



A virtual representation of the future Coventry railway station, complete with VLR connection. Coventry CC

VLR: COVENTRY'S VISION FOR FUTURE MOBILITY

Nicola Small of Coventry City Council and Dr Nick Mallinson of WMG update *TAUT* on the latest progress with the UK city's radical new lightweight urban rail concept.

Imagine a city where residents, workers and tourists alike have a number of attractive, emissions-free and sustainable transport options, all connected within a network that allows for seamless door-to-door journeys. E-bikes and scooters, electric taxis, autonomous pods and urban rail solutions all offer improved alternatives to private car usage, encouraging modal shift and new travel behaviours.

This vision is being embraced by the 2021 UK City of Culture, Coventry, seeking to build upon its proud heritage of innovative transport solutions by creating a new model of mobility. At its heart, Coventry City Council (CCC) is developing a new, affordable, environmentally-friendly concept in urban mass transit – Very Light Rail (VLR). Using proven concepts derived from world-beating local automotive expertise, allied to cutting-edge materials and construction methodologies, the city's VLR pilot seeks to establish the wider West Midlands within which it sits as a centre of excellence for Very Light Rail design and manufacture.

It is envisaged that this 'new industry' will utilise a regional supply chain to create jobs and prosperity, while at the same time having the potential to revolutionise urban mass transit for smaller cities and towns who may currently struggle to make the business case stack up for a traditional LRT system with its average costs of upwards of GBP25m/km (EUR27.5m/km).

Although the genesis of VLR dates back to early 2000, it now sits within a wider regional framework as the West Midlands

was named as the UK's first 'Future Transport Zone' in October 2018. This title came with GBP20m (EUR22m) in funding for the West Midlands Combined Authority (WMCA) and its transport arm Transport for West Midlands (TfWM) to develop innovative new solutions to make journeys quicker, cheaper and more environmentally-friendly.

The VLR R&D programme is being funded jointly by the WMCA and the Coventry and Warwickshire Local Enterprise Partnership (CWLEP) with GBP14.6m (EUR16.2m)

“The initial proposed route serves a key corridor, making VLR an attractive, affordable and accessible option.”

derived from Growth Deal and Devolution Deal sources. On 4 August a further GBP1.8m (EUR2m) in grant funding was confirmed from the UK Government's Get Building Fund. This is part of a wider GBP66m (EUR73.2m) package that is to be shared amongst projects across the West Midlands.

As well as new modal concepts such as VLR, TfWM is working closely with technology providers to trial new ideas such as Mobility as a Service, car sharing programmes, e-bike and scooter initiatives, as well as using advanced data analytics to reduce congestion on the region's roads.

The importance of collaboration

Analysis of existing policy, plans, and strategies has demonstrated that the introduction of VLR in Coventry (population 365 000) will help to deliver several critical policy objectives.

A number of challenges have been identified that are holding back the city's potential. Like most cities in the UK, we have a heavy reliance on the private car; prior to this year's COVID-19 pandemic, around two-thirds of work-related journeys in the city were by car, leading to high levels of both road congestion and tailpipe emissions. These problems have contributed to poor air quality in the city and restricted economic development and growth.

Ambitious targets in terms of housing and employment growth are already in place to help the city grow, but without co-development within an integrated transport framework these would add further pressure onto the already congested road network if they were developed in isolation.

Establishing a working partnership with the neighbouring Dudley Metropolitan Borough Council (DMBC), CCC is collaborating with WMG (based at the University of Warwick) and TfWM to establish the West Midlands as a world-class investment location. To fulfil their ambitions, the region requires world-class transportation to maximise its potential, and this is a key driver behind the establishment of a VLR 'backbone' that will dramatically improve urban connectivity, and drive up skill levels through a focus on the development of the associated technologies for future commercialisation.

Some of the city's challenges – and how Urban VLR will help – include:

Challenge 1: Constraining infrastructure in the city centre, leading to congestion and under-capacity on the road network.

Urban VLR solution: Frequent headways, especially during peak times when commuter demand is greatest, and a high quality and highly reliable service, will lead to high passenger confidence and remove the need – and desire – for independent journeys.

Challenge 2: Above average unemployment and areas of high deprivation and inequality (Coventry's unemployment rate was 4.7% in 2019, compared to a UK average of 3.8%).

