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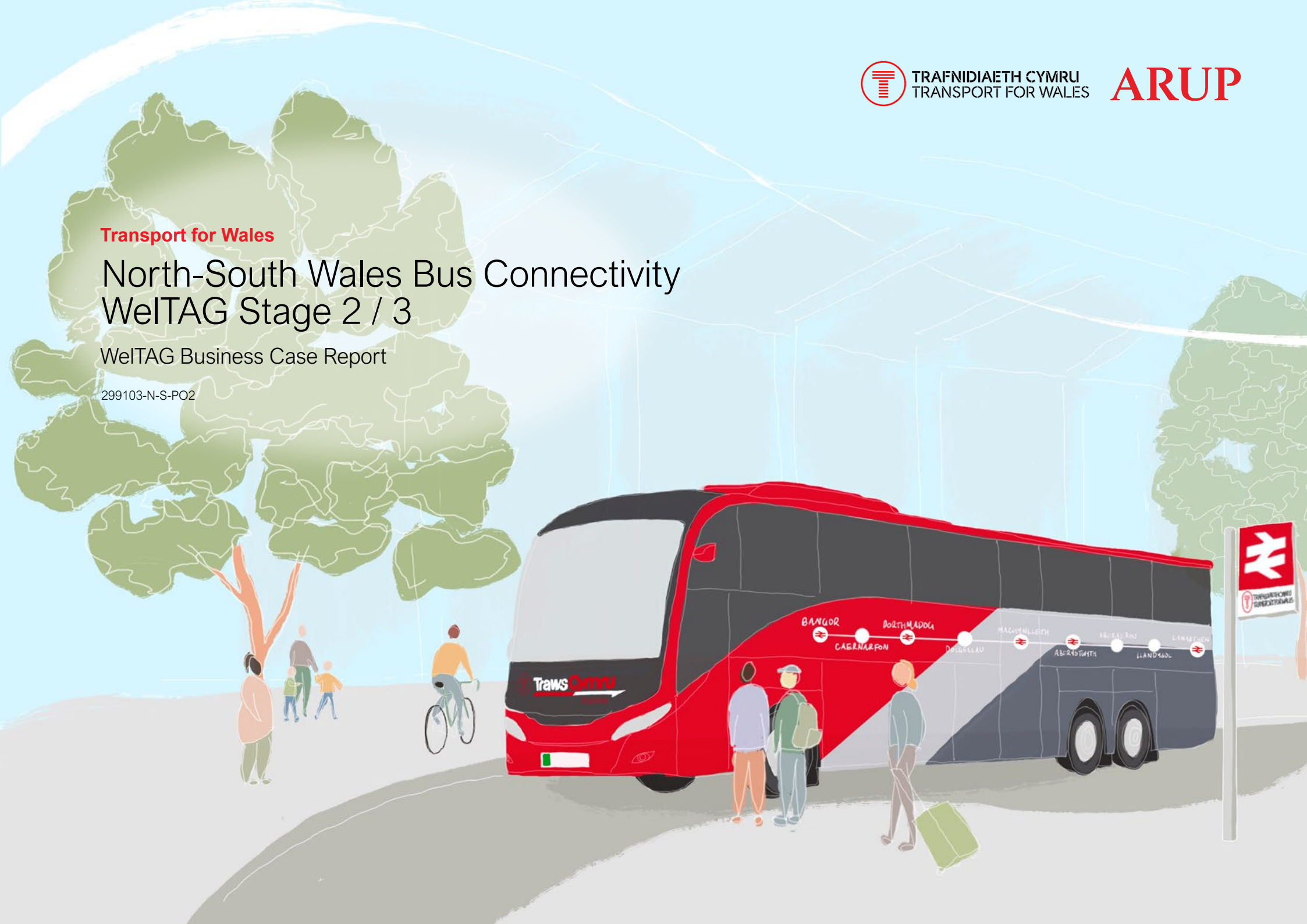
Transport for Wales

North-South Wales Bus Connectivity WelTAG Stage 2 / 3

WelTAG Business Case Report

299103-N-S-PO2



Executive Summary

Improving public transport connectivity between North and South Wales is a headline WG ambition

As outlined in the Co-operation Agreement 2021, this will support transition to a greener Wales to tackle the climate change and nature emergency. There is currently no direct rail connection, and a TfW study recently concluded that end-to-end rail infrastructure is not feasible in the short term.

Whilst existing TrawsCymru services are, and will continue to be, strategically important components of the bus network in Wales, they are almost exclusively used for short trips (less than 1 hour). Frequent stopping patterns mean that journey times are not competitive with car over longer distances, and current vehicles do not have facilities that passengers require over longer distances (toilets, reclining seats, luggage storage etc).

Transport Mode	Typical Journey Time
Car	~3.5 hours – 4 hours
Existing T1/T2 Bus	6 hours 20 minutes
Rail (via Shrewsbury)	6 hours 20 minutes
TrawsCymru Express	4 hour 45 minutes

A new express coach service should be established between Bangor and Carmarthen, cutting around 90 minutes from current end-to-end bus/rail journey time

This is the key conclusion of this study which considers improvements to bus connectivity. It is suggested that the service should aim to replicate a rail level of service to enhance connectivity within Wales' multi-modal, integrated transport system.

Whilst public transport demand on the corridor is currently low, there is scope to enhance frequency to correspond with increased public transport mode share in line with Llwybr Newydd aspirations, which could potentially support the case for enhancing rail infrastructure over the longer term.

Development of this WelTAG Stage 2/3 business case identifies a good case for this investment

The challenging funding context and reduction in spending power is acknowledged. However, the proposed solution, including operationally is very low by comparison with alternative rail infrastructure options.

A high-quality electric bus could support other Welsh Government priorities, and low-carbon tourism. Two key user groups have been identified for an improved transport service:

Tourism: Only 4% of visitors to Wales currently travel by bus or coach. Improving public transport connectivity to key tourist destinations, such as Eryri National Park and the mixture of coastal routes and views of Yr Wyddfa, the Llyn Peninsula and Cardigan Bay offer opportunities to increase sustainable tourism, and opportunities for marketing the service to increase demand.

University Students: The service could also address accommodation and post-COVID engagement challenges for universities in Wales while providing faster, more cost-effective travel options and affordable fares for students.

Ending of the Welsh Government's Co-operation Agreement with Plaid Cymru represents a key risk

The Co-operation Agreement, which ended in May 2024 has been a key driver of this study. The Deliverability Dimension identifies that shortlisted options can be delivered in the short term, demonstrating good opportunity for improvements by the end of the current Senedd term (understood to be 2026) and provides an indicative view of the likely involvement of different parties in delivery of interventions if typical processes are followed.

Next steps to complete the full business case involve the confirmation of funding availability with Welsh Government, public consultation, procurement investigation (to establish tender documentation, detailed costs, and lead times for vehicles) and additional design of supporting infrastructure and electricity grid upgrades (linked to wider bus franchising depot strategy). These next steps should be expedited to facilitate delivery of the service, alongside supporting digital marketing and social media campaigns and development of a monitoring and evaluation framework.

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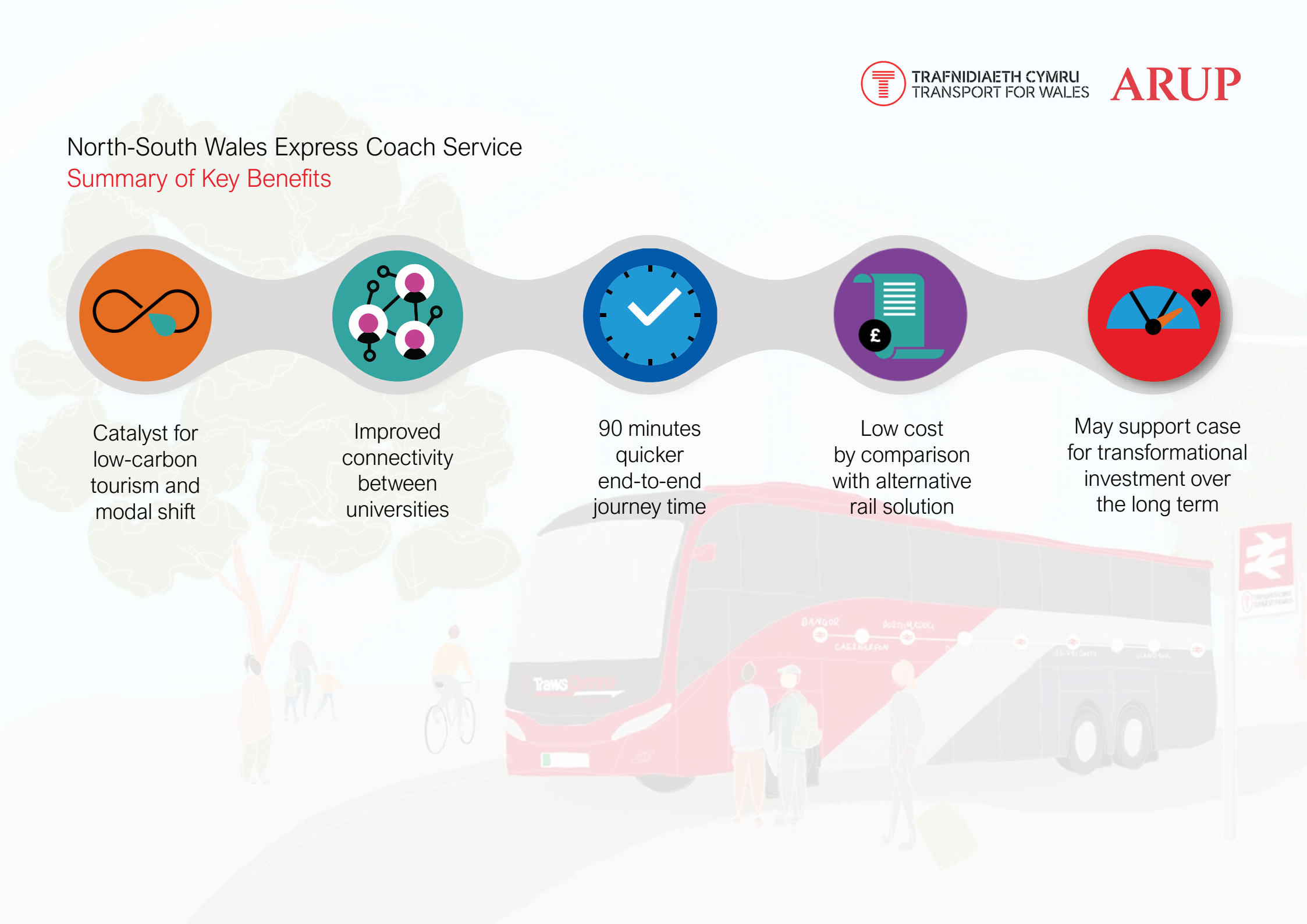
North-South Wales Express Coach Service

Summary of Key Benefits

- Catalyst for low-carbon tourism and modal shift
- Improved connectivity between universities
- 90 minutes quicker end-to-end journey time
- Low cost by comparison with alternative rail solution
- May support case for transformational investment over the long term



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Disclaimer

Due to the high-level nature of the study and time limitation, our quantitative values in this report are indicative and accordingly, no representation or warranty of any kind (whether expressed or implied) will be given by Arup as to the accuracy of the outputs. Arup will accept no liability of any kind and disclaim no responsibility for the consequences of any person acting or refraining from acting in reliance on the outputs of this study for any decisions made or not made which are based upon the outputs.

Contents

1. Introduction

1. Introduction

This study considers the case for an express coach service to improve bus connectivity between North and South Wales

1.1 Study Overview

Ove Arup and Partners Ltd (Arup) have been commissioned by Transport for Wales (TfW) to undertake a Welsh Transport Appraisal Guidance (WelTAG) Stage Two / Three study considering the design and delivery of an express coach service to improve connectivity between North and South Wales, along the west coast between Bangor and Carmarthen via Aberystwyth and Llandysul.

The aspiration for improving public transport options on the corridor is outlined in the Co-operation Agreement 2021 between Welsh Government and Plaid Cymru, which asked TfW *to explore the development of transport links between North and South Wales, including how to protect potential travel corridors on the west coast of Wales. [Note: The Welsh Government's Co-operation Agreement with Plaid Cymru ended in May 2024]*

Whilst there are ambitions of restoring former railway services along the corridor a WelTAG Stage One study undertaken by WSP (September 2022) concluded that the introduction of end-to-end schemes for rail would be very challenging due to the costs associated with rail infrastructure and overall distance requirement. That said, this study is part of a wider programme of work by TfW which is considering options to protect former railway alignments for future development.

The preference to deliver a coach service using this corridor was established within the previous WelTAG Stage Two study which considered a range of service, infrastructure and interchange interventions for improving North-South bus connectivity, including improvement to existing TrawsCymru services.

Frequent stopping patterns of existing TrawsCymru mean that journey times are not competitive with car over longer distances, and on-board facilities are not suitable for passengers travelling longer distances (e.g. availability of on-board toilets). WelTAG Stage Two concluded that the service offering for longer-distance travel could be improved with an express coach type service, more akin to rail services, which may help build demand for rail corridors over the long term.

This study develops a detailed case for the proposed service, considering an express coach services' ability to replicate a rail service by focusing on its integration with the wider rail network. The study seeks also explores synergies with TfW / WG's wider bus franchising plans including the potential short-term use of electric bus vehicles ultimately destined for operation on local bus services, and synergies in the co-location of depots / DNO connections for the proposed coach service and local services.

Customer experience has been put at the heart of the proposed service design, with the recommendations of this report informed by consideration of key user groups (e.g. tourism and university students) supported by targeted engagement with representative bodies through the WelTAG Review Group.

The remainder of the report is structured as follows:

- Section 2 summarises the *Strategic Fit*, considering the case for change and fit with policy, largely completed within the previous stage;
- Section 3 summarises option development in relation to the route design;
- Section 4 considers the service design options, focusing on journey time, service frequency and integration with rail services in particular;
- Section 5 provides an overview of possible vehicles that could be procured to support the route including supporting infrastructure;
- Section 6 provides an overview of the *Well-being Dimension*, including a summary of the Integrated Well-being Appraisal to narrow down options;
- Section 7 presents the *Affordability Dimension* of the business case, highlighting whether an express coach service represents good public value for money;
- Section 8 considers the *Deliverability Dimension* of proposed interventions including an envisaged procurement strategy, and risk management;
- Section 9 develops the *Management Dimension*, considering the implementation programme and approach to monitoring and evaluation; and
- Section 10 provides a summary of the recommendations and next steps.

1. Introduction

Critical Success Factors (CSFs) have been developed to inform option development and shortlisting ahead of the well-being appraisal

1.2 Option Development and Appraisal Methodology

The following is a list outlining the option development and appraisal process undertaken for this WelTAG study.

1. *Strategic Fit Review and Validation*
    - Review and validation of Strategic Fit developed at WelTAG Stage 2
    - Confirm WelTAG objectives
    - Identify key user groups for proposed service

2. *Option Development and Initial Appraisal*
    - Identify Critical Success Factors (CSFs) to inform Service Design, Route Design and Vehicle and Supporting Infrastructure option development
    - Initial appraisal against CSFs to identify shortlisted

3. *Well-being Appraisal*
    - Shortlisted options assessed against the four WTS well-being ambitions
    - Preferred option selected
    - Check and challenge workshop to identify any gaps and alignment with WelTAG objectives

4. *Affordability, Deliverability and Management Dimensions*
    - Affordability, Deliverability and Management dimensions developed for the preferred option
    - Implementation roadmap identified to aid decision making by TfW and Welsh Government

1. Introduction

This study provides decision makers with an evidence base for selection of a final option toward full implementation of the service

1.3 WelTAG 2024 Guidance

This report has been prepared using WelTAG 2024 guidance, published in February. The following 10 key points were published alongside the updated guidance:

1. WelTAG should be firmly focused on achieving WTS outcomes including modal shift.
2. WelTAG reports should not be overly long documents written solely by consultants.
3. Evidence of clear outcome-focused thinking.
4. Use of innovative approaches and technology in both developing and implementing projects.
5. Draw on existing analysis and plans, including the work of the Transport for Wales (TfW) Geospatial and Strategic Transport Analysis unit (G-STAT).
6. A proportional approach should be taken to WelTAG studies.
7. The five ways of working set out in the Well-being of Future Generations (Wales) Act 2015 including involving people should be followed.
8. Use of quantitative and qualitative evidence should be provided, even if BCRs are not.
9. Disincentives for car use as well as incentives for sustainable travel should be considered.
10. Well-being should be embedded in the design of the project, not a bolt on at the end.

WelTAG stage terminology used in this report

As a follow on from a WelTAG Stage 2 project, this study would typically be titled a WelTAG Stage 3 Full Business Case. However, during the study, several factors have required revisiting and reconsideration of options discounted at the previous stage, additional option development and option appraisal work rather than a straightforward reliance on the preferred option taken forward from Stage 2.

Whilst ambiguity over the project stages is not in line with TfW Better Business Cases best practice, WelTAG 2024 sets out the following reasoning to avoid pressing on without sufficient reconsideration of conclusions of the previous stage: *Where the change in circumstances presents a significant risk to the success of the project, it may be necessary to rethink the programme or project. In this case, do not be afraid to go back a step. This might involve simply revisiting some earlier assumptions, rethinking some options or even revisiting the case for change* (WelTAG 2024 Guidance p.35).

The following are contributory factors in the need to reconsider the conclusions of the WelTAG Stage 2 report:

- Publication of WelTAG 2024 guidance.
- Changes in Welsh Government affordability context, and comments made by key stakeholders within the Review Group.
- Rapid development of zero-emission (electric and hydrogen) coach technology in the UK and globally, meaning that additional vehicle options have been identified.
- Publication of WG Roadmap to Bus Reform in March 2024 and complexity of incorporating the proposed service within, and synergies with wider franchising plans.
- Implementation of default 20 mph speed limits, which have impacted the journey time analysis undertaken at WelTAG Stage 2 and associated implications for compliance with driver time regulations and Peak Vehicle Requirements.

As such, the current stage of study does not represent design of a single option (Full Business Case) and is thus titled 'WelTAG Stage 2 / 3'.

This is consistent with the conclusions of the Review Group that the study should provide decision makers with an evidence base, costs and justification for selection of a final option, which may include a roadmap toward full implementation of the proposed service over time.

Table 1.1 overleaf provides a checklist summary of WelTAG 2 & 3 elements considered complete and requiring further updates for service design and infrastructure measured (e.g. depot infrastructure, Dolgellau Interchange).

Table 1.1: WelTAG 2 & 3 Checklist Summary

WelTAG Stages	TfW Plan of Work	WelTAG Checklist / Key Requirements	Service Design	Infra. Measures
Stage 2	Stage B	Narrow down of options from long list to short list of options using all dimensions. Assessment of shortlisted options against scheme objectives	Yes	Yes
Stage 2	Stage B	Five ways of working demonstrated in the business case	Yes	Yes
Stage 2	Stage B	Consideration of behavioural change as well as new services and infrastructure	Yes	Yes
Stage 2	Stage B	Evidence of public engagement in line with engagement plan	No	No
Stage 2	Stage B	Consideration of future information/work required for Stage 3	Yes	Yes
Stage 2	Stage B	Determined if future project will need planning consent and /or Statutory Orders and if so, is that work underway	Yes	Yes
Stage 2	Stage B	Updated high-level procurement strategy	Yes	Yes
Stage 2	Stage B	High-level risk register	Yes	Yes
Stage 3	Stage C and D	Overall description of the project (incl. programme/timetable, specifications and standards) that describes work packages and outcomes	Yes	Yes
Stage 3	Stage C and D	Project is justified, work packages match outcome, strategic fit, well-being contribution and affordability are clear. Team confident of deliverability	Yes	Yes
Stage 3	Stage C and D	Statutory impact assessments completed. Stage 2 RSA undertaken. Consideration of need for formal consultation made	Yes	No
Stage 3	Stage C and D	Preferred option developed into concept design that meets agreed quality criteria. Service standards (e.g. KPIs) developed where applicable	Yes	Yes
Stage 3	Stage C and D	Public engagements completed to confirm concept design (including input from groups/representatives with protected characteristics)	No	No
Stage 3	Stage C and D	Routes to obtaining statutory consents, regulatory approvals and other necessary permissions established/initiated	Yes	No
Stage 3	Stage C and D	IWBA completed, findings support business case, detail provided in supporting annexes	Yes	No
Stage 3	Stage C and D	Updated final, detailed, monitoring and evaluation plan, costings (incl. budget quotations) and risk register	No	No
Stage 3	Stage C and D	Detailed procurement strategy prepared including tender documents, funding routes secured. Ready for implementation	No	No

1. Introduction

TrawsCymru services are strategically important, but do not offer a compelling alternative to car over long distances

1.4 Historic Context

Closure of Historic Railway Lines

Historic railway routes are shown in Figure 1.1. The Carnavonshire Railway (between Bangor and Afon Wen) and the, Carmarthen to Aberystwyth line were closed as part of the Beeching cuts in the 1960s. The lines that strengthened West-East connectivity between Wales and England were prioritised based on higher levels of demand and profitability.

TrawsCambria

TrawsCambria started in 1979 as an experimental coach service route between Cardiff and Bangor on weekdays operated by Crosville and National Welsh.

