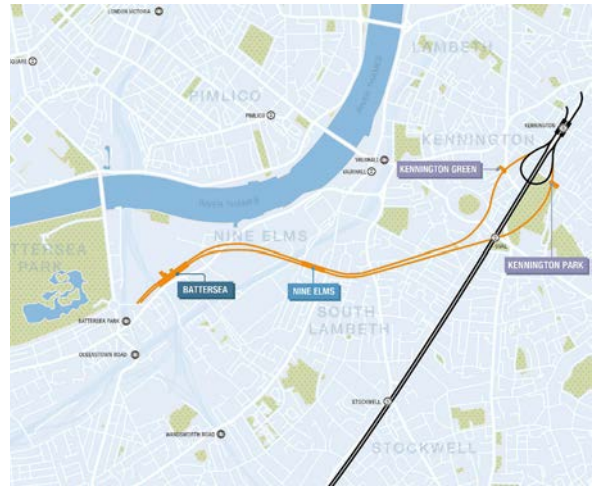
During RAIL's visit on July 19, the launch shaft was a hive of activity to support the TBMs, which had already tunnelled approximately 1km and were closing in on the site of the station box being excavated to eventually host Nine Elms station.

In time-honoured tradition, both TBMs had also been officially named and they are Amy (after aviation pioneer Amy Johnson) and Helen (after British astronaut Helen Sharman) as the result of a competition held with local schools.

Surrounding the launch shaft are hundreds of precast concrete segments used for lining the tunnels, while a high-angle conveyor emerges from its depths to bring spoil to the surface. The material will be transported down the Thames by barges to a site in Essex, where it will be used to create arable farmland.

RAIL's guide, Jonathan Cooper, is

THE NLE ROUTE



Source: Transport for London.

► project manager for the tunnels, and estimates that of the 20,000 precast concrete segments required for the entire project, there are only enough to support two to three days of tunnelling on site at any one time. This is because the size of the worksite and the competing demands of other nearby construction projects restricts FLO to relying on Just-In-Time delivery of material.

The worksite is split roughly into two halves, because immediately adjacent to the launch shaft is Battersea Station box, which

is being built from the top down. A vast concrete raft has already been laid which will eventually bear the weight of oversite development, while earth is dug out from around it. The construction schedule also means that tunnelling takes place before the station boxes are excavated to the same depth, unlike Crossrail, where the station boxes were built first, in advance of the TBMs reaching them.

Entering the northernmost of the two tunnels, Cooper explains that the

100m-long TBMs can advance at a rate of 30m a day. This includes the installation of approximately 20 1.5m-wide concrete-lined rings.

Each complete ring is made up of five precast concrete segments - it takes approximately 30 minutes to excavate the earth and another 20 minutes to construct each one.

The TVM is operated by about 15 people working three shifts every 24 hours, and it excavates the tunnel bore to a diameter of 6m, which is reduced to 5.7m after the rings are put in place and backfilled with grout.

This makes the tunnels slightly narrower than Crossrail, but wider than the rest of the Northern Line, with room for an escape walkway.

Although the route of the tunnels has been carefully mapped, Cooper says that vibration levels from the TBMs are continually monitored given the proximity of a large number of Victorian and Georgian terraced houses, and both the Northern and Victoria lines near Kennington.

FLO has an added advantage, in that the tunnelling teams for Crossrail encountered similar geological conditions between 2012-2015, and have been able to share that knowledge. Should Crossrail 2 be given the go-ahead to open as planned in 2033, then that process will continue, potentially keeping Cooper and his team busy underground for many years to come.

He says: "We're mainly digging through London clay, which is a really good tunnelling medium as it's quite easy to control. But there are other hazards like critical utilities, and we pass right under Oval station, so we're carrying out a lot of monitoring in anticipation of that, and so we stay within our agreed tolerances."

"We've learned a lot of lessons from Crossrail, however, and we're building on that best practice. A lot of the people here have worked on Crossrail and these TBMs have been designed using knowledge of how the Crossrail TBMs behaved." ■



“ We’re mainly digging through London clay, which is a really good tunnelling medium as it’s quite easy to control.”

Jonathan Cooper, Project Manager for tunnels, TfL