Urban VLR solution: New development projects and employment sites will emerge along the rapid transit corridor – the 'regeneration effect' – due to the improved connectivity. This is reflected in the Coventry City Council Local Plan (2017) which makes provisions for a minimum of 24 600 additional dwellings between 2011 and 2031.

Such developments will help to make Coventry a more attractive place to live and do business. Proposed growth and employment sites expected to be established by 2031 will benefit directly from VLR connectivity.

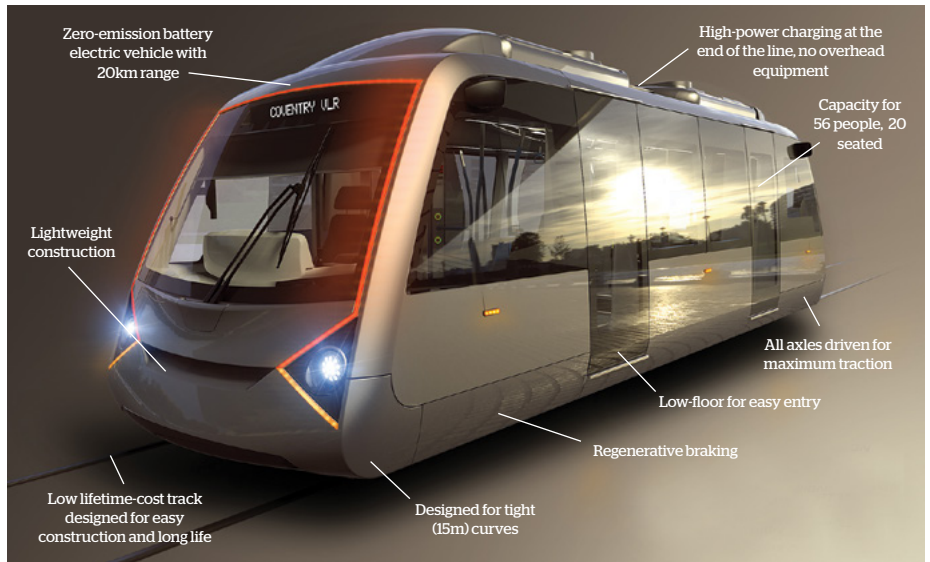
Challenge 3: Poor connectivity between key locations and varying levels of access to a car.

Urban VLR solution: The initial proposed route serves a key city corridor, making VLR an attractive, affordable and fully-accessible option for those with no private means of travel around the city.

Secondly, for those who currently use the highway network to travel within the city, VLR will be an option as part of a full or multi-modal journey. It is also likely that commuters into Coventry by car (31 483)¹ who are also able to use the national rail network will choose to travel to the city by rail and finish their journey via VLR due to its fast and frequent service.

Challenge 4: Poor air quality – and one that is only getting worse.

Urban VLR solution: As we enter a post-COVID world, the need to offer attractive, safe public transport that meets the needs of the 'new normal' whilst addressing the ever-present challenge of climate change will be essential.



▲ ◀ ABOVE and LEFT: The future VLR Shuttle vehicle is being designed, engineered and manufactured within the UK's West Midlands. Courtesy of TDI

Urban VLR has been identified as a significant intervention to combat these issues, at the same time helping to 'future-proof' the city's mobility network.

Environmentally, VLR will improve air quality within the Coventry Air Quality Management Area and assist CCC in achieving its challenging Climate Change and Air Quality targets, due to the expected modal shift from cars which will reduce carbon and other damaging emissions.

Due to its state-of-the-art vehicle technologies and innovative track system, VLR offers a lightweight, rail-based mass transit solution that is relatively simple, quick and cost-effective to construct. The target cost is GBP10m/km (EUR11m/km).

Once proof of concept is achieved, a first route is planned to be built in Coventry. Once proven in service, smaller cities

and towns will have a new, attractive and affordable option for rail-based transit as part of their integrated public transport offer.