In 1980, the service ran daily and was joined by a Cardiff-Llandudno and Cardiff-Wrexham service. In the late 1980s, TrawsCambria ran daily to Anglesey and Bristol. Cutbacks followed privatisation of the National Bus Company subsidiaries. In the 1990s, Crosville continued to run the service jointly with Rhondda Transport, with the main route uniquely linking all the Welsh universities: Glamorgan, Cardiff, Swansea, Lampeter, Aberystwyth and Bangor.

By 2000, Crosville passed to Arriva Group and Rhondda Transport passed to Stagecoach Group, as the network became one coach route linking Holyhead and Bristol. The TrawsCambria name was used for the 701 coach route, linking Holyhead and Bristol via Dolgellau, Aberystwyth, Carmarthen and Cardiff. This route was modified in the early 2000s, with the northern terminus changed to Llandudno and withdrawal of the Cardiff to Bristol extension.

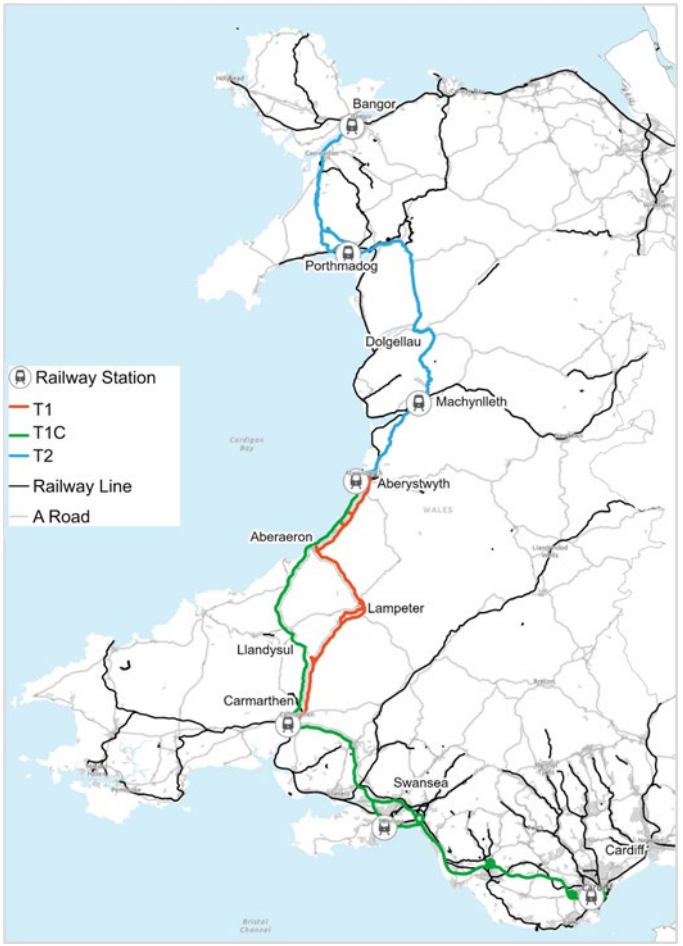
TrawsCymru

In 2013, the network was renamed TrawsCymru to reflect its wider coverage across the whole of Wales. TrawsCymru is a network of medium-to-long-distance, strategically important bus services that connect key towns in Wales – complementing the rail network.

Today, TrawsCymru provides regular and reliable bus services connecting many of Wales' major towns and cities, as well as rural communities and tourist destinations. The network operates a range of modern, comfortable, and environmentally-friendly vehicles, which aim to help Welsh Government meet net-zero targets and improve the passenger experience.

Whilst TrawsCymru services represent strategically important links in the bus network, they have evolved over time into a compromise solution between former coach services and regular service buses. Frequent stopping patterns mean that journey times are not competitive with car over longer distances, and there is a view that service offering for longer-distance travel could be improved with an express coach type service, more akin to rail services, which may help build demand for rail corridors over the long term.

Figure 1.1: Existing T1/T1C and T2 TrawsCymru Routes



2. Strategic Fit

2. Strategic Fit

Proposal aligns with policies to enhance sustainable transport systems, improve connectivity and grow sustainable tourism

2.1 Policy Context

A thorough review of policies, strategies and plans relevant to improving North-South Wales connectivity has been conducted and updated for the Strategic Fit validation. The objectives, interventions and appraisals are compared with key objectives in major policy documents throughout this report. Key policies, strategies, plans and takeaways are provided below.

National / Regional Policy and Well-being Goals

- Llwybr Newydd: the Wales Transport Strategy (WTS) (2021);
- Well-being of Future Generations (Wales) Act (WFGA) (2015);
- Labour / Plaid Cymru Co-operation Agreement (2021) *[Note: The Welsh Government's Co-operation Agreement with Plaid Cymru ended in May 2024]*;
- Net Zero Wales (2021);
- Healthier Wales Policy; Taking Wales Forward; 2016 – 2021;
- Prosperity for All: The National Strategy;
- Prosperity for All: The Economic Action Plan;
- Transport for Wales (TfW) Policy;
- Welsh Government Roads Review;
- Future Wales: The National Plan 2040;
- Planning Policy Wales Edition 11;
- Agenda 2030: Implementing the Sustainable Development Goals;
- Programme for Government 2021-2026 – Update;
- Environment (Wales) Act (2016);
- Planning (Wales) Act (2015);
- Active Travel (Wales) Act (2013);
- National Transport Delivery Plan (2022 to 2027);
- Our Roadmap to Bus Reform (2024);
- Welcome to Wales: Priorities for the visitor economy 2020 – 2025;
- Responsible Tourism (2023);
- WelTAG 2024 Guidance; and
- Regional Transport Plans (RTPs) Guidance (2023).

Local Policy

- Gwynedd and Eryri Plan 2035.
- Carmarthenshire County Council: Local Development Plan 2018 – 2033.
- Ceredigion County Council: Local Development Plan 10; Replacement LDP 2 (2018 - 2033) 11; Local Well-being Plan; Mid Wales Joint Local Transport Plan.
- Cyngor Gwynedd Plan 2023-28.

Key policy take-aways pertinent to this study:

- In response to the climate emergency declared in 2019, the Welsh Government is committed to a decisive shift away from fossil fuels. The Net Zero and modal shift targets present significant challenges, necessitating a substantial modal shift and a transition to zero-tailpipe emission buses by 2035.
- The Labour / Plaid Cymru Co-operation Agreement highlights the need for improved transport connections along Wales' western coast. *[Note: The Welsh Government's Co-operation Agreement with Plaid Cymru ended in May 2024]*
- WelTAG guidance ensures public funds maximise well-being contributions and promote sustainable development. Policies aim for growth and prosperity at all levels and have been considered in formulation of the WelTAG objectives. TfW aims to develop ambitious transport interventions, with this study focusing on creating a competitive, high-quality public transport service akin to a rail service, which could help build demand over the long-term.
- Wales Tourism Strategy includes an ambition to grow tourism for the good of Wales, and sustainable transport is a key focus of the strategy. N-S Wales coach service could act as a tactical intervention to grow demand through targeted digital marketing and social media, as well as supporting growth of international demand of core growth markets (e.g. Ireland and near European countries).

2. Strategic Fit

The Case for Change has largely been established within previous WelTAG stages, as summarised below

2.2 Case for Change Summary

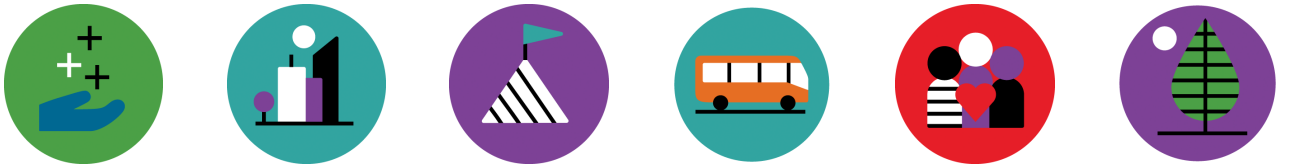
The WelTAG Stage One and Stage Two studies highlighted numerous challenges and limitations along the corridor.

The Case for Change, identified in the previous WelTAG stages, has been reassessed following engagement to ensure that the objectives and potential transport interventions are in line with the latest context, needs and challenges.

These issues, summarised on the right, persist as the rationale for change within the study area, having undergone review to confirm their continued relevance and absence of significant alterations. Hence, they will be maintained as they effectively capture the present context and circumstances.

The North-South Wales corridor faces challenges in economy (low productivity, employment and GVA), social and cultural aspects (high car reliance, limited access to services, seasonal visitor economy), transport integration (poor interchange catchments, fare and service integration), travel demand (low bus usage, long journey times, frequent road closures), customer experience (limited bike carriage, comfort issues, poor digital connectivity) and environmental constraints (environmental factors, AQMAs, intersection with Eryri National Park).

Figure 2.1: Case for Change Summary



Economy	Social and Cultural	Transport Integration	Travel Demand	Customer Experience	Environment
Low and lagging productivity	High reliance on car for journeys to work	Many key interchanges have low catchments within 20 minutes	Existing demand is low for bus travel	Limited opportunity for the carriage of bikes on TrawsCymru services	There are numerous environmental constraints adjacent to the corridor
Decline of people in employment	'Access to services' deprivation is high along the study corridor as a whole	Lack of fare integration between rail and bus	Long distance services have too many stops, meaning longer journey times	Limited comfort facilities (i.e. toilets)	There are AQMA's within Carmarthen along the A40
GVA per head is significantly below Wales average	Seasonal visitor economy	Lack of integration with local and community bus services	Traffic collisions are the most common cause of closures on the road network	Poor digital connectivity	The corridor intersects Eryri National Park (Snowdonia)

2. Strategic Fit

Continuity in action: previous study objectives continue to guide option development and assessment

2.3 WelTAG Objectives

The Stage One study objectives have been refined in accordance with WelTAG guidance, following thorough investigation, analysis of transport data, consideration of problems and challenges, and stakeholder feedback at WelTAG Stage Two. These objectives remain consistent for the current stage, as agreed with the WelTAG Review Group. For the remainder of this report, the Strategic Fit is summarised using these objectives, providing the framework for option development and assessment.

Objective 1: Improve public transport connectivity between North and South Wales

Provide a low-carbon alternative to the car to encourage the uptake of public transport between North and South Wales.

Provide an express service with competitive journey times between key regional centres to encourage a modal shift from private car to more sustainable options.

Deliver a route that would provide interchange opportunities to other bus and rail services for onward travel.

Support the delivery of the North Wales, and Swansea Bay and West Wales Metro proposals, as well as the Rural Pathway and other transport integration programmes in Wales.

Enhance connectivity to universities and tourist destinations to foster educational collaboration and bolster tourism.

Objective 2: Improve public transport integration and customer experience

Provide an ambitious new service that enhances, links, and supports existing services including TrawsCymru, the rural bus network, and Fflecsi/Bwcabus services.

Provide improved interchanges at key locations to support a smooth transition between different modes and services.

Improve integrated ticketing between bus and rail services.

Offer safe, reliable, and affordable public transport journeys with a positive and comfortable customer experience that can appeal to a new market.

Produce an inclusive public transport network that is accessible to all.

Provide a service that appeals to and caters for our key user groups, students and tourists, in terms of accessibility and affordability.

Objective 3: Support the transition to a low-carbon economy

Support well-being and the economy by improving public transport links to work, business, healthcare and education.

Provide infrastructure to support sustainable tourism.

Provide active travel connections in synergy with public transport to provide opportunities for walking and cycling.

Support the transition to low emission buses on the TrawsCymru network by 2026.

Objective 4: Provide an affordable, long-term solution that is resilient to future funding challenges

Provide a shorter term, deliverable alternative to rail between North and South Wales, within the period of the Labour and Plaid Cymru Co-operation Agreement (to 2026), allowing demand to build over time. *[Note: The Welsh Government's Co-operation Agreement with Plaid Cymru ended in May 2024]*

Produce a solution which is reliable over the long-term and resilient to future funding challenges.

Promote the solution through strong branding and marketing.

Grow public transport demand over time which could support the case for rail interventions in the longer term.

2. Strategic Fit

Improved connectivity could support growth in sustainable tourism, and help address structural challenges in the university sector

2.4 Key User Groups & Tourism

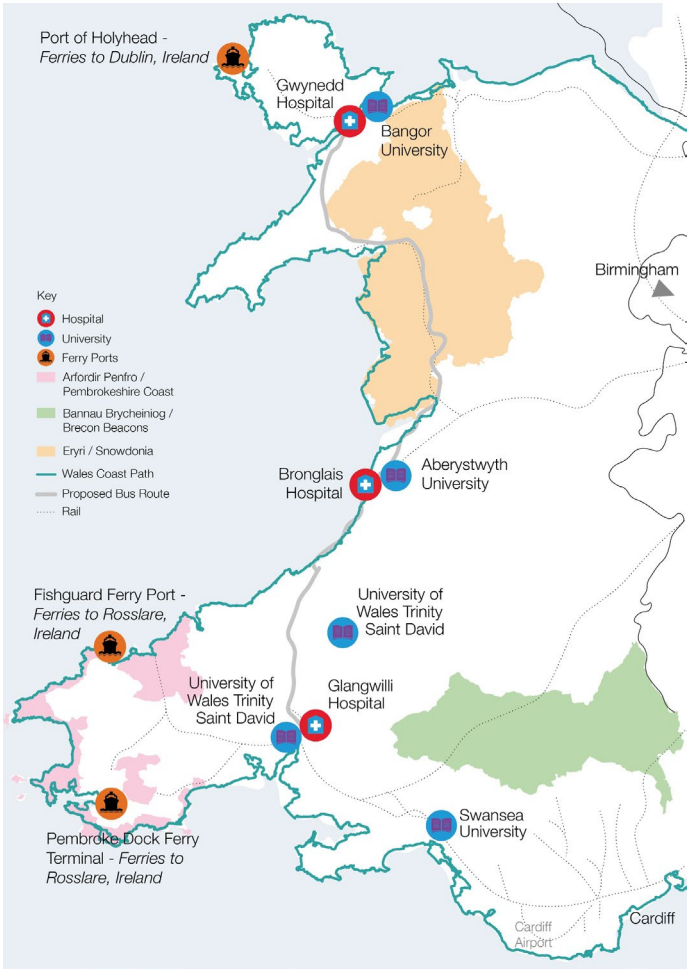
Figures 2.3 and 2.4 overleaf identify that there is low demand for long-distance trips by public transport on the corridor currently. The proposed measures to enhance connectivity should be delivered in parallel with measures to stimulate demand through a targeted approach. Key user groups for the proposed service have been identified to inform option development: tourists and students. Key considerations are noted below.

The proposed service supports the key goals outlined in the *Welcome to Wales tourism strategy*. Car use currently dominates travel by domestic visitors. The car is more frequently used for domestic travel to Wales (70%), than for trips taken in rest of Great Britain (65%). A lower proportion of travel to Wales is by public transport with 16% of journeys by train and only 4% by bus or coach. The most popular activities for those staying overnight are relaxing, short walks, sightseeing on foot, visiting a beach and long walks. Only 11% of people say they sightsee by car in Wales. Visitors from Ireland represent the most significant proportion of international visits to Wales at 17% of the total, and the proposed service could join up rail connectivity to Holyhead, Fishguard and Pembroke Dock ferry terminals. Improving public transport connectivity to key tourist destinations such as Eryri National Park and the Welsh Coast (alongside digital marketing and social media promotion) and giving visitors confidence that it's a reliable option (including on weekends), could be a significant opportunity for growing sustainable tourism in Wales – both in terms of reducing the impacts of car travel, and increasing access to nature for those without a car (Data source: *Welcome to Wales: Priorities for the Visitor Economy 2020-2025*).

The proposed service would also directly *improve connectivity to Bangor, Aberystwyth and University of Wales Trinity Saint David*, and other universities in Wales and beyond by connecting with the rail network. Universities in Wales (and the UK more broadly) are facing several structural challenges including reduced funding, lower demand from international students post-Brexit, challenges around engaging and connecting with students (due to prevalence of remote teaching during the pandemic) and shortages in accommodation with students living further away from campus (reported on recently at Bangor University).

Coach services could provide more cost-effective travel and affordable fares for students which may help address some of these challenges. Students could travel more conveniently between campuses, explore academic resources and collaborate across universities. Reducing travel times for those without access to a car could also allow students to allocate more hours to study, research and extracurricular activities.

Figure 2.2: Key Tourism and University Destinations



Existing TrawsCymru Demand Patterns

T1 Aberystwyth to Carmarthen

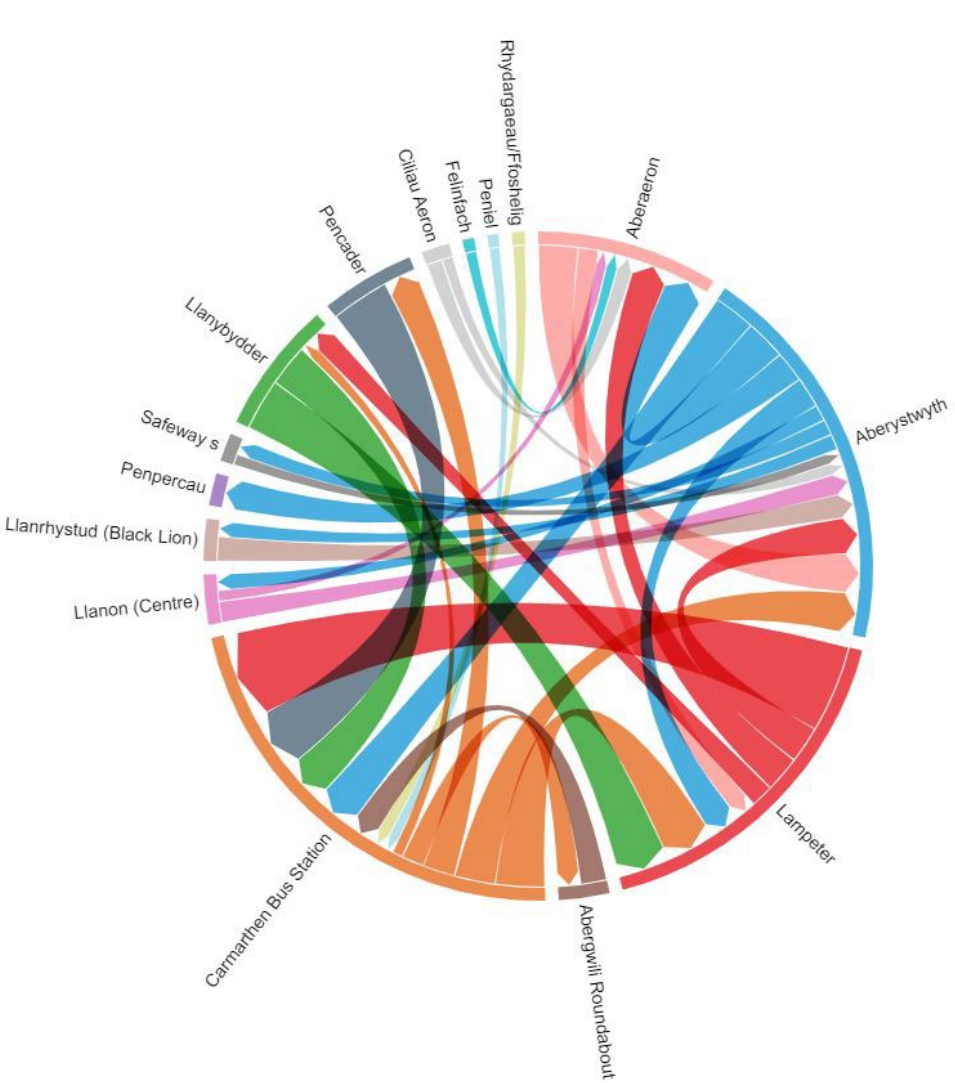


Figure 2.3: T1 Origin-Destination Chord Charts

T2 Aberystwyth to Bangor

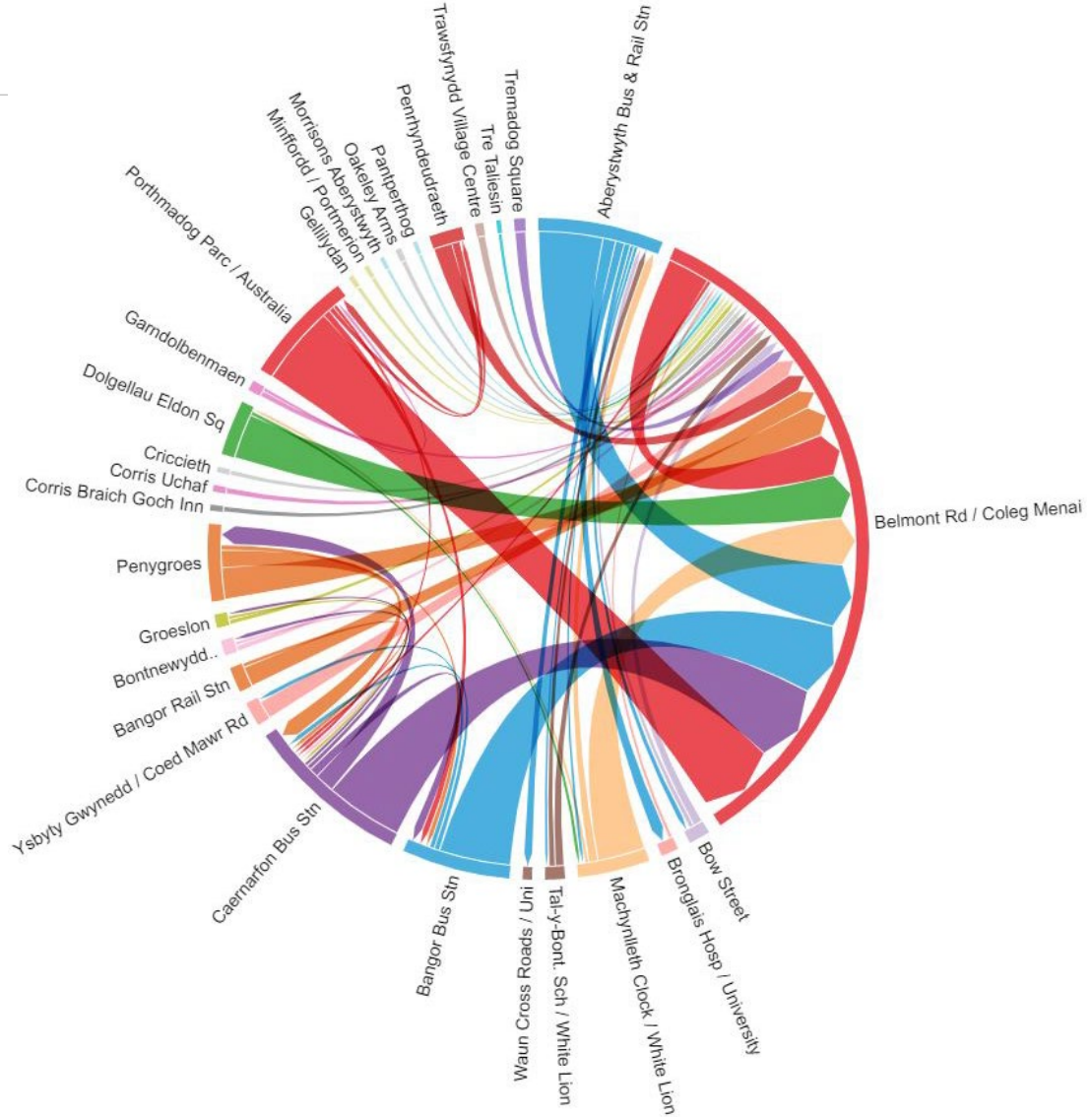


Figure 2.4: T2 Origin-Destination Chord Charts

2. Strategic Fit

Stakeholders supported an express coach service with strategic town centre and rail station stops for efficiency and accessibility

2.5 Engagement

WelTAG guidance recommends stakeholder engagement to design transport infrastructure and services that meets people's needs and ensures project success. Engagement aligns with the five ways of working outlined in the Well-being of Future Generations (Wales) Act 2015, with involvement and collaboration as essential components. This engagement involved regular meetings with TfW to discuss progress and seek feedback, and one-to-one meetings with key stakeholders including Carmarthenshire County Council (CaCC), Ceredigion County Council (CeCC), Cyngor Gwynedd (CG) and TfW teams developing plans for bus franchising, to maximise their inputs into the study and synergies with other parallel projects.

The project team engaged with vehicle operators, Yutong and Newport Transport, and TfW's decarbonisation team to address technical aspects and to explore potential solutions for the effective implementation of the proposed service.

Key insights from these discussions include:

- Yutong: Discussed market share, unique offerings, product range, battery technology, vehicle accessibility features, cost considerations and partnerships. Addressed concerns about vehicle size and turning capabilities.
- Newport Transport: Gained an understanding behind choosing Yutong; for its reliability and after-sales service. Noted the good performance and durability of Yutong electric vehicles and the need for charging infrastructure at both ends of the Bangor-Carmarthen route.
- TfW Bus Decarbonisation Team: Discussed the need to decide between a bus or coach service and the implications for bus franchising roadmap. Highlighted the need to align decarbonisation and franchising with depot strategy, considering the challenges of charging infrastructure and Distribution Network Operator connections. The current depot in Carmarthen may need to consider a 300kW charger and potential battery buffer/on-site solar.

Review Group Workshop

On 14th March 2024, stakeholders from TfW, CaCC, CeCC, CG, Snowdonia National Park Authority and University of Wales Trinity Saint David gathered for a WelTAG Review Group Workshop to solidify the approach and focus areas for option development.

The invitation for the Review Group workshop was extended to a wider audience than typical, specifically targeting contacts from the tourism industry and universities to seek to better understand of the needs and expectations of key user groups.

Key points raised are summarised as follows:

- Concerns were raised regarding bus stop locations, emphasising space limitations and mismatched passenger locations. It was suggested that stop locations be reconsidered focusing on incorporating more town centre locations, especially in Caernarfon and Dolgellau.
- The Review Group acknowledged the ambitious nature of the proposed service but stressed exploring lower-cost alternatives, such as short-term diesel-operated services.
- Various options for route design, service frequency and vehicle type were discussed. Stakeholders favoured an express coach service with limited stops at town centre locations and rail stations.
- Consensus was reached on the need for a phased implementation roadmap for the proposed service.
- Agreement was reached on addressing the specified problems and objectives, focusing on the needs of university students and tourists. Serving the nine key locations along the route was deemed crucial, with insights from user group representatives informing service design.

2. Strategic Fit

How could an Express Coach service help build demand for longer-term investment?

2.6 Potential Long-term Scalable Approach

Whilst there are ambitions of restoring former railway services along the corridor this will be very challenging in the short to medium term. Figure 2.5 identifies a potential scalable and adaptable approach that could evolve the service should demand for travel between north and south Wales warrant additional investment.

Figure 2.5: Levels of Scalable Mass Transit

Future change in service level conditional upon increasing patronage, continued political support and availability of funding

Level 2 – TrawsCymru Express Coach

- Faster journey time due to limited stopping pattern
- On-board passenger facilities to support long distance travel
- Limited bus stop upgrades and charging infrastructure to support initial running of the service
- Safeguarding rail corridor from future development

Level 1 – Existing TrawsCymru Services

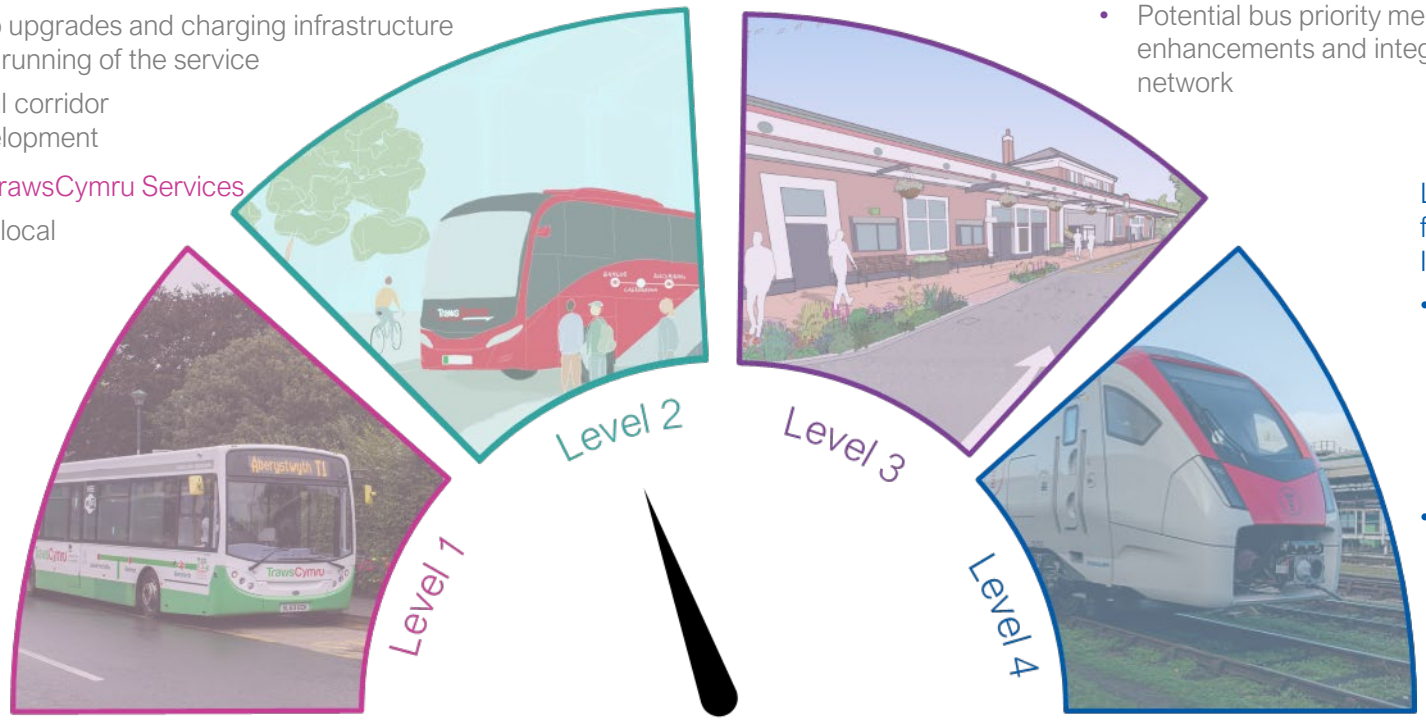
- Primarily serves local journeys
- Local bus stop infrastructure
- Very limited bus priority

Level 3 – Establish Permanence of Express Service

- Infrastructure upgrades to support seamless coach, local bus and rail interchange (e.g. Carmarthen, Machynlleth, Dolgellau, Bangor)
- Potential bus priority measures, service frequency enhancements and integration with franchised bus network

Level 4 - (Re-)Consider Case for Fixed Public Transport Investment

- Express service may help build demand for rail corridors over the long term, subject to availability of funding and strong political support
- However, the introduction of end-to-end schemes for rail would be very challenging due to the costs associated with rail infrastructure and overall distance requirement



3. Option Development: Route Design

3. Option Development: Route Design

Route Design CSFs have been developed to allow focussed option development and select a preferred option

3.1 Route Design Critical Success Factors

Review of Stage Two Conclusions

The previous Stage 2 Study explored a range of options to improve bus and coach-based connectivity between North and South Wales, along the west coast between Bangor and Carmarthen via Aberystwyth.

This recommended a limited-stop express coach service from Bangor to Carmarthen, with the southern section of the route via Llandysul (rather than Lampeter) due to faster journey times, and as Lampeter would continue to be served by the T1. The service aims to reduce journey time by significantly limiting the number of stops compared to the existing bus services and avoiding detours where possible.

Such an express style service would not be intended to compete with existing TrawsCymru services, which are generally used for shorter trips. Hence it would be perceived as a different offering to what is currently provided, particularly targeting tourists and students if marketed appropriately, and closely linking to rail stations.

At the southern end of the route, it is proposed to terminate the service in Carmarthen due to delays caused by congestion going into Swansea and to avoid duplication between existing bus/rail networks. This is also representative of stakeholder views during the workshop held as part of the study.

Integration of the proposed service with the rail network is a key consideration of the study. The service seeks to replicate the level of services provided by rail as far as possible and integrate with the wider rail network to provide onward travel to a wider range of destinations.

Route Design Critical Success Factors

To allow a focused assessment of options, a series of 'critical success factors' (CSFs) have been developed for the route design options:

1) Enhance (rather than compete with) existing bus and rail services
2) Provide competitive journey times by operating a limited stop/express service (typically 10-20 miles between stops)
3) Serving town centre locations and established transport hubs, particularly rail stations
4) Serve key user groups, in particular students and tourists who will typically be undertaking longer distance journeys

The characteristics of the settlements along the route relating to these critical success factors are shown in Table 3.1 overleaf, which shows population, university and tourist destinations, along with key public transport interchanges.

Figure 3.1: Previous Stage 2 Preferred Option

Table 3.1: N-S Wales Corridor Settlement Characteristics

Location	Population (2021 Census)	Universities (No. Students)	Key Tourist Destinations (Annual Visitors)	Public Transport Provision (Annual Rail Patronage)	Express Stop?
Bangor	15,100	• Bangor University (12,000)	• Penrhyn Castle (134,900) • Zip World Penrhyn Quarry (145,000) • Treborth Botanic Garden (35,000)	• Rail (578,000) and Bus Stations	Yes
Caernarfon	10,100		• Royal Welch Fusiliers Regimental Museum (149,200) • Welsh Highland Railway (186,200) • Caernarfon Castle (199,100) • Snowdon Mountain Railway (143,900) • Walkers on Snowdon (587,900)	• Bus Station	Yes
Penygroes	3,100				No
Criccieth	1,700		• Criccieth Castle (47,000)		No
Porthmadog/ Penrhyndeudraeth	4,200/ 2,000		• Snowdonia National Park (10,000,000) • Welsh Highland Railway (186,200) • Portmerion (245,700)	• Rail Stations (69,000 & 56,000)	Yes
Dolgellau	2,600			• Regional Bus Hub	Yes
Corris	600		• Corris Craft Centre (55,000) • King Arthur's Labyrinth (33,400)		No
Machynlleth	2,200		• MOMA Machynlleth (22,700) • Dyfi Forest (50,200) • Falconry Experiences Wales (60,000)	• Rail Station (100,000) and Regional Bus Hub	Yes
Bow Street	1,900			• Rail Station (23,000)	No
Aberystwyth	10,700	• Aberystwyth University (6,000)	• Aberystwyth Cliff Railway (85,000) • Aberystwyth School of Art Museum (35,000) • Vale of Rheidol Railway (54,000) • Bwlch Nant yr Arian Forest Visitor Centre (114,400)	• Rail (242,000) and Bus Stations	Yes
Llanrhystud	350				No
Llan-non	670				No
Aberaeron	1,300		• Llanerchaeron (53,000)		Yes
Llanarth	1,600				No
Lampeter	2,500	• UW Trinity Saint David (2,000)			No
Llanybydder	1,600				
Synod Inn / Post-Mawr	300			• Proposed Transport Hub	No
Llandysul	2,500				Yes
Pencader	350				No
Carmarthen	14,600	• UW Trinity Saint David (1,500)	• Carmarthen Castle (18,800) • Gwili Railway (31,000)	• Rail (293,000) and Bus Stations	Yes

3. Option Development: Route Design

Striking the right balance between an express stopping pattern and serving key locations is key to lowering journey times

3.2 Option Sifting and Shortlisted Options

Route options have been developed in line with the overarching route proposals from the earlier Stage 2 work. In considering route options against the critical success factors, the options have been developed balancing the competing requirements of an express service against serving key locations, i.e. an express service requires limited stops, but at the risk of missing centres of demand. The range of options are set out below, with the preferred option described in more detail overleaf.

Table 3.2: Route Options and associated journey times and stopping locations

Option	Do Nothing	Do Minimum	Intermediate Option	Do Something	Do More	Do Maximum
Features	Stopping Bus Service: Existing T1/T1C & T2 Stopping at every stop on route	Express Bus Service: Following T1C/T2 Route with reduced stops	Coach Intermediate Stops: Town Centre locations and rail stations Two stops in larger towns/cities	Express Coach Limited Stop: Town Centre locations and rail stations Single stop per town (except Aberystwyth)	Express Coach Limited Stop: Town Centre locations and rail stations Single stop per town	Express Coach Very limited stop: Edge of town locations except when serving rail stations
Stops	All existing stops (Approx 55 stops)	Circa 20-25 stops	Bangor Bus Station Bangor Rail Station Caernarfon (Bus Station) Porthmadog Rail Station Dolgellau (Eldon Square) Machynlleth Rail Station Aberystwyth University) Aberystwyth (Bus Station) Aberaeron (existing bus stop) Synod Inn Llandysul Glangwili Hospital Carmarthen Rail Station Carmarthen Bus Station	Bangor Rail Station Caernarfon (Bus Station) Porthmadog Rail Station Dolgellau (Eldon Square) Machynlleth Rail Station Aberystwyth University Aberystwyth (Bus Station) Aberaeron (existing bus stop) Llandysul Carmarthen Rail Station	Bangor Rail Station Caernarfon (Morrisons) Porthmadog Rail Station Dolgellau (Bala Road) Machynlleth Rail Station Aberystwyth (Bus Station) Aberaeron (existing bus stop) Llandysul Carmarthen Rail Station	Bangor Rail Station Porthmadog Rail Station Dolgellau (Bala Road) Machynlleth Rail Station Aberystwyth (Bus Station) Aberaeron (including new stop) Carmarthen Rail Station
Approx Journey Time	6 hours 20 minutes	5 hours 45 minutes	5 hours 15 minutes	4 hours 45 minutes	4 hours 35 minutes	4 hours 25 minutes
CSF 1: Enhance Services	-	Partial	Yes	Yes	Yes	Yes
CSF 2: Journey Time	-	No	Partial	Yes	Yes	Yes
CSF 3: Stop Locations	-	Yes	Yes	Yes	Partial	No
CSF 4: User Groups	-	No	Partial	Yes	Partial	Partial
Decision	Discount	Discount	Carried forward	Preferred way forward	Carried forward	Discount

3. Option Development: Route Design

The service will call at key transport interchanges. Appendix A provides a study of options for a new bus interchange in Dolgellau

3.3 Preferred Route Design

The preferred option is set out below from north to south, with a summary of the rationale for the selected stops and the main alternatives considered. Vehicle swept path analysis has been undertaken for the selected stops to ensure that they would be suitable for larger coaches, and is included in Appendix B.

Bangor - Use of the bus stops on the Rail Station forecourt would provide the closest integration with rail services, and also link with a wide range of local and regional bus services which use the adjacent stops outside the station. The 'Bangor Gateway - Station Quarter' project will enhance the station in the future. The headroom constraint of 4.1m would exclude the use of some double-deck coaches. Alternatives options considered included the Bus Station and Ysbyty Gwynedd but both were excluded as the Rail Station would better meet the objectives, however the Bus Station could be included as an additional stop should this be deemed useful.

Caernarfon – The Bus Station was selected as the preferred location to more closely integrate with the local bus services and provide good links with the town centre. Alternatives included the existing stops adjacent to Morrisons on Ffordd Y Gogledd, or new stops on the A487 Caernafon Bypass in order to reduce the delay involved with journeys into the town centre, however stakeholder feedback was very clear that serving the town centre was a key requirement.

Porthmadog – An improved stop adjacent to the Rail Station was selected as the preferred option to provide close linkage to rail services and to minimise the delay associated with serving stops closer the town centre. Northbound and Southbound services would use the same stop, u-turning at the High Street/New Street Roundabout. An enhanced interchange with improved facilities could potentially be included at a later stage.

Dolgellau – A wide range of options were considered given the constrained nature of the town centre and complexities of the existing TrawsCymru bus service operation, however Eldon Square was selected as the preferred option due to the proximity of the town centre. The next best alternative would be new stops on Bala Road, which would reduce the delay to the service but would increase the separation to town centre, or a new bus interchange in Marian Mawr car park. The latter is considered further in Appendix A, which provides a review of alternative locations for the interchange between TrawsCymru services.

Figure 3.2: Stage 2/3 Preferred Route Option

3. Option Development: Route Design

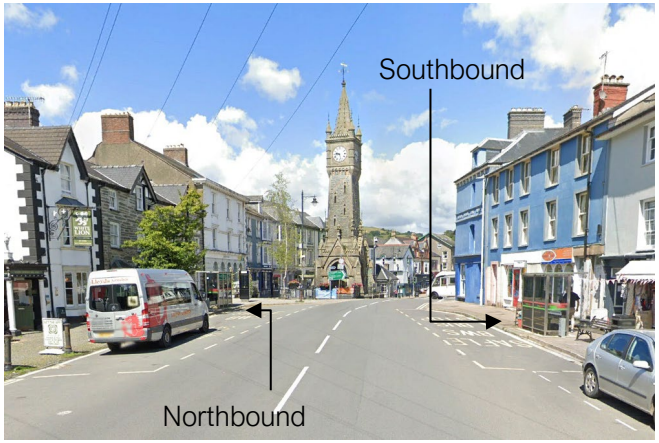
Potential stops that do not meet a demand threshold, or that would involve a diversion are excluded to reduce delays

3.3 Preferred Route Design (continued)

Machynlleth – In the longer term, the preferred option would be the proposed Interchange at the rail station (see Figure 3.4 overleaf), as this would provide the closest integration between bus and rail services.

Given that the interchange could take time to implement, consideration has also been given to temporary on-street arrangements, including adjacent to the rail station, and in Machynlleth Town Centre. The existing stops adjacent to Machynlleth Town Clock (see Figure 3.3) provide the best short-term alternative, given that the highway network in the immediate vicinity of the station is constrained without sufficient space for shelter/layby provision.

Figure 3.3: Existing Machynlleth Town Clock Stops



Bus-rail interchange is less critical to the 'One Network' approach from the perspective of getting the service up and running as alternatively passengers could change at Aberystwyth to the south and Porthmadog to the North.

Aberystwyth – Given the proximity of the existing bus station to the rail station, this was selected as the preferred stop location, as this will provide good integration with existing local and regional buses, the rail network, and is well located to serve destinations in the town centre. To serve the large number of university students based at the Penglais Campus, an additional stop has also been included on the preferred route as this can be achieved using the existing stop infrastructure with no detour from the most direct route.