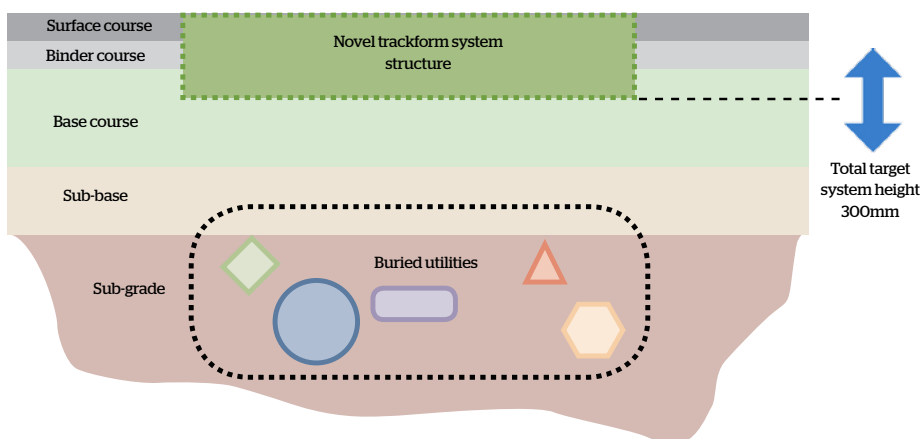
R&D already well underway...

Thanks to the GBP14.6m from CWLEP and WMCA, the R&D phase is well underway.

Engineers from WMG have worked with their subcontractor, Transport Design International, on the design of a battery-powered VLR vehicle, with the first prototype due to be delivered in late 2020 ahead of initial performance trials starting in February 2021. To avoid any confusion with traditional trams, we refer to this as a shuttle.

The longer-term objective is that the shuttle will be autonomous – removing the operational cost of drivers – with the capacity to carry over 50 passengers on a high-quality 'turn up and go' service much like a modern metro, and with reliable journey times competitive to the private car. The vehicle has been designed to be very lightweight using a multi-material approach to achieve a stiff structure at an economic cost. Using a steel chassis, there is widespread use of aluminium components and glass fibre composite panels. The body design is modular to minimise the number of panel types and maximise any economies of scale that can be achieved in manufacture. Onboard battery power coupled with rapid charging removes the need for overhead catenary, which is both costly and unsightly, especially in the historic street environments that remain in Coventry.

In parallel, a R&D programme is underway to deliver a shallow low-cost trackform which can be easily installed into the city's roads. WMG is working with CCC and French civil engineering company Ingerop Conseil et Ingénierie to deliver this novel track solution; ▶



▲ ABOVE: A simplified side profile of the novel trackform, currently under development.

RE-ESTABLISHING A PROUD HERITAGE

Coventry operated steam-powered double-deck trams on a 3ft 6in-gauge system from 1884, with electrification coming in 1895. The network grew steadily in the early years of the 20th Century, being taken over by Coventry Corporation on 1 January 1912 and reaching its fullest extent in 1930.

Increasing road congestion saw the tramway shrink route by route from 1932 onwards, although the system's fate was ultimately sealed by the devastating bombing raids of October and November 1940 which made much of the tramway's infrastructure unusable.

The final three routes were formally abandoned in February 1941, with the remaining trams and equipment sold for scrap or to other systems. Motor buses (some of which had to be

hired from other undertakings) were brought in to take over operation of services.

Re-establishing an urban rail service to the city from 2025, the basic principles of the future VLR operation are:

- A five-minute peak frequency
- Service flexibility by running vehicles in multiple
- Junction priority to achieve high commercial speeds
- Reliable journey times which are competitive with the private car
- High quality passenger experience (smooth ride, level boarding access, real-time information and high levels of wireless connectivity).

the ultimate aim being an affordable modular system that can be quickly and easily removed if necessary to allow access to utilities. This will reduce the need for under-street apparatus to be relocated at significant cost (often multi-millions of pounds) during the route's construction; such costs and the associated disruption have proved significant barriers for traditional tramway systems.

The integrated system (vehicle and novel trackform) will be tested at the Dudley Very Light Rail National Innovation Centre (VLRNIC), which is currently under construction and due to formally open in Autumn 2021. However, a 2.7km (1.7-mile) test track is scheduled to be ready for use in January 2021, with testing of the demonstrator vehicle commencing in February 2021 and continuing throughout the year. A prototype of the trackform is planned to be ready for testing in Summer 2022; this will be achieved through the construction of a second test track which will allow the trackform, vehicle performance and integrated testing to be carried out by December 2022.