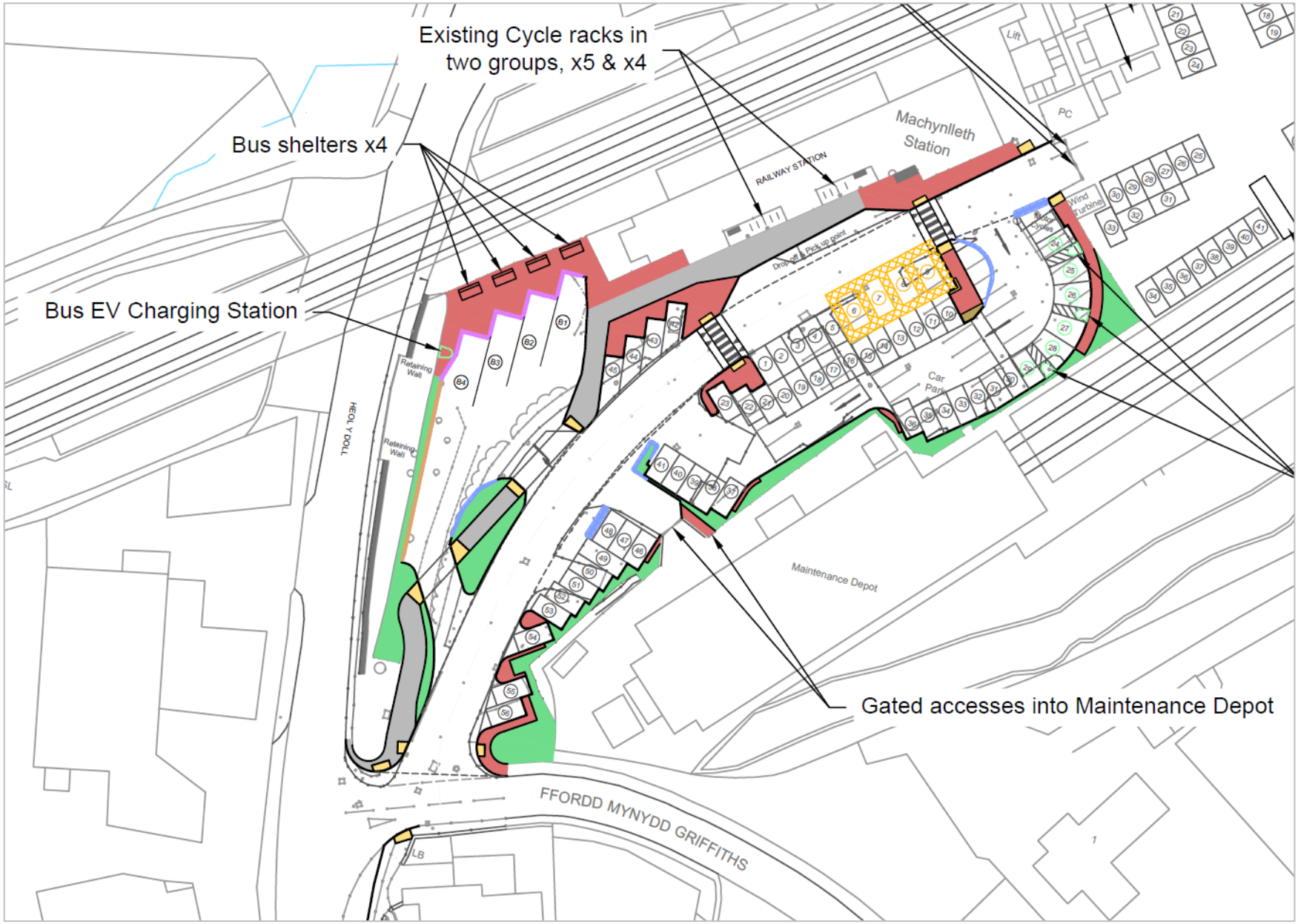
Aberaeron – The preferred option utilises the existing bus stops on Alban Square as these are well located to serve the town centre and allow easy interchange with other bus services. As the stops are on one side of the road, northbound services are required to complete a loop of Alban Square adding delay. However, the alternative of adding a new stop on the opposite side of the road is not considered feasible given the significant impact on the constrained vehicle parking.

Synod Inn – a new Transport Hub is the recommendation of a 2023 WelTAG Lite Study, improving interchange between buses, and providing a Park & Ride opportunity. Should this Hub be delivered, it could be included as a stop on N-S Express Service, however this would add additional delay, and given the proximity to Aberaeron, this stop is not included within the preferred option at this stage.

Llandysul – The preferred option uses the existing King Street bus stop for northbound services, and St Tysul's Church bus stop for southbound services. The proposed Express Service would provide additional public transport options for Llandysul beyond the very limited T1C/T1X. Lampeter, on the competing route from Aberaeron to Carmarthen already has a good service from the T1 and other local buses.

Carmarthen – An improved stop at the Rail Station is the preferred location for the stop, as this will provide close integration with the rail services, and minimise delay compared to serving more central locations. The proposals for the improvements at the station are being developed in parallel to this study. The King Morgan footbridge over the river provides pedestrian linkage towards the bus station and town centre. An additional stop at the Bus Station was considered beneficial, but excluded from the preferred option due to the additional delay involved. Similarly, a stop at Glangwili Hospital would serve the large demand, but also incur significant delay to the service compared to the more direct route via the A40.

Figure 3.4: Proposed Machynlleth Transport Interchange



3. Option Development: Route Design

The table outlines prioritisation of off-board passenger facilities, noting that there are spatial constraints in each location

3.4 Recommended Station Facilities

The following section provides recommendations on passenger facilities to guide the initial rollout of the service and any potential future upgrades, ensuring the most critical facilities are implemented first and less critical ones are considered as future enhancements are considered. The MoSCoW prioritisation framework is used, consisting of the following categories:

1. Must have (M): Passenger requirements that are necessary. These are non-negotiable elements that provide the minimum usable subset of requirements.
2. Should have (S): These interventions are considered important but not vital. Their inclusion would add significant value to customer experience.
3. Could have (C): This category includes requirements that have a much smaller impact when left out of the project and could be seen as 'nice to have' interventions.
4. Won't have (W): This final category includes elements that are not considered necessary or could detract from the scheme overall.

In summary, *Bus – Rail Interchanges* must have:

- waiting areas/shelters;
- real time information boards;
- appropriate branding;
- accessibility features;
- lighting;
- route maps; and
- internet connectivity (e.g. Wi-Fi / 4G / 5G).

Bus – Rail Interchanges should have:

- laybys;
- USB charging points;
- restrooms;
- baby changing facilities;
- vending machines;
- drinking water refill facilities;
- access to local bus/taxi services/information;
- bicycle parking; and
- should be equipped with CCTV/security equipment and tourist information.

Bus – Rail Interchanges could have:

- luggage storage;
- entertainment facilities;
- coffee/retail outlets;
- pick-up/drop-off laybys and parking.

Bus Only Stop/Interchanges must have:

- waiting areas/shelters;
- real time information boards;
- appropriate branding;
- accessibility features;
- lighting;
- route maps;
- local bus/taxi service access and information.

Bus Only Stop/Interchanges should have:

- internet connectivity (e.g. Wi-Fi / 4G / 5G);
- bus laybys;
- bicycle parking;
- CCTV/security systems and tourist information.

Bus Only Stop/Interchanges could have:

- USB charging points;
- luggage storage;
- restrooms;
- baby changing facilities;
- pick-up/drop-off laybys and parking.

Bus Only Stop/Interchanges won't have:

- entertainment facilities;
- coffee shop and retail outlets.

4. Option Development: Service Design

4. Option Development: Service Design

The journey times for the proposed service are not possible with a single driver under current UK driver regulations

4.1 Service Design Option Identification

Critical Success Factors

In order to allow a focused assessment of service design options, a series of 'critical success factors' have been developed for the route design options. This are linked with the agreed WelTAG Objectives.

1) The services must act broadly as an addition to the bus network (rather than replacing T1/T2 services) and reduce abstraction from these services for shorter journeys.
2) The services must replicate existing rail levels of service and be timetabled to offer onward travel by rail and bus at key interchanges.
3) The services must be timetabled to allow for electric vehicle charging/refuelling as necessary.
4) The services must balance the cost of a higher frequency service with the revenue of demand.

Option Identification

The following service design frequencies have been considered:

- 0 coaches per day (cpd) i.e., do nothing option.
- 2 and 4 cpd – low frequency options that provide a low-cost express service.
- 6-8 cpd – options that provide one bus every 2-2.5 hours in line with local train services.
- 9cpd – has the potential to be operated more efficiently than 8cpd.
- 10cpd – a high frequency, high ambition option designed to stimulate the maximum possible demand.

Timetabling

The timetabling for each service frequency has been checked against UK daily driver limit regulations. They are as following:

- Drivers must have a minimum of 11 hours rest period between shifts.
- A driver may not drive more than 9 hours in a shift.
- Any single period of driving may not exceed 4.5 hours, after which a driver must take a break of at least 45 minutes.

The timetabling also considers time for EV charging. 60 minutes in total has been allowed for a quick charge when a bus reaches the end of its route at either Bangor or Carmarthen. This includes 15 minutes for arrival at the charging point and 45 minutes to allow for a quick charge. The assumed journey times are discussed in section 4.2.

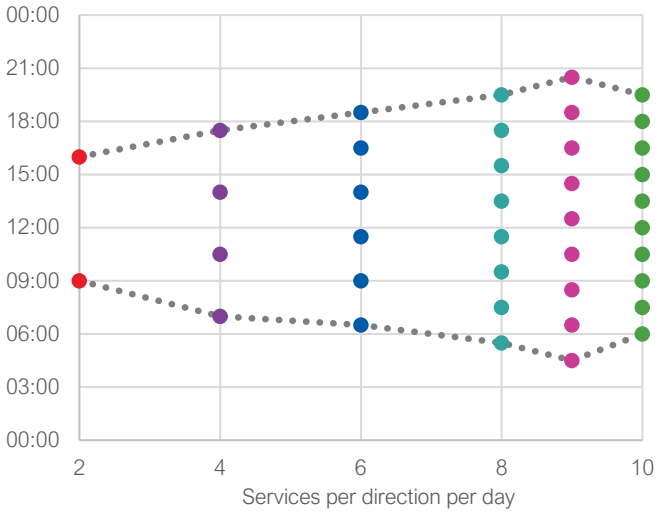
The PVR and minimum drivers are shown in Table 4.1.

Table 4.1: Peak Vehicle Requirement and Minimum Drivers

Frequency	2cpd	4cpd	6cpd	8cpd	9cpd	10cpd
PVR	2	4	6	6	6	8
Minimum Drivers	4	6	9	13	15	16

Figure 4.1 gives a graphical representation of how each service frequency fits into an operational day. 9cpd has the largest range of operational hours, and that 10cpd has the highest frequency, at once every 1.5 hours.

Figure 4.1: Departure times from Bangor and Carmarthen



4. Option Development: Service Design

The end-to-end journey time for the proposed service is around 1.5 hours faster than the next quickest public transport option

4.2 Journey Time Assessment

INRIX highway journey time data was used to calculate the journey times used in the calculation of the timetables for each service frequency. The journey time data was collected over October 2022 and October 2023 for a neutral month and July 2023 for the summer.

Key findings upon analysing the INRIX data are as follows:

- There is no evidence of significant congestion along the corridor.
- There is no evidence of summer peak effect on congestion.
- The 20mph speed limit has had a noticeable impact on journey times (up to 12 minutes on an end-to-end journey time).

The following assumptions were made when determining the timetabled route journey time:

- The timetabled journey times were based on the busiest hour, an October weekday 8am northbound and 3pm southbound.
- The 75th percentile journey time was used. This means that we'd expect the bus to be on time during the above hours three quarters of the time.
- The preferred route highlighted in section 3.4 was assumed when calculating the journey time.

Figure 4.2 shows an example INRIX journey time graph showing the journey times of the section throughout the day. It also shows the 25th/75th and 5th/95th percentiles. You can see that on this section, the highest congestion is around 16:00.

Table 4.2 shows that the proposed service is around 1 and a half hours faster than the next quickest public transport option.

Figure 4.2: INRIX Data Example for Bangor to Caernarfon Southbound

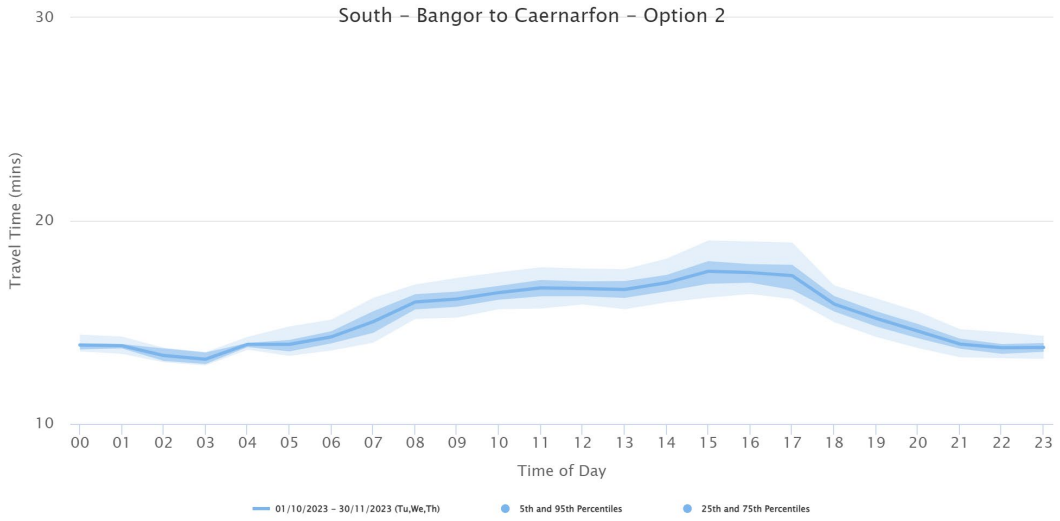


Table 4.2: Journey Time Comparison for Preferred Option and alternatives

Travel Mode	Northbound	Southbound
Proposed Express Coach Service	4 hours 45 minutes	4 hours 40 minutes
Existing TrawsCymru Services (inc. interchange)	6 hours 30 minutes	6 hours 5 minutes
Rail	6 hours 15 minutes	6 hours 25 minutes
Car	3 hours 30 minutes – 4 hours	3 hours 30 minutes – 4 hours

4. Option Development: Service Design

Lower frequency service options are likely to need a proportionally lower subsidy than higher frequency services

4.3 Demand, Cost and Revenue Assessment Summary

Demand

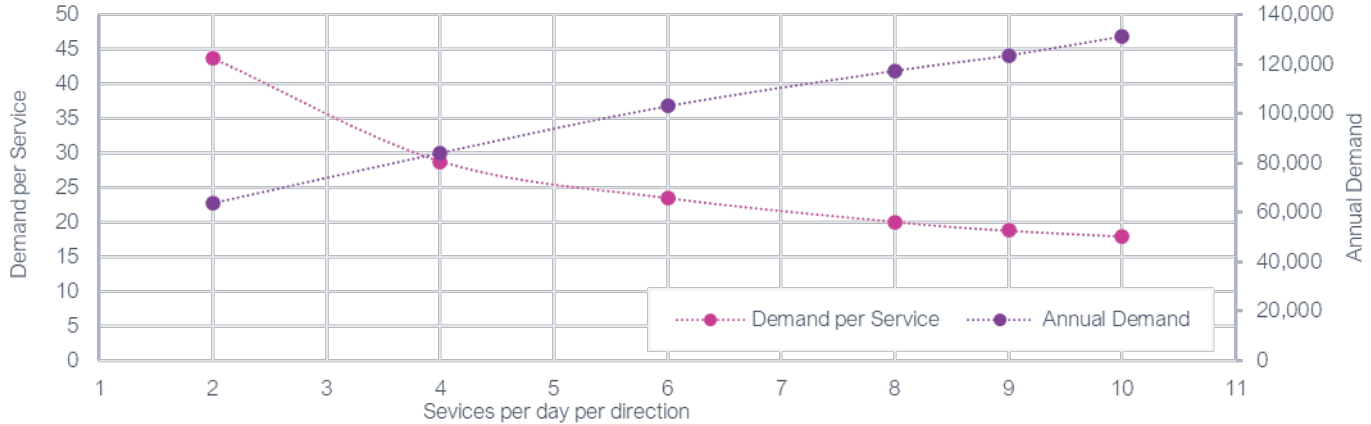
Figure 4.3 shows the total annual demand and demand per service of each service frequency. The demand covers demand on the new service only and does not cover demand stimulated or abstracted in other services (see section 7.2). It shows that the annual demand increases as service frequency increases, but the demand increases diminish at the higher frequencies. The graph also shows that low frequency services have a high demand per service, meaning crowded buses. This diminishes as service frequency increases.

Note that at 2 coaches per day (cpd) the demand reaches 44 passengers per coach, approaching the limit of the estimated coach capacity at around 53 passengers per coach.

Costs

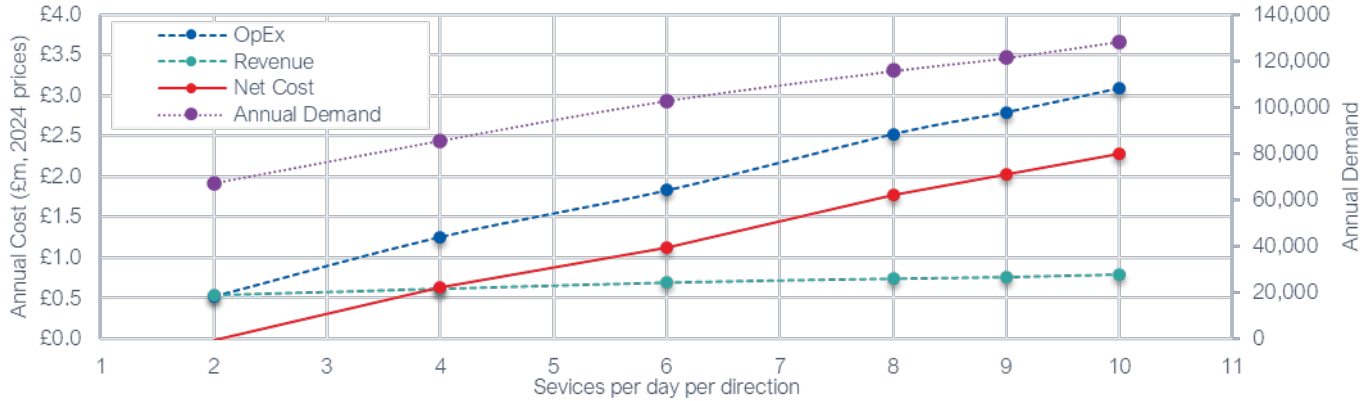
Figure 4.4 shows the relation between OpEx, Revenue, Net Cost (i.e. Government Subsidy) and Annual Demand. The revenue covers fares for the proposed service only and is based on a bus-rail average fare per km (see section 7.2). It shows that as the service frequency increases, the operational expense increases more quickly than the revenue. This means that lower frequency services need a proportionally lower subsidy than higher frequency services. The costs have a 2024 base year and are in 2024 prices. See section 7 for more details.

Figure 4.3: Demand by Service Frequency



Note: Given the limited existing demand for long distance trips in the study area, assessing future demand is not a straightforward exercise, and the results should be utilised as a high-level indication of potential demand rather than relied upon as an accurate forecast. It is also noted that to stimulate demand, measures beyond delivering the service will be required such as digital marketing and social media campaigns, engagement with universities and tourism bodies etc.

Figure 4.4: Cost by Service Frequency



4. Option Development: Service Design

Enabling interchange with the rail network and local bus services will be key to facilitating wider travel for key user groups

4.4 Integration with Rail Services

Integration with existing rail services will be important to make the proposed coach service feel part of the same network. This can be achieved through integrated ticketing, alignment between timetables, and supporting infrastructure.

Consideration has been given to timetabling and interchange with rail services at key hubs such as the typical arrival and departure profile of existing rail services, and a coach service timetable assuming one coach every two hours. The resulting wait time is shown in Table 4.3.

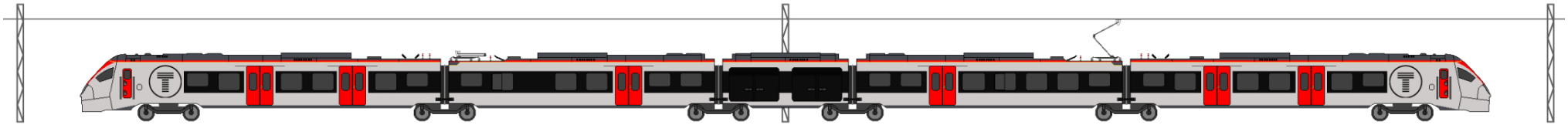
Tables 4.4 – 4.7 overleaf contain example timetables for 4cpd and 8cpd options. Further tweaks to each timetable will be required in future to minimise rail service interchange times and to roster staff with local bus services to facilitate driver swaps in Aberystwyth for UK Drivers' Hours regulation compliance. This will require comprehensive operator involvement as part of a future procurement exercise.

Interchange timings with local bus services such as at Eldon Square in Dolgellau require careful thought. Currently, the T2 and T3 in both directions converge on Eldon Square every odd hour causing capacity challenges. Attention should be given to the timing of the proposed service, to ensure it arrives just before or after this confluence to avoid capacity issues and to maximise interchange opportunity.

TfW are actively considering improvements to bus and rail network integration in Wales, including using integrated ticketing. Figure 4.5 shows existing 'virtual rail stations' – bus stops added to the national rail system. This enables joined-up journey planning and through ticketing via the TfW app (as shown for a Cardiff to Lampeter trip on rail and TrawsCymru services) or third-party apps such as Trainline. It is anticipated that all stops on the proposed service can become virtual stations. Figure 4.5 also highlights real time rail departures displayed on-board a T1 service, improving the multi-modal journey experience. There will be opportunities to utilise this technology on the proposed coach service to integrate with rail services.

Table 4.3 Interchange Times

Location	Bus-Rail wait time (mins)	Rail-Bus wait time (mins)
Northbound		
Bangor	24-59	-
Porthmadog	46-96	30-70
Machynlleth	10-60	5-75
Aberystwyth	18	117
Carmarthen	-	40-90
Southbound		
Bangor	-	20-50
Porthmadog	24-94	32-102
Machynlleth	19-69	6-116
Aberystwyth	61	74
Carmarthen	18-48	-



Potential Timetables for Proposed N-S Wales Express Coach Service

Table 4.4: Example Northbound 4cpd Timetable
Note: Darker shaded rows highlight rail interchanges

Stop	Coach 1	Coach 2	Coach 3	Coach 4
Carmarthen	07:00	10:30	14:00	17:30
Llandysul	07:34	11:04	14:34	18:04
Aberaeron	08:08	11:38	15:08	18:38
Aberystwyth	08:47	12:17	15:47	19:17
Machynlleth	09:30	13:00	16:30	20:00
Dolgellau	10:07	13:37	17:07	20:37
Porthmadog	10:50	14:20	17:50	21:20
Caernarfon	11:30	15:00	18:30	22:00
Bangor	11:46	15:16	18:46	22:16

Table 4.5: Example Southbound 4cpd Timetable
Note: Darker shaded rows highlight rail interchanges

Stop	Coach 3	Coach 4	Coach 1	Coach 2
Bangor	07:00	10:30	14:00	17:30
Caernarfon	07:27	10:57	14:27	17:57
Porthmadog	08:02	11:32	15:02	18:32
Dolgellau	08:48	12:18	15:48	19:18
Machynlleth	09:21	12:51	16:21	19:51
Aberystwyth	10:04	13:34	17:04	20:34
Aberaeron	10:40	14:10	17:40	21:10
Llandysul	11:10	14:40	18:10	21:40
Carmarthen	11:42	15:12	18:42	22:12

Table 4.6: Example Northbound 8cpd Timetable
Note: Darker shaded rows highlight opportunities for interchange with rail services

Stop	Coach 1	Coach 2	Coach 3	Coach 4	Coach 5	Coach 6	Coach 1	Coach 5
Carmarthen	05:30	07:30	09:30	11:30	13:30	15:30	17:30	19:30
Llandysul	06:04	08:04	10:04	12:04	14:04	16:04	18:04	20:04
Aberaeron	06:38	08:38	10:38	12:38	14:38	16:38	18:38	20:38
Aberystwyth	07:17	09:17	11:17	13:17	15:17	17:17	19:17	21:17
Machynlleth	08:00	10:00	12:00	14:00	16:00	18:00	20:00	22:00
Dolgellau	08:37	10:37	12:37	14:37	16:37	18:37	20:37	22:37
Porthmadog	09:20	11:20	13:20	15:20	17:20	19:20	21:20	23:20
Caernarfon	10:00	12:00	14:00	16:00	18:00	20:00	22:00	00:00
Bangor	10:16	12:16	14:16	16:16	18:16	20:16	22:16	00:16

Table 4.7: Example Southbound 8cpd Timetable
Note: Darker shaded rows highlight opportunities for interchange with rail services

Stop	Coach 4	Coach 5	Coach 6	Coach 1	Coach 2	Coach 3	Coach 4	Coach 5
Bangor	05:30	07:30	09:30	11:30	13:30	15:30	17:30	19:30
Caernarfon	05:57	07:57	09:57	11:57	13:57	15:57	17:57	19:57
Porthmadog	06:32	08:32	10:32	12:32	14:32	16:32	18:32	20:32
Dolgellau	07:18	09:18	11:18	13:18	15:18	17:18	19:18	21:18
Machynlleth	07:51	09:51	11:51	13:51	15:51	17:51	19:51	21:51
Aberystwyth	08:34	10:34	12:34	14:34	16:34	18:34	20:34	22:34
Aberaeron	09:10	11:10	13:10	15:10	17:10	19:10	21:10	23:10
Llandysul	09:40	11:40	13:40	15:40	17:40	19:40	21:40	23:40
Carmarthen	10:12	12:12	14:12	16:12	18:12	20:12	22:12	00:12

Table 4.8 and 4.9 contain indicative timetables for an 8cpd option with late start and early termination at the mid-point Aberystwyth. This is presented on the basis that there could potentially be higher demand to a mid-point location at the start/end of the day, and to allow connections with the wider rail network, with operational cost savings vis-à-vis full route operation.

Whilst no detailed assessment on the cost savings, this is likely to be linear (i.e., circa 12% lower operational cost). Equally this change may have an equivalent slight negative impact on demand (due to reductions in the frequency of services from longer-distance origin/destination pairs) but this has not been assessed in detail at this stage. It is also noted that the existing T1/T2 services could facilitate shorter journeys at alternative times (albeit with longer journey times).

The impact of such timetable amendments could be explored further once the availability of funding for the proposed service is confirmed, and as part of detailed operational timetabling / staff rostering during the operator procurement exercise. UK Drivers' Hours regulations will necessitate a rostering of staff with local bus services to facilitate a driver swap at Aberystwyth which will require comprehensive planning by operator(s) at a future procurement stage. In addition, termination of services at Aberystwyth would require additional stabling and supporting infrastructure (e.g. chargers) for two coaches.

Finally, for all 8cpd and mid-point timetables presented across Tables 4.6 – 4.9, certain coaches conducting the full route service (i.e. not terminating at Aberystwyth) would need to terminate at alternate ends of the route every other day, potentially causing operational issues (e.g. if facilities cannot be shared, or more than one operator is chosen for the service). If this proves problematic, adjustments to scheduling could be made to ensure identical departure and termination locations.

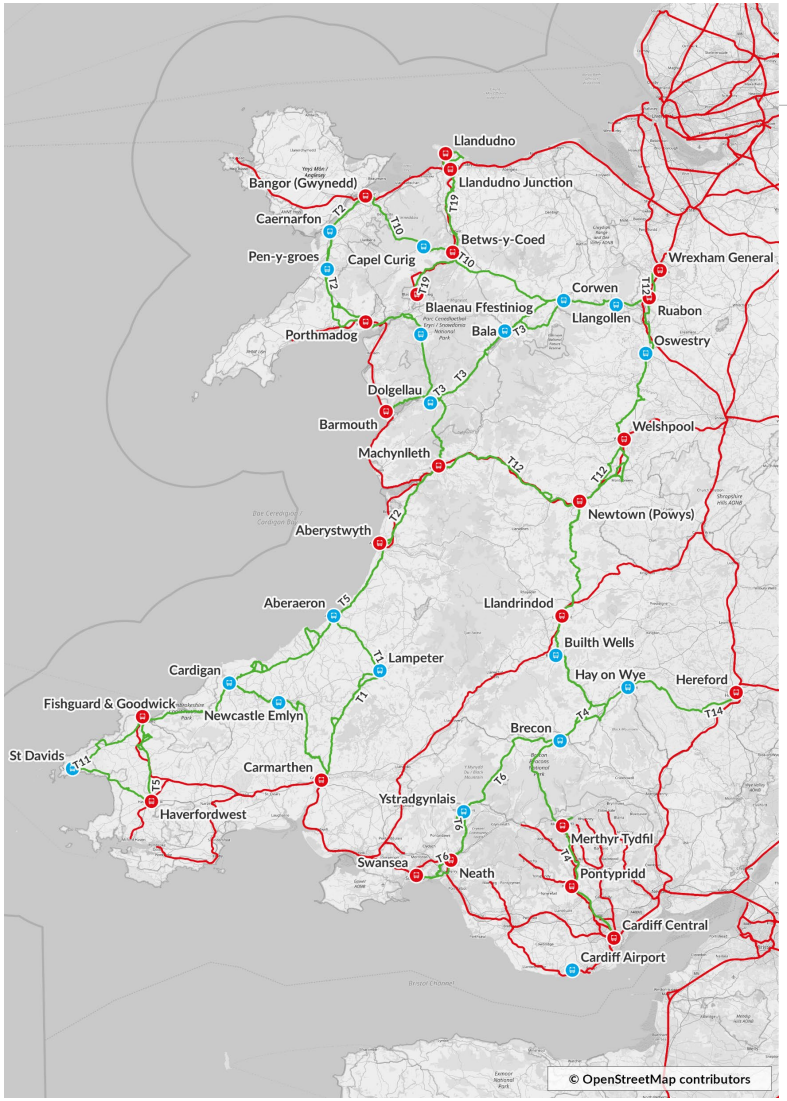
Table 4.8: Example Northbound 8cpd Timetable (late start / early termination at mid-point Aberystwyth)
Note: Darker shaded rows highlight opportunities for interchange with rail services

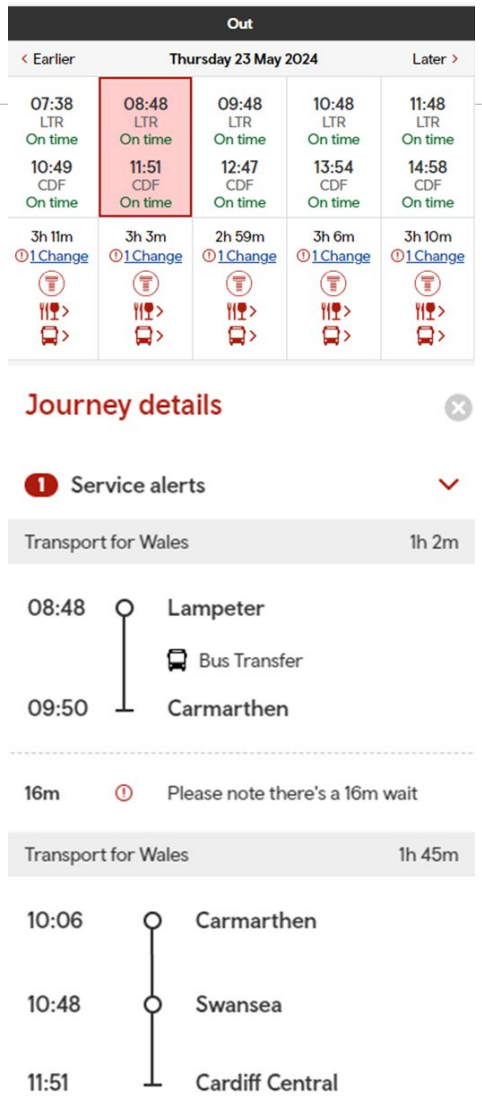
Stop	Coach 1	Coach 2	Coach 3	Coach 4	Coach 5	Coach 6	Coach 1	Coach 5
Carmarthen	-	07:30	09:30	11:30	13:30	15:30	17:30	19:30
Llandysul	-	08:04	10:04	12:04	14:04	16:04	18:04	20:04
Aberaeron	-	08:38	10:38	12:38	14:38	16:38	18:38	20:38
Aberystwyth	07:17	09:17	11:17	13:17	15:17	17:17	19:17	21:17
Machynlleth	08:00	10:00	12:00	14:00	16:00	18:00	-	22:00
Dolgellau	08:37	10:37	12:37	14:37	16:37	18:37	-	22:37
Porthmadog	09:20	11:20	13:20	15:20	17:20	19:20	-	23:20
Caernarfon	10:00	12:00	14:00	16:00	18:00	20:00	-	00:00
Bangor	10:16	12:16	14:16	16:16	18:16	20:16	-	00:16

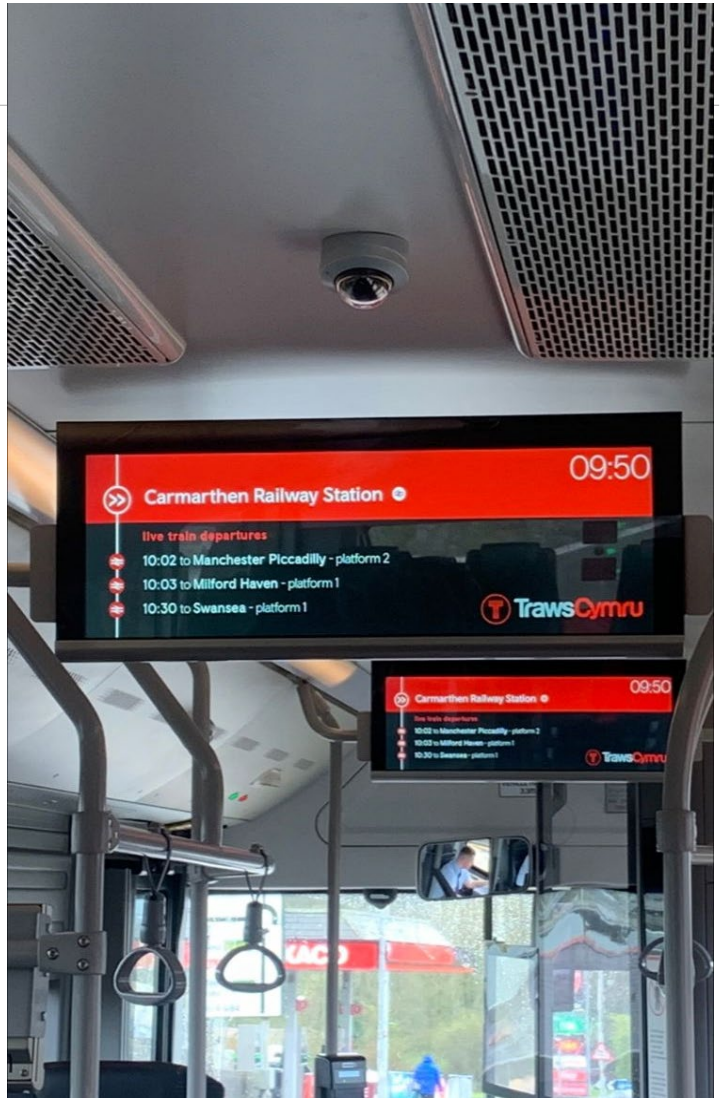
Table 4.9: Example Southbound 8cpd Timetable (late start / early termination at mid-point Aberystwyth)
Note: Darker shaded rows highlight opportunities for interchange with rail services

Stop	Coach 4	Coach 5	Coach 6	Coach 1	Coach 2	Coach 3	Coach 4	Coach 5
Bangor	-	07:30	09:30	11:30	13:30	15:30	17:30	19:30
Caernarfon	-	07:57	09:57	11:57	13:57	15:57	17:57	19:57
Porthmadog	-	08:32	10:32	12:32	14:32	16:32	18:32	20:32
Dolgellau	-	09:18	11:18	13:18	15:18	17:18	19:18	21:18
Machynlleth	-	09:51	11:51	13:51	15:51	17:51	19:51	21:51
Aberystwyth	08:34	10:34	12:34	14:34	16:34	18:34	20:34	22:34
Aberaeron	09:10	11:10	13:10	15:10	17:10	19:10	-	23:10
Llandysul	09:40	11:40	13:40	15:40	17:40	19:40	-	23:40
Carmarthen	10:12	12:12	14:12	16:12	18:12	20:12	-	00:12

Figure 4.5: Examples of TfW Bus-Rail Integration which would be adopted for the proposed service







4. Option Development: Service Design

Higher frequency service options require additional subsidy, but better match operating hours of the rail network to facilitate interchange

4.5 Service Design Options Shortlist

Using the evidence base explored in section 4.2, Table 4.10 below summarises the success of the explored bus service frequencies and how they measure up against the service design critical success factors.

Table 4.10: Shortlisted Service Design Options

Critical Success Factor	Do Nothing: No coach service	Option 1: 2 coaches per day	Option 2: 4 coaches per day	Option 3: 6 coaches per day	Option 4: 8 coaches per day	Option 5: 9 coaches per day	Option 6: 10 coaches per day
CSF1: Must not take demand from other services.	No change	Yes: Stimulates demand on other services	Yes: Stimulates demand on other services	Yes: Stimulates demand on other services	Partial: Takes moderate demand long-distance demand off other services	No: Likely to significantly impact demand for existing TrawsCymru services	No: Likely to significantly impact demand for existing TrawsCymru services
CSF 2: Must replicate and integrate with rail	No change	No: Low frequency means longer waits	No: Low frequency means longer waits	Partial: Low frequency means longer waits	Yes: 2hr frequency matches other local services	Yes: 2hr frequency matches other local services	Yes: 1.5hr frequency exceeds other local services
CSF 3: Must be allow for electric vehicle charging	No change	Yes: Charging time requirements achievable	Yes: Charging time requirements achievable	Yes: Charging time requirements achievable	Yes: Charging time requirements achievable	Yes: Charging time requirements achievable	Yes: Charging time requirements achievable
CSF 4: Must balance the cost with demand	No change	Yes: Little increase in demand, but low cost	Yes: Moderate increase in demand, but lower cost	Partial: Increase in demand, moderate cost	Partial: Increase in demand, moderate cost	Partial: Diminishing increase in demand, but high cost	No: Diminishing increase in demand, but very high cost
Other Comments	Does not contribute to the WelTAG objectives, or meet the political ambition for the project	Limited improvement to connectivity. Buses may be overcrowded at peak times	Provides a lower cost alternative, although poor level of service when compared to rail services	Provides a lower cost alternative, although poor level of service when compared to rail services	On-balance considered the best option to meet the CSFs, and deliver on the political ambition for the service	Has potential for operational efficiencies with broadly comparable demand to 10cpd	Limited benefit over 9cpd option
Decision	Discount	Discount	Carried Forward	Carried Forward	Preferred Way Forward	Carried Forward	Discount

5. Option Development: Vehicle and Supporting Infrastructure

5. Option Development: Vehicle and Supporting Infrastructure

Critical success factors for the vehicle and supporting infrastructure are largely defined by the long-distance nature of the route

5.1 Vehicle and Infrastructure Critical Success Factors

The selection of an appropriate vehicle for deployment on the express coach route will require the concurrent evaluation of a number of interdependent critical success factors (CSFs). For example, the vehicle chosen needs to be affordable over the course of its lifetime – total cost of ownership (TCO); it must not require prohibitively complex supporting infrastructure or maintenance regimes; and it must be feasible to deploy in required time frames. The CSFs considered in this section are described in Table 5.1. Each factor is supported by key performance indicators (KPIs) where applicable.

Table 5.1: Critical success factors for vehicle and supporting infrastructure options

Critical Success Factor and Description	Possible KPI(s)
Comfort and Amenities: The vehicle chosen must provide the necessary comfort levels required for this long-distance route. This could be demonstrated by, but is not limited to, low general cabin noise, vibration, and harshness; reclining seats and tables for work or food/drink consumption; toilet facilities, internet access, luggage storage, extra leg room, and power sockets.	• No. of amenities provided. • Toilet (Y/N)
Performance: The vehicle and supporting infrastructure chosen must be capable of the fuel/energy storage capacity and subsequent range required to complete the long-distance route. Performance variation under differing operating conditions must be considered and, high-level supporting infrastructure design to attain the performance (e.g., charging infrastructure ratings).	• Energy/fuel consumption per unit distance and variation
Accessibility: The vehicle selected must comply with the Public Service Vehicles Accessibility Regulations 2000 (PSVAR) which requires vehicle to have a space for a wheelchair and its safety provisions, a boarding device for wheelchair users, priority seats for disabled passengers, bell pushes, handrails and audio/visual (A/V) based signals for various functions including route/destination information and/or stopping the vehicle etc.	• PSVAR compliance (Y/N)
Emissions and Air Quality: TfW have a clear ambition to decarbonise transport services within Wales. For example, the TrawsCymru fleet is to be zero emission by 2035 and the wider bus fleet is to be 50% zero emission (prioritised based on emissions) and 100% zero emission by 2028 and 2035 respectively. These emissions targets coincide with a desire to reduce transport related air quality impacts – typically from noxious pollutants and particulate matter (PM). Therefore, the selection of a low-emission vehicle that also has low air pollution potential is also a priority.	• LCA emissions (CO2e) • Air pollution contribution (e.g., PM)
Reliability: Vehicles and supporting infrastructure on this route will need to be reliable over a long period of time to minimise potential downtime and financial loss. Where failures do occur or repairs are planned/required, the expected staff training, facilities, and high-level ease of vehicle and/or infrastructure upkeep needs to be understood – especially for novel vehicle/infrastructure technologies.	• Expected vehicle, infrastructure and/or component lifespan
Vehicle and Infrastructure Cost (Capital and Operating): Vehicle TCO is a fundamental measure to aid in the selection of a vehicle for a public transport service. Often, vehicle operational costs (e.g., due to maintenance, operator salaries and fuel requirements) can outweigh initial vehicle capital outlay. Vehicle TCO will be considered in conjunction with an estimate for supporting infrastructure cost.	• Estimated TCO (£)
Practicality: The feasibility of a vehicle and supporting infrastructure choice depends on many variables such as but not limited to vehicle/infrastructure procurement and commissioning by circa. 2026 (planned service start date); new staff hiring/training, vehicle swept path analysis, and preferred ownership models (incl. alignment with bus franchising).	• Swept path analysis outcome (Y/N)

5. Option Development: Vehicle and Supporting Infrastructure

Based on assessment against the CSFs, use of a bus is not recommended for the route, and coach powertrain options are limited

5.2 Vehicle and Infrastructure Option Identification

The following section draws on the requirements of each CSF to provide a shortlist of vehicle and supporting infrastructure options. The section begins by exploring the potential to utilise a bus (with some long-distance amenities) to potentially 'de-risk' the upfront investment in the proposed service. Table 5.2 contains an overview of coaches and buses that could be fitted with some coach amenities.