The VLRNIC is intended to be a one-stop-shop for R&D in VLR technology, working collaboratively with the industry and public sector to deliver low-cost rail solutions relevant to traditional railways and urban tram systems as well as encouraging the development of better connected public transport services.

The VLRNIC will not be connected to the rail network (vehicles will be transported in and out on low-loaders) but it will be adjacent to a West Midlands Metro tramstop when the new route from Wednesbury to Brierley Hill opens, making the centre easily accessible.

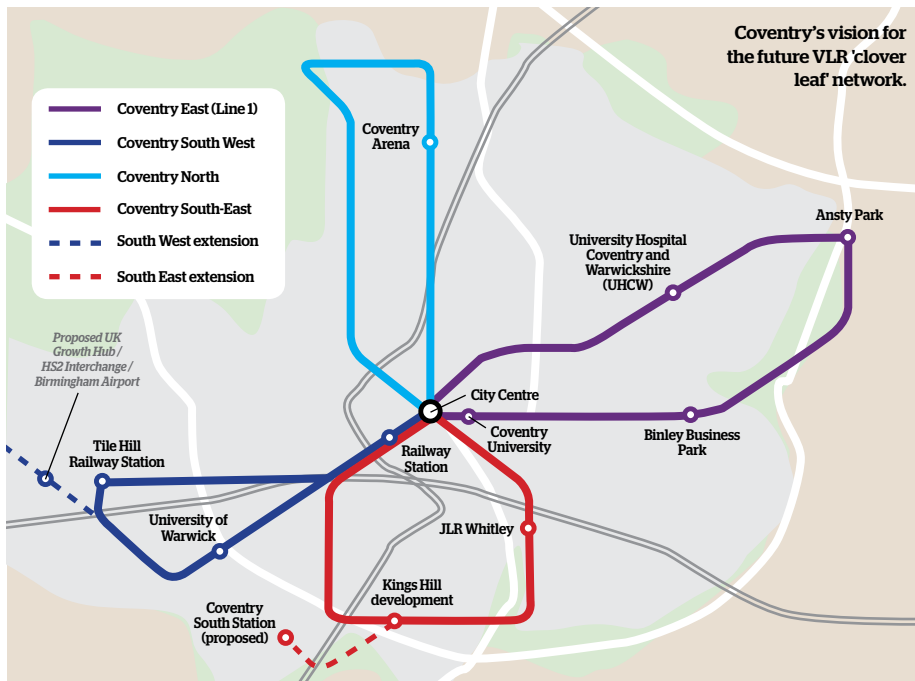
The first route

CCC is working with its framework consultants, WSP, to develop the business case for the first route across Coventry and beyond. A Strategic Outline Business Case is already in place.

The data used by WSP for the assessment included information on the method of journey to work, traffic delay, queuing and bus reliability data. Based upon the queuing assessment, the initial issues identified include:

- High car usage within the city centre
- Lower than national average walking and cycling modal share for short distance trips
- Longer than scheduled journey times during peak periods on public transport corridors into the city from the east and west
- Poor journey time reliability on key corridors such as the Eastern Bypass
- High traffic volumes on the A46, A45, Ring Road and main radial routes into and out of the city
- Housing & employment growth in areas away from key public transport corridors
- Large delays at the UHCW access junction
- The M6 motorway, A429 south and A4600 Ansty Road are forecast to have the largest traffic increases within the study area.

◀ LEFT: Using onboard battery power, rapid charging will take place at the termini using commercially-available chargers developed for electric buses. Courtesy of TDI





▲ ABOVE: The future VLR National Innovation Centre, under construction in Dudley and due to open in late 2021. Courtesy of Dudley Metropolitan Borough Council

The first viable Coventry VLR route therefore aims to provide enhanced connectivity across the city, running for approximately 6.5km (four miles) from the railway station, through the city and out to the University Hospital Coventry and Warwickshire (UHCW). There is further potential to extend to a new park-and-ride site near M6 Junction 2 north east of the city centre.