Table 5.2: Comparison of coach and bus operating conditions.

Element	Bus	Coach
Typical purpose	Local or regional travel stopping frequently along a route.	Long-distance travel, making fewer stops along a route.
Seating and capacity	Lower seating capacity per unit area as sanding space available for busy periods. Vehicle seating could be upgraded to be more padded/recline. Limited legroom unless seats removed.	Higher seating capacity per unit area as standing space is generally not provided. Vehicles contain comfortable, reclining seats with more legroom and footrests.
Other amenities	Buses cannot be specified with on-board toilets due to their low floor; they rarely have luggage storage (e.g., like airport buses), tables or on-board entertainment, but often have Wi-Fi and power outlets (likely USB).	Coaches often have on-board toilets and formal luggage storage due to their high floors. They can have Wi-Fi for passenger use, more comprehensive power outlets, tables, and on-board entertainment systems.
Accessibility	Buses often have level boarding (where raised kerbs are provided) for quick wheelchair access. Priority seating areas are available for passengers with disabilities, A/V equipment helps visually or audibly impaired users.	Due to high floors, coaches require wheelchair lifts which lengthen dwell times at stops. Some coaches have split floor levels for level boarding. Wheelchair spaces, priority seating and A/V messaging are specifiable.

[1] Low carbon and HVO fuels likely 'main focus' in coach (route-one.net)
[2] First biogas coaches (Iveco and Scania) in Europe by Flixbus & Flixbus and Scania 50 LNG-powered Irizar i6s.
[3] Irizar i4H: A coach for tomorrow's cities, today - Irizar UK Coach Sales
[4] Temsa HD Fuel Cell hydrogen-powered coach makes debut - routeone (route-one.net)

Overall, due to this study's route length, the use of low floor buses, even with some coach amenities is not recommended as buses cannot be specified with a toilet due to their low floor configurations. Moreover, noise, vibration and harshness is likely to be worse for a bus given its chassis / suspension characteristics.

Alternative coach powertrain technology options

Powertrains comprise all vehicle components that generate power and deliver it to the road surface to provide motion. Coach powertrain options have generally lagged buses due to the smaller market size of this classification of vehicle. Furthermore, there are barriers to importing vehicles to the UK from vehicle manufacturers who typically produce left hand drive vehicles. The following list contains coach powertrain technologies that are available now/in the short term (2025) on the UK market:

Conventional internal combustion coaches are fuelled with diesel or lower carbon 'drop-in' fuels e.g., hydrotreated vegetable oil (HVO)[1] or other bio/electro fuels.

Alternative internal combustion coaches typically utilise gaseous fuels (e.g., compressed methane or similar gases) which have lower lifecycle emissions, still produce combustion by-products and are currently available in Europe[2].

Hybrid internal combustion coaches are the same as conventional internal combustion coaches but utilise an additional powertrain (usually battery electric) to augment their operation. Only hybrid coach available is from Irizar[3].

Battery electric coaches utilise electrical energy stored within a battery to power an electric motor. Yutong are currently the only manufacturer in the UK.

Hydrogen fuel cell coaches' storage gaseous hydrogen and supply it to a fuel cell to generate electricity which is utilised by a battery electric powertrain. The only hydrogen fuel cell coach widely publicised in the UK is the Temsa HD available from 2025[4].

5. Option Development: Vehicle and Supporting Infrastructure

Hydrogen and gas-powered vehicles are not recommended. Diesel, hybrid and battery electric options are carried forward.

5.2 Vehicle and Infrastructure Option Identification (Continued)

Discounting compressed gas and hydrogen fuel cell coaches

Due to the lack of established gas-powered or hydrogen fuel cell coach options in the UK at the time of writing, these powertrains have been discounted. However, some investigation of the technology options was carried out (for buses), concluding that there is uncertainty surrounding the efficacy of both powertrains. There is disagreement amongst operators on the use of compressed natural gas (CNG) buses (biomethane, biogas or fossil fuel derived). Generally, they consume more energy than equivalent diesel buses, but the procurement of gas produced via anaerobic digestion has a strong potential to reduce lifecycle GHG emissions[1]. Transport for London (TfL) recently stated that *"given the effectiveness of Euro VI emissions standards, gas-powered buses no longer offer a significant air quality benefit"* and they have *"considerable cost and logistical constraints"* however, FirstGroup have deployed gas-powered buses due to lower upfront cost[2].

The potential for fugitive emissions (i.e., leaked methane) from gas supply chains is also a concern due to its high GHG potential[3]. Similar infrastructural concerns also exist for hydrogen, as there are currently not enough refuelling stations to provide a viable public transport corridor[4] and recent studies indicate that fuel cell buses are more costly to operate than battery electric[5] and fuel prices can be volatile.

Analysis of diesel, hybrid and battery electric coaches against CSFs

To reach a final shortlist of powertrains, this section considers diesel, hybrid, and battery electric coaches against the CSFs.

Comfort/amenities: the three coaches will offer the comfort and amenities required for the proposed coach route, however, there is slight concern that luggage capacity could be constrained on certain battery electric coaches. For guidance 10.5m has been stated to be National Express' luggage capacity requirement[6].

Performance: the coach options will all be capable of completing the North-South route. However, battery electric coaches will need to be recharged regularly. Due to the outer-urban nature of the route, a hybrid powertrain may not perform well.

Accessibility: all coaches considered can be made PSVAR compliant.

Emissions/air quality: battery electric coaches produce zero exhaust emissions and reduce air pollution. Hybrid coaches can reduce fuel use by 20%[7] and thus emissions and air pollution. HVO could reduce diesel or hybrid coach lifecycle emissions however its sustainability and cold weather performance is uncertain[8].

Reliability: Diesel coaches are well established; battery electric and hybrid powertrains have proved reliable in other vehicles but are less established.

Cost CAPEX: hybrid and battery electric coaches are more expensive than a typical diesel coach. They also require the development of infrastructure to support their operation. The market for used diesel coaches could reduce capital costs.

Cost OPEX: diesel and hybrid coaches are less efficient than battery electric coaches leading to higher energy consumption per unit distance. Internal combustion powertrains have more moving parts and hybrid powertrains are complex so could require more maintenance[9].

Practicality: the coach route is likely to reduce the efficacy of a hybrid powertrain (as its not urban) and so its additional cost, complexity and emissions makes it hard to recommend versus a conventional diesel coach. The battery electric coach will require more analysis to determine its feasibility, considered overleaf.

[1] Low Emission Bus Scheme monitoring programme (publishing.service.gov.uk)
[2] BUS TECH CNG (tfl.gov.uk)
[3] Methane emissions along biomethane and biogas supply chains are underestimated - ScienceDirect
[4] The path to zero emission for the coach
[5] Monitored data and social perceptions analysis of battery electric and hydrogen fuelled buses
[6] The path to zero emission for the coach sector
[7] Irizar i4H: A coach for tomorrow's cities, today
[8] https://www.mdpi.com/1996-1073/4/6/845
[9] Low Emission Bus Scheme monitoring programme

5. Option Development: Vehicle and Supporting Infrastructure

Hybrid is discounted after analysis against critical success factors, detailed analysis of diesel and battery electric is needed

5.2 Vehicle and Infrastructure Option Identification (Continued)

Table 5.3 contains a summary mapping of CSFs against coach options. Diesel and battery electric coach powertrains are the final shortlisted options.

Table 5.3: CSFs mapped against coach options.

CSF	Diesel	Hybrid Diesel Electric	Battery Electric
Comfort/Amenities	Yes	Yes	Partial
Performance	Yes	Partial	Partial
Accessibility	Yes	Yes	Yes
Emissions/Air Quality	No	No	Yes
Reliability	Yes	Partial	Partial
CAPEX	Yes	No	No
OPEX	Partial	Partial	Yes
Practicality	Yes	No	Partial
Shortlist Decision	Shortlist	Discount	Shortlist

Detailed analysis of shortlisted coaches (diesel and battery electric)

As part of the project, Arup engaged with stakeholders who operate/manufacturer coaches so the state-of-the-art could be re-affirmed. Overall, the Yutong GTe14, TCe12, Caetano Levante 3A, Levante 2 and Van Hool T917 retrofitted to electric by Equipmake for Westway coaches were selected for analysis. Detailed specifications of all vehicles can be found in Table 5.5 on the next page. Note that all vehicles are PSVAR compliant. Figures 5.1 and 5.2 depict changes in battery State of Charge (SoC) over a return journey of the proposed route for the Yutong GTe14 and TCe12. SoC is assumed to begin at 95% (to account for travel to/from route start/end locations). The coaches are assumed to use their maximum charge rate. Energy consumption is based on manufacturer data and Zemo Certificates.

Figure 5.1: Yutong TCe12 – 30min 120kW charge.

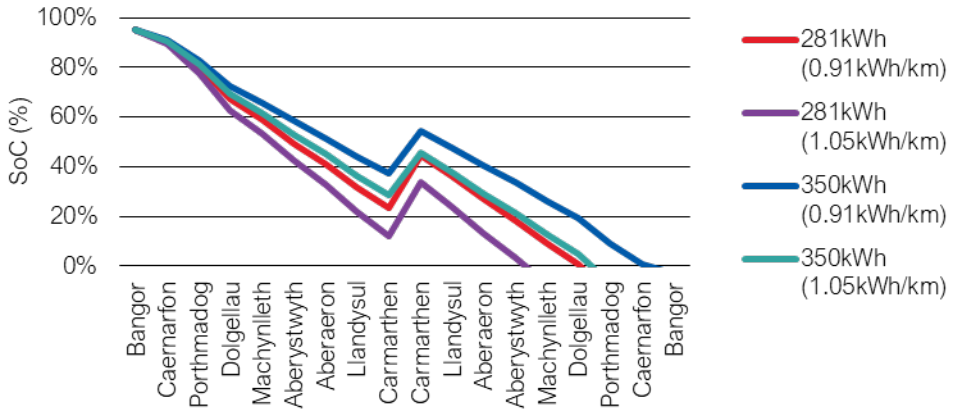
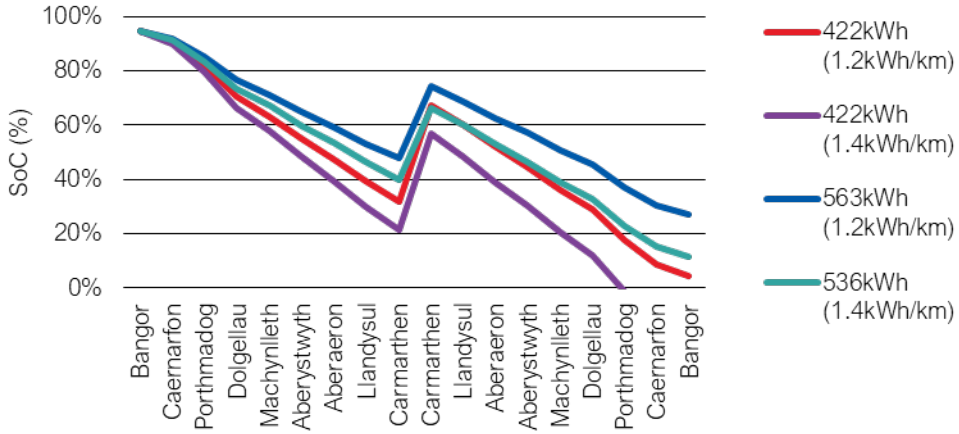


Figure 5.2: Yutong GTe14 – 30min 300kW charge.



5. Option Development: Vehicle and Supporting Infrastructure

Detailed investigation discounts the Yutong TCe12 and Van Hool T917, supporting infrastructure for the GTe14 is considered

5.2 Vehicle and Infrastructure Option Identification (Continued)

Results suggest that the TCe12 and retrofit are both not capable of completing a return journey without longer charge times. Hence, the TCe12 and T917 are discounted. The 563kWh GTe14 can complete the route and is therefore carried forward. It is noted that the proposed express coach route is likely analogous to a rural or outer-urban drive cycle, this could lead to lower vehicle energy consumptions than tested in previous calculations see Table 5.4.

Table 5.4: 281kWh TCe12 energy use variation.

	Rural	Outer Urban	Inner Urban
Energy Consumption (kWh/km)	0.69	0.97	1.33
Compared to 0.91kWh/km	-24%	+7%	+46%
Compared to 1.05kWh/km	-34%	-8%	+27%

Due to the long ranges of both diesel coaches (circa. 1,100 km+) and low refuelling time, these vehicles will be able to comfortably perform the desired route. It should be noted that the used diesel vehicle could have worse range and fuel economy than stated due to degradation over time. This is not a concern.

Supporting infrastructure required – Yutong GTe14

There are two types of charging infrastructure appropriate for the Yutong GTe14: conventional plug-in charging and opportunity charging (that uses an automatic connection device such as a pantograph). Note that these options are not exclusive i.e., the coach could use a combination of the two technologies. The best type of infrastructure will depend on factors such as scheme budget, implementation roadmap, PVR, proposed sharing of infrastructures etc. Pantograph charging is generally used along routes with high PVRs to 'top-up' vehicles using short duration, high-power transfers of energy. This system also can allow for a reduction in vehicle battery capacity, reducing its mass and thus energy consumption. Due to the characteristics of this express coach service, it is suggested that opportunity charging should be discounted to minimise scheme delivery complexity.

Table 5.5: Shortlisted coaches – detailed specifications

Specification	Caetano		Yutong		Van Hool
	Levante 3A	Levante 2	TCe12	GTe14	T917
Condition	New	Used	New	New	Retrofitted
Price	£378,000[1]	£120,000[2] (+ refurb)	£305,000 - £360,000	£515,000	£250,000
Battery/fuel	500L	500L	281kWh (A) / 350kWh (B)	422kWh & 563kWh	545kWh (or higher)
Charger rating	N/A	N/A	120kW (dual port)	300kW	150kW
Energy/fuel use	35 – 45 L/100km	35 – 45 L/100km	0.91 – 1.05 kWh/km	1.2 – 1.4 kWh/km	1.54kWh/km
Range estimate	1111 – 1429km	1111 – 1540km	267 to 385km	402 to 469km	354km
Unladen weight	16,600kg	16,600kg	13,500kg	18,600kg	Unknown
L/W/H (mm)	14300/2550/3850	14300/2550/3850	12365/2550/3400	13970/2550/3900	13840/2550/3750
Capacity (seated)	53	56	50 (A) 46 (B)	53	54
Luggage capacity	10.3m^3	10.3m^3	5m^3 (A) 3.5m^3 (B)	8.25m^3	>10m^3

[1]Edwards to add 86 new coaches - routeone (route-one.net) [2]2018 (67) - Scania Caetano Levante (basecoachsales.com)

5. Option Development: Vehicle and Supporting Infrastructure

Future work should determine a preference for standalone or shared charging infrastructure, and synergies with bus franchising

5.2 Vehicle and Infrastructure Option Identification (Continued)

Standalone and shared infrastructure

To facilitate a GTe14 charging at 300kW for 30 minutes at each terminus station as per Figure 5.2 a plug-in charger rated at 300kW or more will be required at Bangor and Carmarthen. This charging arrangement aims to keep the PVR of the services as low as possible. Although infrastructure could be installed between Carmarthen and Bangor this service is aiming to dwell for as short a period as possible to minimise delay to passengers.

Overall, one charge point will be needed per vehicle with the total number of chargers installed split 50:50 at Bangor and Carmarthen. When this infrastructure and installation location is specified, it should be determined if this is to be standalone infrastructure for this service or infrastructure that can be shared with other services. Several factors could influence this decision including but not limited to:

- Final number of vehicles servicing the route
- Electrical supply headroom at terminus stations
- Number of services that could travel to installation
- Infrastructure budget / planned future investments
- Future policy developments e.g., TfW depot strategy or franchising roll-out
- Availability of existing infrastructure

Existing infrastructure

Carmarthen has several charge points (circa. 60kW) available at the new T1 charging hub at Nant-y-Ci. This facility is near Carmarthan Grid substation which has headroom of over 20MVA and a solar farm. There are limited spatial constraints, and this location is 6 minutes from the terminus station in Carmarthen. It is recommended that this existing hub be upgraded to provide 300kW chargers for the coach.

Figure 5.3: Nant-y-Ci hub for T1 (Carmarthen park & ride)

Tanygrisiau has chargers planned for deployment for the T19 and T22 Traws Cymru services, however, this location is 1hr from Bangor and so is discounted.

Bangor does not currently have charging facilities, however substation headroom in the region is likely to be adequate for standalone infrastructure at the rail station. If a shared charging hub like Nant-y-Ci is desired, Bryn Cegin industrial estate is a prospective location to create such a facility. This could support T2 and T10 services and is already being used as a gas refuelling station for HGVs. The site also has its own substation. It is recommended that future work investigate both a charging hub at this location and/or standalone chargers at the terminus station.

Additional considerations

Infrastructure will be required to support coach maintenance, driver rest, overnight vehicle storage/charging (potentially at lower power levels). Facilities may need to be built/repurposed, and staff hired for the future service. Note that existing facilities could also be let/shared e.g., Arriva has a bus depot in Bangor, similarly Carmarthen has several bus/coach depots in the nearby area. The future roll-out of franchising, the TfW depot strategy and nearby projects to this service (e.g., Bangor gateway) should be monitored closely in future phases of work. The deliverability and management dimensions of this study discuss these considerations in more detail later.

5. Option Development: Vehicle and Supporting Infrastructure

The preferred option is to acquire used diesel coaches for a trial period in the short-term, with transition to battery electric coaches

5.3 Shortlisted Options

Table 5.6 provides an overview of option development and shortlisting for vehicle and supporting infrastructure, including an assessment against the CSFs.

Table 5.6: Shortlisted options – vehicles and supporting infrastructure

Vehicle and Supporting Infrastructure Options	Option Description / Assessment Summary	Comfort	Performance	Accessibility	Emissions	Reliability	CAPEX	OPEX	Practicality	Shortlist Decision
Do Nothing: Existing T1, T1C and T2	No new coach service and existing bus service is utilised for North-South travel. Option is not advisable given the strategic need of this service in line with cooperation agreement.	No	Partial	Yes	Partial	Partial	Yes	Yes	Partial	Discounted
Option 1: Used diesel coach with no new infrastructure	Acquire used diesel coaches to run the service, this saves on up front capital spend and could be faster to deliver for a PVR of 4-6 vehicles. Used vehicles may need to be refurbished. Used diesel coaches are viable in the short term to trial the service (e.g., 2026-2028). Though at a higher service PVR sourcing used coaches could be problematic. Operational life of a used vehicle would not be expected to be particularly long. Refurbishment cost needs to be explored.	Yes	Yes	Yes	No	Partial	Yes	Partial	Yes	Carried forward
Option 2: New diesel coach with no new infrastructure	Acquire new diesel coaches to service the route. Initial CAPEX would be higher, but coaches will likely be more reliable/ efficient than used coaches. Given new coach lifespan is 15-30 years this may increase timeline to decarbonise Welsh public transport. New vehicles would ensure emissions till circa. 2050 even if the vehicles were not used on this route in future.	Yes	Yes	Yes	No	Yes	Partial	Partial	Yes	Discounted
Option 3: Used diesel coach with transition to battery electric	Acquire used diesel coaches for a trial of the service (e.g., 2026-2028) then transition the fleet to battery electric and install supporting infrastructure. Option reduces upfront CAPEX and de-risks future CAPEX spend e.g., future PVR and infrastructure can be better determined based on real-world performance. Impact of potentially lengthy new vehicle lead times can be abated as coaches can be phased in. Potential new powertrain technologies can be used if they become available. Time to align with franchising/depot strategy possible.	Yes	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Preferred way forward
Option 4: Battery electric coach and standalone charging infrastructure	Purchase battery electric coaches to operate service. Install a standalone charging infrastructure at terminus stations for these coaches. Option prioritises decarbonisation, minimises infrastructure spend and complexity to deliver zero emission coach service. However, at higher PVRs this option will become less feasible due to the number of coaches charging. Also does not maximise collaboration with other services that may be decarbonising or incentivise them to do so.	Yes	Yes	Yes	Yes	Partial	Partial	Yes	Yes	Carried forward
Option 5: Battery electric coach with shared charging infrastructure	Purchase battery electric coaches to operate service and a more comprehensive charging infrastructure that can be shared by other local services akin to T1 charging hub. Option prioritises decarbonisation and the support for / collaboration with other services undergoing a similar transition. Deliverability needs to be closely investigated to mitigate risks e.g. lead times. Capital outlay could be higher but potential benefits spread across other services etc.	Yes	Yes	Yes	Yes	Partial	No	Yes	Partial	Carried forward

6. Well-being Dimension

6. Well-being Dimension

The integrated well-being appraisal is used to assess shortlisted options and confirm the preferred option combination

6.1 Option Development and Sifting Summary

The purpose of the well-being dimension is to present the expected impacts of the options. As previously noted, this WelTAG report seeks to undertake option development and initial appraisal against Critical Success Factors for each of the route design, service design, and vehicle and supporting infrastructure options. As identified in Table 6.1 and Table 6.2, the initial sifting has discounted some options, identified a preferred option in each case and carried forward some alternatives for assessment within the well-being appraisal. The emerging preferred option is a limited stop express coach service, building up to a frequency of 8 coaches per day to match the expectations of a rail-like service and maximise opportunities for interchange with the wider rail network, initially using used diesel coaches in the short term with transition to electric coaches and supporting infrastructure. This set of preferred options is tested within this well-being dimension.