The University Hospital is a major travel generator, offering a full range of healthcare services and also being a major employer. The city centre includes four large academic institutions, while Coventry's railway station is located to the south of the city centre, providing inter-urban rail connectivity to key national cities, such as London and Birmingham. Along the route there is a range of major employers and business sites, further helping the creation of a robust business case.

Work has just begun on a major GBP82m (EUR91m) project to rebuild Coventry's railway station. One of the fastest growing stations outside London in terms of year-on-year passenger numbers, a new seven-storey station building is under construction between Station Square and Warwick Road. This is planned for completion in Spring 2021 as the city takes on the role of UK City of Culture.

Once finished, the station building will be home to a range of new retail units, waiting

rooms and bathroom facilities, alongside a new 633-space multi-storey car park.

The ultimate goal is to have a series of routes in a 'clover leaf' VLR network that will add further strategic locations such as the large Jaguar Land Rover campus, the University of Warwick, and of course the proposed HS2 interchange near Birmingham Airport.

It is hoped that once proven the system will be made available to other cities. Interest in the project has already been generated, both from within the UK and around the world.

Why VLR?

With passenger demand for a new mass transit corridor established, WSP hosted a collaborative workshop to generate objectives for such a corridor. Following the identification of a range of issues, the potential opportunities to achieve improved transport connectivity were set out.

An Options Appraisal Framework (OAF) was developed, using four assessment stages to identify the best performing options against four specific criteria: WMCA objectives; scheme objectives; deliverability; and location.

This process sifted through a long and diverse list of transport interventions, including Bus Rapid Transit, cycling and walking infrastructure improvements and traffic speed reductions in high accident areas.

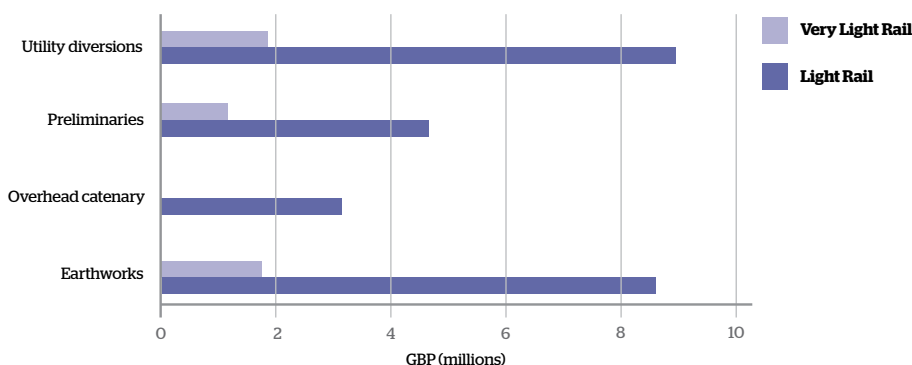
The VLR option performed better than the alternatives on its potential to better connect communities and employment sites along the corridor, along with its political acceptability and contribution to local job creation. Ranking highest overall, it has therefore been taken forward as the preferred solution.

As a new class of rail technology, focused on vehicles which are both lightweight and self-propelled, allied to lighter weight infrastructure, VLR's primary objective is to reduce the cost of light rail systems. Providing a frequent passenger service, it was agreed that smaller vehicles would be appropriate, alongside high-quality modal interchanges.

The shuttle will be 11m long and 2.65m-wide, meaning it would be able to operate on the West Midlands Metro network in the future, with a maximum laden axle weight of 3 tonnes and weighing just one tonne per linear metre. This allows for a lightweight shallow trackform to create an affordable integrated system. One challenge for the trackform will be to also withstand the high axle loads of Heavy Goods Vehicle loads – this and the utilities issue form the crux of the current R&D programme.

Given our likely 'new normal', the team needs to ensure that VLR offers a contactless transport choice, using materials that do not hold bacteria or microbes, allowing airflow within the vehicle to minimise the risk of infection, and autonomy, to enable larger fleets to operate to reduce crowding.

With the significant investment in the VLRNIC, all future technologies can be developed, designed and tested in the heart of the West Midlands, retaining know-how and creating future jobs in the region. **TAUT**



▲ ABOVE: Cost comparison of VLR and traditional LRT per km. Courtesy of RLB (quantity surveyors)

REFERENCES

1 – 2016 West Midlands Travel Trends