An integrated well-being appraisal (IWBA) has been carried out according to the WelTAG 2024 guidance to comprehensively assess the impact of the proposed project on the well-being of communities in Wales and to narrow down the shortlist of options. The approach qualitatively evaluates the various shortlisted options for this coach service could align with Wales' four well-being ambitions and transport targets. This appraisal identifies both positive and negative impacts, addresses key questions related to people and communities, the environment, places and the economy, and culture and the Welsh language. The scoring methodology of this IWBA follows a large, moderate and slight beneficial to slight, moderate and large adverse consequence scale as shown in the tables. Notably, the scores are qualitative and not Benefit Cost Ratios (BCRs), as socio-economic benefits have not been quantified. The full IWBA can be found in Appendix C.

Table 6.1: Option Development and Sifting Summary

Option Topic	Critical Success Factors				Objectives				
Route Design Option	1: Enhance Services	2: Journey Time	3: Stop Locations	4: User Groups	1: Improve NS Connectivity	2: Improve PT Integration	3: Low Carbon Economy	4: Long Term and Resilient	Sifting Decision
Express Bus Service	Amber	Red	Green	Red	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Discounted
Intermediate Stopping Coach Service	Green	Amber	Green	Amber	Moderate beneficial	Moderate beneficial	Slight beneficial	Slight beneficial	Carried forward
Limited Stop Express Coach (+Aber Uni)	Green	Green	Green	Green	Large beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Preferred Option
Limited Stop Express Coach	Green	Green	Amber	Amber	Large beneficial	Moderate beneficial	Moderate beneficial	Slight beneficial	Carried forward
Very Limited Stop Express Coach	Green	Green	Red	Amber	Moderate beneficial	Moderate beneficial	Slight beneficial	Slight beneficial	Discounted
Service Design Option	1: Enhance Services	2: Rail Integration	3: EV Charging	4: Cost ~ Demand	1: Improve NS Connectivity	2: Improve PT Integration	3: Low Carbon Economy	4: Long Term and Resilient	Sifting Decision
2 coaches per day	Green	Red	Green	Green	Slight beneficial	Slight beneficial	Slight beneficial	Large beneficial	Discounted
4 coaches per day	Green	Red	Green	Green	Moderate beneficial	Slight beneficial	Slight beneficial	Moderate beneficial	Carried Forward
6 coaches per day	Green	Amber	Green	Amber	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Carried Forward
8 coaches per day	Amber	Green	Green	Amber	Large beneficial	Large beneficial	Moderate beneficial	Moderate beneficial	Preferred Option
9 coaches per day	Red	Green	Green	Amber	Large beneficial	Large beneficial	Moderate beneficial	Slight beneficial	Carried Forward
10 coaches per day	Red	Green	Green	Red	Large beneficial	Large beneficial	Moderate beneficial	Slight beneficial	Discounted

6. Well-being Dimension

The integrated well-being appraisal confirms the preference for the shortlisted options to the combination depicted in Figure 6.1

6.2 Integrated Well-being Appraisal

Table 6.2: Option Development and Sifting Summary Continued

Vehicle Design and Supporting Infrastructure Option	1: Comfort	2: Performance	3: Accessibility	4: Emissions	5: Reliability	6: CAPEX	7: OPEX	8: Practicality	1: Improve N-S Connectivity	2: Improve PT Integration	3: Low Carbon Economy	4: Long Term and Resilient	Sifting Decision
Used diesel coach	Green	Green	Green	Red	Amber	Green	Amber	Green	Moderate beneficial	Slight beneficial	Moderate adverse	Slight beneficial	Carried forward
New diesel coach	Green	Green	Green	Red	Green	Amber	Amber	Green	Moderate beneficial	Slight beneficial	Slight adverse	Moderate beneficial	Discounted
Used diesel coach + EV transition	Green	Green	Green	Amber	Green	Green	Green	Green	Moderate beneficial	Slight beneficial	Moderate beneficial	Large beneficial	Preferred Option
Battery electric coach + charging	Green	Green	Green	Green	Amber	Amber	Green	Green	Moderate beneficial	Slight beneficial	Large beneficial	Moderate beneficial	Carried forward
Battery electric + shared charging	Green	Green	Green	Green	Amber	Red	Green	Amber	Moderate beneficial	Slight beneficial	Large beneficial	Moderate beneficial	Carried forward

In summery, the options considered in this IWBA are as follows:

Route design:

- Option 2: Coach service with intermediate stops, focusing on town centre locations and rail stations, with two stops in larger towns/cities
- Preferred Option 3: Express coach with limited stops at town centre and rail station locations, features a single stop per town + Aberystwyth Uni.
- Option 4: Express coach with limited stops at town centre locations and rail stations, featuring a single stop per town.

Service design

- Option 2: 4 coaches per day
- Option 3: 6 coaches per day
- Preferred Option 4: 8 coaches per day
- Option 5: 9 coaches per day

Vehicle design and supporting infrastructure

- Option 1: Used diesel coach with no new infrastructure
- Preferred Option 3: Used diesel coach with transition to electric coach and supporting infrastructure.
- Option 4: Battery electric coach and standalone charging infrastructure.
- Option 5: Battery electric coach with shared charging infrastructure

The IWBA confirms the preference of route is an express coach with limited single stops in town centre locations and at rail stations. This route aims to optimise travel times while fostering community connectivity and contributing to the vitality of each town. A service frequency building to eight vehicles per day is recommended as the preferred service option. This option strikes a balance between efficiency, operational costs, reduced overcrowding and enhanced accessibility. In terms of vehicles and their supporting infrastructure, in the short term, used diesel coaches should be utilised as part of a 'trial period' then a transition to battery electric coaches should be completed should the service prove to be successful. This is favoured as it de-risks the introduction of the route, minimises initial capital spend and/or potential for waste. Future transition of coaches aligns with Wales's sustainability objectives, particularly the target for all buses in Wales to be zero tailpipe emission by 2035 outlined in Net Zero Wales.

Table 6.3: IWBA Summary and Preferred Options

Well-being aims	Route Option 2 Inter-mediate	Route Option 3 Express (+Aber Uni)	Route Option 4 Express	Service Option 2 4cpd	Service Option 3 6cpd	Service Option 4 8cpd	Service Option 5 9cpd	Vehicle + Infrastruc-ture Option 1 Diesel	Vehicle + Infrastruc-ture Option 3 Diesel - EV Transition	Vehicle + Infrastruc-ture Option 4 Electric Standalone	Vehicle + Infrastruc-ture Option 5 Electric Shared
Equality	Slight beneficial	Moderate beneficial	Moderate beneficial	Slight beneficial	Moderate beneficial	Large beneficial	Moderate beneficial	Slight beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial
Health	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight adverse	Neutral/No Impact	Neutral/No Impact	Slight beneficial
Confidence and safety	Slight beneficial	Slight beneficial	Slight beneficial	Neutral/No Impact	Neutral/No Impact	Slight beneficial	Slight beneficial	Neutral/No Impact	Slight beneficial	Slight beneficial	Slight beneficial
Carbon emissions	Neutral/No Impact	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight adverse	Slight beneficial	Moderate beneficial	Large beneficial
Biodiversity	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact
Soils and water	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact
Waste	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Large beneficial	Slight beneficial	Slight beneficial
Cohesive communities	Moderate beneficial	Moderate beneficial	Moderate beneficial	Neutral/No Impact	Slight beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Large beneficial	Moderate beneficial	Moderate beneficial
Placemaking	Slight beneficial	Slight beneficial	Slight beneficial	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial
Innovation	Slight beneficial	Moderate beneficial	Moderate beneficial	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Slight adverse	Large beneficial	Moderate beneficial	Large beneficial
Distribution of goods	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Slight beneficial	Slight beneficial	Slight beneficial
Transport affordability	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Slight beneficial	Slight beneficial	Slight adverse	Large beneficial	Moderate beneficial	Moderate beneficial
Welsh language	Slight beneficial	Slight beneficial	Slight beneficial	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Neutral/No Impact	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial
Art, sport and culture	Slight beneficial	Moderate beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Moderate beneficial	Moderate beneficial	Slight beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial
Historic environment	Moderate beneficial	Moderate beneficial	Moderate beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial
Avg. unweighted score (Qualitative)	0.93	1.2	1.13	0.53	0.67	0.87	0.8	0.27	1.47	1.2	1.40

7. Affordability Dimension

7. Affordability Dimension

Capital expenditure for the proposed service is required for vehicles, supporting infrastructure and bus stop improvements

7.1 Capital Costs

The purpose of the Affordability Dimension is to present the expected costs of the options and whether the options would provide value for money. Estimated capital costs are shown in Table 7.1, 7.2 and 7.3. The capital costs include the cost of the vehicle and any other associated initial costs. The electric vehicle prices are based upon 10-year averages for the GTe14 and the diesel upon the Caetano Levante III. For the purchase of an electric vehicle there may be additional grid and station upgrades needed. These have not been included as the costs can be shared between other services upgrading to electric vehicles. For the purchase of used diesel vehicles there may be associated refurbishment costs. These have not been included as the cost will vary depending on the necessary extent of refurbishment. Infrastructure improvements associated with minor improvements to stops in Porthmadog and Eldon Square are included, although those improvements considered in parallel studies are excluded here. All costs presented are in 2024 prices and are exclusive of optimism bias.

Table 7.1: CapEx Unit Costs Per Vehicle

Component	New Electric	New Diesel	Used Diesel
Vehicle Cost	£515,000	£378,000	£120,000
Battery	£100,000	-	-
Charging Infrastructure	£50,000	-	-
Grid and Station Upgrades	TBC	-	-
Refurbishment Costs	-	-	TBC
Total	£665,000	£378,000	£120,000

Table 7.2: CapEx by Peak Vehicle Requirement

	New Electric	New Diesel	Used Diesel
2 PVR	£1,330,000	£756,000	£240,000
4 PVR	£2,660,000	£1,512,000	£480,000
6 PVR	£3,990,000	£2,268,000	£720,000

Table 7.3: Bus Stop Improvement CapEx Requirement

	Improvement Proposed?	Associated Project	Improvements	Cost Range	Estimated Cost
Bangor	Yes	Bangor Gateway - Station Quarter	Considered within parallel study, thus costs not included within the scope of this study	-	-
Caernarfon	No	-	-	-	-
Porthmadog	Yes	North South Wales Bus	Stop infrastructure only: Kerb/junction realignment, raised bus boarding kerb, new shelter, minor drainage amendments etc	£100,000 - £200,000	£150,000
Dolgellau	Yes	North South Wales Bus	Eldon Square Improvements only. Dolgellau Bus Interchange improvements associated with local bus services considered within Appendix A.	£1,000,000 - £2,000,000	£1,500,000
Machynlleth	Yes	Machynlleth Transport Interchange	Considered within parallel study, thus costs not included within the scope of this study	-	-
Aberystwyth	No	-	-	-	-
Aberaeron	No	-	-	-	-
Llandysul	No	-	-	-	-
Carmarthen	Yes	Station Interchange Improvements	Considered within parallel study, thus costs not included within the scope of this study		
				Total	£1,650,000

7. Affordability Dimension

Operating costs for electric vehicles are around 10% lower than equivalent diesel operating costs, largely due to lower fuel costs

7.2 Operating Costs

The operating cost are shown in Table 7.4. They have been developed based on the following assumptions:

- Fuel efficiency based on coach manufacturer data
- Driver salary costs come from ASHE 2023
- 25% overheads/on-costs added to salary costs
- Fuel costs are from the latest TAG data book
- Vehicle depreciation is not included as this is included within up front capital purchase of vehicles
- Assumed vehicle life span of 15 years
- Assumed 10% operator profit margin

Operating costs for the full range of service frequency options are provided given that this decision will be largely based on available budget for the service.

The following conclusions are drawn:

- Electric vehicles have a lower annual operational expense than diesel. This is mainly driven by lower fuel and maintenance costs.
- The cost per km of higher frequency services tends to be lower than low frequency services.
- 9 buses per day has broadly the same cost per km as 8 buses per day. This is because the increase in operating cost is almost exactly proportional to the increase in fleet kilometres in both scenarios. This is because the PVR and the headway are equal in both scenarios.
- The PVR is the same for electric vehicles and diesel vehicles. This is because the timetable of each frequency option has been designed with charging times in mind.
- The total operating costs over a 15-year lifespan of the coaches is £50.1m for electric coaches and £51.9m for diesel vehicles (see Table 7.8 & 7.9).

Table 7.4: OpEx (2024 base year, 2024 prices)

Service Frequency	PVR	Electric		Diesel	
		Annual OpEx	Cost per Km	Annual OpEx	Cost per Km
2cpd	2	£526,000	£1.54	£565,000	£1.65
4cpd	4	£1,260,000	£1.54	£1,352,000	£1.65
6cpd	4	£1,832,000	£1.45	£1,974,000	£1.56
8cpd	6	£2,524,000	£1.43	£2,723,000	£1.54
9cpd	6	£2,794,000	£1.42	£3,014,000	£1.54
10cpd	6	£3,089,000	£1.34	£3,347,000	£1.46

It is noted that whilst these costs are a best estimate, the bus industry has been significantly affected by inflation in recent years. The overall number of bus operators in Wales is declining which is leading to upward pressure on costs due to limited competition, which may require additional expenditure on operating costs (and additional government subsidy).

Figure 7.1: Electric Vehicle OpEx (2024 prices)

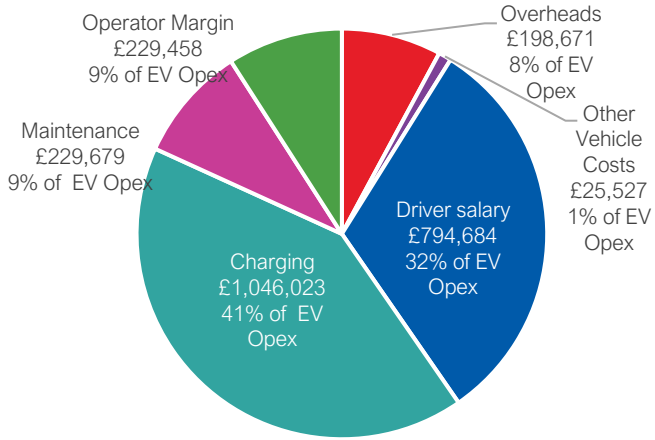
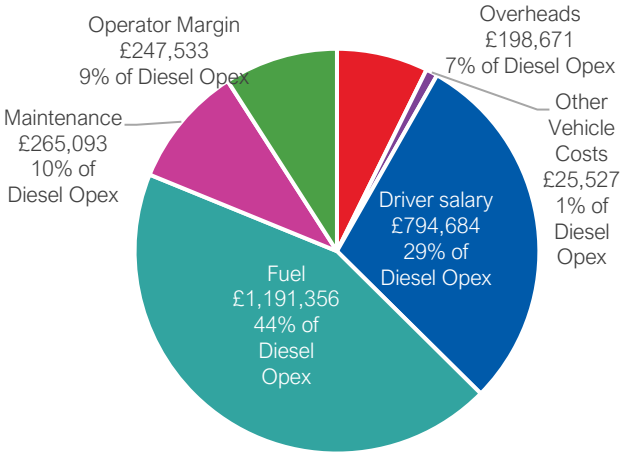


Figure 7.2: Diesel Vehicle OpEx (2024 prices)



7. Affordability Dimension

Identifying demand for the service is difficult given low current levels of demand. Measures to stimulate demand will be required

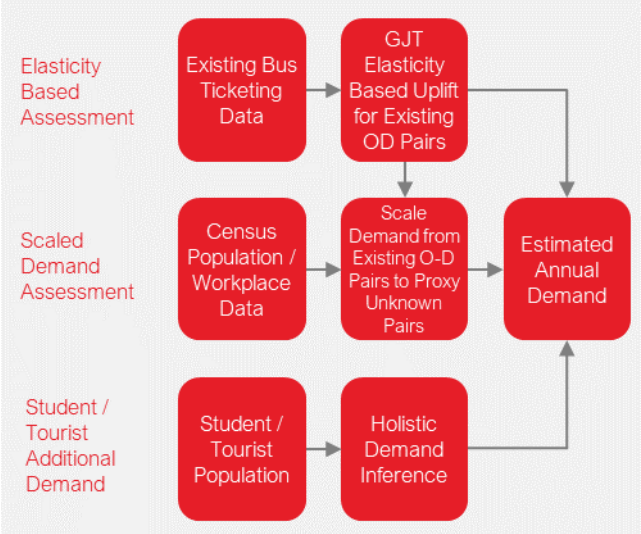
7.3 Demand Assessment Methodology

An assessment has been undertaken to ascertain potential demand for the service. It is noted that, given the limited existing demand for long distance trips in the study area, this is not a straightforward exercise, and the results should be utilised as a high-level indication of potential demand rather than relied upon as an accurate forecast. It is also noted that to stimulate demand, measures beyond delivering the service will be required such as digital marketing and social media campaigns, engagement with universities and tourism bodies etc.

A demand assessment has been undertaken building on work undertaken at Stage Two and for the options developed as part of this study. Whilst noting the constraints above, the demand assessment methodology has been developed in accordance with relevant WelTAG / TAG guidance where possible. Figure 7.3 provides a summary of the methodology, highlighting the three components.

The existing bus demand between each stop is calculated using ticketing data. The potential uplift in passenger demand is then calculated by applying an elasticity of demand with respect to Generalised Journey Time (GJT), where elasticity is a parameter which determines the relationship between changes in GJT and changes in demand. This approach can only be applied to origin and destination (OD) pairs that can be travelled by existing services. For example, this approach cannot be used for demand between Carmarthen to Bangor because there is no direct service between them.

Figure 7.3: Demand Assessment Methodology Overview



Scaled Demand Assessment

Where existing demand data was not available, demand from the elasticity-based assessment between similar OD pairs was scaled using population and workplace Census 2021 data from both the origin and destination.

Student/Tourist Additional Demand

The student populations and number of tourist visit to popular destinations near each of the stops were collected. An average of 0.25 trips per student per annum was assumed to calculate the additional student demand. For each tourist visit, a return trip was assumed, then the trips were scaled by catchment population and mode split. The sum was then scaled in line with the variation in demand due to service frequency from the other assessments.

Base Demand

Table 7.5 presents demand for the TrawsCymru T1 and T2 services. The source of the data is ETM ticket data for the whole of the 2023 calendar year, as provided by TfW for the purposes of this study. A subset of demand from TrawsCymru and other services that served the urban area around the proposed stop was used in the demand assessment for the new service.

Table 7.5: Base TrawsCymru Demand (2023)

Service	Av. Daily	Annual
T1	800	287,000
T2	900	331,000
Total	1,700	618,000

In recent years, demand on TrawsCymru services has been increasing rapidly due to post Covid recovery and efforts to attract demand. Whilst it remains difficult to estimate background growth, a growth rate of 5% per year has been assumed for demand on the new service.

7. Affordability Dimension

Assumptions on fares are based on an average mid-point of equivalent costs between bus and rail services

7.4 Revenue Assessment

An initial revenue assessment has been undertaken, based on analysis of potential fares and the initial demand assessment. Noting the challenges of undertaking the demand assessment and that fares for the service have still to be defined, the quantitative values are indicative and accordingly, no reliance should be made on the outputs of this study.

The average daily and annual patronage and annual revenue estimated for the proposed service for various service frequencies is identified in Table 7.7. The average demand per service did not exceed service capacity for any scenario, therefore no capping was deemed necessary.

It is important, when deciding on fares for the new service, to strike a balance between an affordable service in line with current bus provision, and providing a service in line with rail, with shorter travel times, toilets and seat booking. Example fares for the new service over a range of fare scenarios are shown in Table 7.7, based on a mid-way point of current average bus and rail fares, resulting in an average fare of £7.28.

The farebox revenue calculation was based on fare per kilometre applied to the distances between stops. The fare per kilometre for buses was calculated using the T1 and T2. The fare per kilometre for rail was calculated using an average of several long-distance rail journeys in Wales.

A key working assumption is that concessionary pass users would be entitled to a 1/3 discount (equivalent to discount for holding a railcard on a rail service), but would not be entitled to free travel as they would be on local bus services.

The following assumptions were made in the calculation:

- Concessions consisted of 35% of patrons as calculated using the 2023 T1 and T2 ETM data.
- Concessions have a 1/3 off discount on the new service in line with railcard discounts. They are assumed not to pay fares for other services.

Table 7.6: Estimated Fares (2024 prices)

Estimated Fares	Service Distance (Km)	Bus Based Fare Estimate	Rail Based Fare Estimate	Bus-Rail Average Fare Estimate
Carmarthen - Bangor	219	£10.72	£28.47	£19.59
Carmarthen - Aberystwyth	79	£3.86	£10.25	£7.06
Aberystwyth - Bangor	140	£6.86	£18.22	£12.54
Caernarfon - Bangor	14	£0.67	£1.78	£1.23
Carmarthen - Llandysul	26	£1.25	£3.33	£2.29
Average Fare per Km	1	£0.05	£0.13	£0.09
Assumed Average N-S Express Coach Fare				£7.28

Table 7.7: Forecast Demand (2024 base year, 2024 prices)

Intervention	Elasticity and Scaled Demand	Student / Tourist Demand	Total Demand for New Service	Stimulated Demand / Abstracted From Other Services[1,2]	Change in Farebox Revenue (£)
2cpd	60,000	7,000	67,000	35,000	+£583,000
4cpd	80,000	9,000	88,000	16,000	+£641,000
6cpd	97,000	11,000	108,000	3,000	+£707,000
8cpd	111,000	12,000	123,000	-10,000	+£743,000
9cpd	117,000	13,000	130,000	-16,000	+£758,000
10cpd	124,000	13,000	138,000	-21,000	+£788,000

Notes:

[1] At low frequencies, the new service is modelled to stimulate extra demand in other services because the increased frequency would made travel by bus altogether more attractive. At higher frequencies, the new service starts to abstract demand from existing services serving the same origins and destinations as the new service out-competes the existing service.

[2] The demand/fare calculations do not consider the positive effect on fares of stimulating demand on bus and rail services that connect to but do not run on the same corridor as the proposed service (due to extra connection opportunities).

7. Affordability Dimension

The responsibility for deciding affordability and frequency of the service rests with the Welsh Government

7.5 Affordability Assessment

Insufficient funding is available to achieve all of WG's aims for transport. Record high levels of inflation and budgetary pressures in relation to healthcare, education and the cost of living mean significant reduction in spending power in the short term. Measures identified within this study represent strategic, sustainable transport projects which align well with WG policy, political ambitions and have a positive case for investment. A summary of the CapEx, OpEx, revenue and government subsidy is provided in Table 7.8 for electric coach operations and Table 7.9 for equivalent diesel operations. It is acknowledged that it may not be possible to deliver everything amidst tighter funding in the short term. The ultimate responsibility for deciding whether these costs are affordable, and at what frequency the proposed service should be introduced at rests with the Welsh Government. In any case, the costs are significantly lower than an equivalent rail service along the corridor.

Table 7.8: Total Cost of Ownership for 15-year Vehicle Lifetime – Electric Coaches, 8cpd

Year	Electric					
	CapEx	OpEx	Total Cost	Additional Demand	Revenue[2]	Government Subsidy
2026	£4.4m	£2.6m	£7.0m	124,000	£0.8m	£6.2m
2027	£0.0m	£2.7m	£2.7m	130,000	£0.9m	£1.7m
2028	£0.0m	£2.7m	£2.7m	137,000	£1.0m	£1.7m
2029	£0.0m	£2.8m	£2.8m	144,000	£1.0m	£1.7m
2030	£0.0m	£2.8m	£2.8m	151,000	£1.1m	£1.7m
2031	£0.0m	£2.9m	£2.9m	158,000	£1.2m	£1.7m
2032	£0.0m	£3.0m	£3.0m	166,000	£1.3m	£1.7m
2033	£0.0m	£3.0m	£3.0m	175,000	£1.4m	£1.6m
2034	£0.0m	£3.1m	£3.1m	183,000	£1.5m	£1.6m
2035	£0.0m	£3.2m	£3.2m	193,000	£1.6m	£1.6m
2036	£0.0m	£3.2m	£3.2m	202,000	£1.7m	£1.5m
2037	£0.0m	£3.3m	£3.3m	212,000	£1.8m	£1.5m
2038	£0.0m	£3.4m	£3.4m	223,000	£2.0m	£1.4m
2039	£0.0m	£3.5m	£3.5m	234,000	£2.1m	£1.3m
2040	£0.0m	£3.6m	£3.6m	246,000	£2.3m	£1.3m
Total	£4.4m	£45.7m	£50.1m	2,679,000	£21.8m	£28.3m

Notes:
[1] Costs are in 2024 prices, i.e. no discounting has been applied to future years
[2] Revenue growth is consistent with inflation, along with demand growth at 5% per annum

Table 7.9: Total Cost of Ownership for 15-year Vehicle Lifetime – Diesel Coaches, 8cpd

Year	Diesel					
	CapEx	OpEx	Total Cost	Additional Demand	Revenue[2]	Government Subsidy
2026	£2.7m	£2.8m	£5.5m	124,000	£0.8m	£4.6m
2027	£0.0m	£2.9m	£2.9m	130,000	£0.9m	£2.0m
2028	£0.0m	£2.9m	£2.9m	137,000	£1.0m	£1.9m
2029	£0.0m	£3.0m	£3.0m	144,000	£1.0m	£1.9m
2030	£0.0m	£3.1m	£3.1m	151,000	£1.1m	£1.9m
2031	£0.0m	£3.1m	£3.1m	158,000	£1.2m	£1.9m
2032	£0.0m	£3.2m	£3.2m	166,000	£1.3m	£1.9m
2033	£0.0m	£3.3m	£3.3m	175,000	£1.4m	£1.9m
2034	£0.0m	£3.3m	£3.3m	183,000	£1.5m	£1.9m
2035	£0.0m	£3.4m	£3.4m	193,000	£1.6m	£1.8m
2036	£0.0m	£3.5m	£3.5m	202,000	£1.7m	£1.8m
2037	£0.0m	£3.6m	£3.6m	212,000	£1.8m	£1.7m
2038	£0.0m	£3.7m	£3.7m	223,000	£2.0m	£1.7m
2039	£0.0m	£3.7m	£3.7m	234,000	£2.1m	£1.6m
2040	£0.0m	£3.8m	£3.8m	246,000	£2.3m	£1.5m
Total	£2.7m	£49.3m	£51.9m	2,679,000	£21.8m	£30.2m

Notes:
[1] Costs are in 2024 prices, i.e. no discounting has been applied to future years
[2] Revenue growth is consistent with inflation, along with demand growth at 5% per annum

8. Deliverability Dimension

8. Deliverability Dimension

Procurement options for service including vehicles and supporting infrastructure need to align with plans for bus franchising

8.1 Procurement Approaches

This section of this study describes how the express coach service will be delivered, and who may be involved. Considerations within this section include high-level procurement strategy/sourcing options, route to market, commercial arrangements (e.g., contract lengths and pricing/payment information); planning permission or other permissions/agreements; overall responsibilities, delivery risks and risk allocation/transfer.

Procurement and alignment with franchising

Responsibility for procurement for this coach service rests with TfW. Drawing on TrawsCymru delivery experience TfW will be able to secure an appropriate route to market with the supply chain for a diesel or electric coaches. It is likely that this procurement exercise would require open tender however considering the limited suppliers of battery electric coaches a 'competitive' tender may be challenging.

During 2026-28 bus franchising zones are expected to roll out in Wales with zones procured, mobilised and run under the management of TfW. As part of franchising, it is envisaged that TfW will purchase, and own vehicles used by operators running franchised services. Therefore, it is recommended that TfW also purchase vehicles for this service and lease them as they would for a bus service under the new reforms. Note that it is likely that this service will cross multiple franchise zones.

Operators would be required to maintain said vehicle as defined in a franchise contract which will would also define service specification, frequency, quality, customer care requirements, financial arrangements and risk allocation etc. TfW could adopt ten-year contracts like TrawsCymru or may wish to contract a shorter trial period for this service. Note it is not expected that operators accept concessionary fares on this service. Typical service contract types may include:

Deficit Coverage: Operator keeps fare revenue and may receive subsidy to cover any deficit. Deficit and subsidy may differ per month. This model is common in Eastern Europe. TfW would bear all risk.

Net Cost Contract: Operator keeps fare revenue and may receive a previously determined, fixed additional compensation. This model has been applied in France and the Netherlands. The operator bears all risks.

Gross Cost Contract: TfW keeps fare revenues and pays the Operator a service fee for delivered services (mostly per vehicle km). This is the most widely used model for bus contracting in Wales. Revenue and cost risks sit with TfW and the Operator, respectively.

Infrastructure and Interchange Procurement

Under franchising TfW predict a mixed economy approach to depot and supporting infrastructure procurement (i.e., public or private ownership on a case-by-case basis). Public ownership should be used where greatest value is delivered e.g., considering infrastructure impact on competition, other services, enabling decarbonisation, and stimulation of a wider low-carbon economy for Wales etc.

Infrastructure delivery broad contractual options are listed below. Within each approach there is considerable variation in risk allocation/transfer to the contractor and this would be a key consideration in later stages of the WelTAG process.

Traditional: separates between design and construction processes.

Design and Build: single contract tendered for asset design and construction.

Early Contractor Involvement: used mainly for larger projects where contractor is involved as an integrated team member in early project stages to contribute to the design process, project buildability and sequencing with a focus innovation.

Overall Strategy

TfW in collaboration with Corporate Joint Committees (CJCs) and Welsh Government will need to devise the procurement strategy for this service and could open a competition on Sell2Wales or analogous framework. Note that Welsh Government are in the process of delivering a National Electric Vehicle Charging Infrastructure Framework which could be utilised for depot infrastructure.

8. Deliverability Dimension

Example permissions and consenting considerations are listed but dependent on final service design

8.2 Permissions and Consenting Considerations

Requirements for planning permissions and third-party land acquisition will depend on final service design. Currently, the following consent considerations are anticipated for each type of infrastructure:

Service Design Options

- Work carried out by the highway authority within the road boundary does not constitute development according to the TCPA 1990 and therefore planning permission is not required.
- Installation of signage associated with public service vehicle operation is deemed permitted development (Part 17, Class H of the TCPA 1990)

Infrastructure Options

- Work carried out by the highway authority within the road boundary does not constitute development according to the TCPA 1990 and therefore planning permission is not required (subject to land ownership acquisition).

Bus Stop Improvements

- Depending on interchange design the development may constitute a permitted development (Part 17 Class H of GPDO 1995) as development on operational land of the undertaking. This however will be subject to land acquisition.
- Permission from Network Rail may be required before work commences if working on/near the railway line.
- It is likely that changes proposed to provide interchange facilities will require approval under section 22 of the Railways Act 1993 (amendments to access agreements). An application should be made to the Office of Rail and Road.
- Construction of new buildings (for example for retail uses, offices, car park) would require planning permission.

Other considerations

The following issues may be relevant to some of the developments listed in this study, however these should be detailed at the next stage once a more detailed design is under way:

- Land acquisition
- Road Traffic Regulation Act 1984
- New roads and Street Works Act 1991
- Traffic Signs Regulations
- General Directions 2002
- Traffic Management Act 2004
- Listed building consent
- Conservation area consent
- Tree preservation orders
- Environmental Impact Assessment Regulations
- Habitats Regulations
- Wildlife and Countryside Act 1981
- Land Drainage Act 1991
- Utility diversions
- Connection agreements
- Grid code
- Electricity Act 1989
- Security and Quality of Supply Standard (SQSS)

8. Deliverability Dimension

Outlining responsible, accountable, consulted and informed stakeholders for shortlisted option delivery

8.3 Responsibilities Matrix

Delivery of the preferred option will involve a mix of stakeholders. The RACI matrix in Table 8.1 gives an indicative view of the likely involvement of key members of this mix of stakeholders to deliver certain tasks which establish the shortlisted option. It is noted that this is an initial assessment – niche stakeholders are introduced here which may/may not play a role depending on detailed design tasks e.g., Operator, Independent Connection Providers (ICPs), Charge Point Operators (CPOs) and CJCs. As the project approaches delivery, responsibility 'ownership' may change from one entity to another, depending on, for example, who will take on the procurement risk and who will be ultimately responsible for operation of the infrastructure. Matrix terms are defined as follows:

- Responsible (R): Task delivery is assigned directly to this party. The responsible party is the one who does the work to complete the project/deliverable;
- Accountable (A): The party who delegates and reviews the task/work involved;
- Consulted (C): Those who provide input/feedback on task plans/execution;
- Informed (I): Those kept informed of project development (often the public).

Table 8.1: RACI Matrix

Example Tasks – Delivery Stage	TfW	WG	Vendors	Operators	CJCs	LAs	DNO	CPO	ICP	Network Rail	Public
Programme management and governance	R	A	-	C	C	C	-	-	-	-	I
Change management (e.g., staff hiring and training)	R	-	C	R	-	-	-	C	-	-	-
Statutory processes	R	A	-	R	C	C	R	R	R	R	I
Stakeholder engagement	R	A	-	-	-	C	-	-	-	-	-
Community engagement (e.g., marketing)	R	A	-	R	R	R	R	-	-	R	C
Fleet procurement and deployment	A	C	R	I	-	-	C	C	-	-	-
Infrastructure procurement and deployment	R	A	-	C	C	C	C	C	C	C	I
Fares and ticketing	R	A	C	C	I	I	-	C	-	-	I
Service evaluation	R	A	I	C	I	I	I	I	-	I	I

9. Management Dimension

9. Management Dimension

The Management dimension considers the delivery arrangements and how the project is going to be managed through its lifetime

9.1 Delivery Programme

The management dimension considers the delivery arrangements for the project and how the project is going to be managed through its lifetime. The management dimension seeks to demonstrate that the project is achievable and identifies the different arrangements put in place to deliver it. It is assumed that TfW working with the local authorities in the study area would be responsible for taking the options identified through the next stages towards scheme delivery. Table 9.1 contains a high-level programme of delivery.

Table 9.1: Delivery Programme

WelTAG Stage	Stage Two: Outline Business Case	Stage Three: Full Business Case	Stage Four: Delivery		Stage Five: Monitoring and Evaluation
TfW Plan of Works	Stage B: Option development & selection	Stage C and Stage D: Preliminary design and statutory processes	Stage E: Detailed design	Stage F: Construct, commission, handover	Stage G: Closeout
Stage Aim	Determine and assess a short-list of options against WelTAG objectives. Use evidence-based approach and processes such as IWBA to select a preferred option.	Full business case of final option. Preliminary design required and full project programme, so it is deliverable. Decision to proceed required (based on business case and public engagement). Statutory processes are a parallel activity.	Detailed design and appraisal used to refine design of the preferred option identify final price and set of deliverables.	Construction and deployment of service is completed, and end of works can be finalised.	Project in use and to be maintained.
Key Requirements	• Assessment of shortlisted options against scheme objectives and selection of preferred option. • Five business case dimensions used. • Evidence of public engagement in line with engagement plan. • IWBA and EQIA completed. • Updated high-level procurement strategy. • High-level risk register. • Permissions/consent requirements identified, and surveys identified.	• Preferred option concept design meets minimum quality criteria • Public engagement to confirm concept design (including input from groups/representatives with protected characteristics); • Stage 2 RSA undertaken, IWBA completed. • Updated monitoring and evaluation plan, business case (costs etc.), and risk register. • Statutory impact assessments completed. • Statutory consents, regulatory approvals and other necessary permissions obtained	• Detailed designs meet agreed quality criteria • Tender documents incl. Bill of Quantities prepared • Procurement strategy confirmed and implemented. • Updated risk register, business case acceptable and funding available • Updated monitoring and evaluation plan.	• Ongoing dialogue and progress reports provided to capture any variance from intended outputs. • Handover of required documentation e.g., as built drawings. • Completion/finalisation of all contractual provisions e.g., DNO grid connection, franchising, vehicle registrations, training etc.	• Outturn business case • Evidence of project outputs • Did project meet expected outcomes/ outputs? • Lessons learned report

9. Management Dimension

Key risks are highlighted which should be mitigated carefully through subsequent stages of the project

9.2 Risk Register, Allocation and Mitigation

As the project approaches delivery, several potential risks could present themselves. These are outlined in Table 9.2 below. The type of risks are presented for project Scope (S), Cost (C), and Programme (P). Pre-mitigation risk levels are labelled as Low (L), Medium (M) and High (H). Note that the 'ownership' of these risks is indicative.

Table 9.2: Risk Register - Key Programme, Scope and Cost Related Risks

#	Issue	Risk Level	Risk Type	Risk Owner	Mitigation
1	Feasibility work conducted at this stage needs to be reviewed before the next stage of work so that any issues can be addressed.	L	S	-	Feasibility work will be reviewed by stakeholders before next stage.
2	Restrictions on timescales and requirements/outputs associated with funding. Uncertainty about future funding allocations and disconnect between allocations and local authority, TfW and Welsh Government priorities poses a delivery risk.	M	C	TfW, WG, LAs	Clear communication between TfW, Welsh Government and LAs about funding allocation.
3	Maintaining strong support from LAs could be challenging to coordinate from multiple entities. There may be challenges in adopting regional thinking which spans beyond LA boundaries and in accepting an evidence-based approach to scheme design.	L	S	TfW	LAs and CJCs engaged throughout feasibility and WelTAG stages. TfW need to continue to engage with LAs as the programme develops further.
4	Need to co-ordinate and bring on boarder stakeholders e.g. landowners, the public, target users etc.	M	P	TfW	Stakeholder and community engagement plan implemented at next stage incl. public consultation. Focus could be made on student/tourism stakeholders via university fairs, tourism boards etc.
5	Mechanism to collect fares and conduct ticketing needs to be determined e.g., using Traws Cymru existing app, need to consider data/security of applications.	L	S, P, C	TfW	During next stage, a commercial and digital work package should be completed that outputs a preliminary fare/ticketing design.
6	Although 8cpd has been determined as a preferred service frequency, it is unclear to what extent realised demand will support this level of vehicle deployment immediately.	M	S, P, C	TfW	The deployment of vehicles could be phased up to the 8cpd recommendation with an evaluation of realised demand conducted regularly to de-risk implementation. Efforts have been made to use the most appropriate data sources. TfW should continue to review the study outcomes as new data becomes available.
7	Pace of delivery has potential to be constrained by resource capacity (e.g., within TfW and LAs). Risk of expectation on TfW actions e.g., business case focus/proposition (public vs private), wider economic benefits, active travel, service integration, role of other parties.	M	P	TfW, WG	Internal capacity building and use of consultants where there is not sufficient internal resource. Use of stakeholders e.g., coach/infrastructure vendors to upskill/train staff.

Table 9.2: Risk Register - Key Programme, Scope and Cost Related Risks (continued)

#	Issue	Risk Level	Risk Type	Risk Owner	Mitigation
8	Planning consent routes for new transport infrastructure and associated more onerous design and consultation requirements (e.g. Transport and Works Act Order and Developments of National Significance) – typically 5 years +	L	P	TfW, LAs	This is factored into the likely phasing, but TfW and local authorities should be proactive and timely in their planning application submissions.
9	The requirement for third party land would require interface with the relevant landowner, Network Rail, key stakeholders as well as cooperation with a developer	M	P	TfW, WG, LAs	Early engagement with landowners and Network Rail in future stages will abate conflict/issues.
10	Some options, such as those that reallocate road space, may not receive acceptance from the public or stakeholders.	L	S	TfW, LAs	This can be mediated with early/well considered messaging or in some cases, public consultation.
11	The effectiveness of any infrastructure measures or new/improved services towards achieving modal shift and the objectives will be dependent on quality supporting measures such as: integrated fares and ticketing, compatible timetables for interchange, demand management measures, approach to land use and transport policy, measures to encourage a shift away from car.	M	S	TfW	TfW should continue to work with relevant stakeholders and continue adjacent workstreams related to demand management, behaviour change and integrated ticketing in particular.
12	It remains unclear what the remit will be for the regional transport bodies (CJCs) and clarification between this and Transport for Wales's remit.	L	S	TfW	This can be mediated with early and continuous engagement.
13	It is unclear what the impact of procurement lead times will be for vehicles and supporting infrastructure, changes to these lead times e.g., for battery electric coaches, used coaches or charging infrastructure and associated grid connections could delay the speed of delivery or adjust programme timings e.g., the transition from diesel to electric.	M	P, C	TfW	Early engagement with the supply/value chain, vendors, and key stakeholders (e.g., DNOs, ICPs etc.) is key to ensuring risks to delivery are mitigated from a procurement strategy perspective.
14	The case for the service is founded on a strong political aspiration – ending of the Co-operation agreement and political changes could mean support for the service wanes	H	S, P	WG	Alignment with long-term well-being aspirations, effective business case and community support for the service.
15	Stakeholder / public / political pressure for additional stops leads to additional delays which erode the faster journey times and differentiation of the service over time	H	C	TfW	Additional stops must be very carefully considered in the context of journey times. Integration with existing T1/T2 services with regular stopping pattern should negate the need for additional stops.
16	Due to larger vehicle size, coach is not suitable for operating on parts of the route with tighter highway geometry constraints	M	S, C	TfW	Should be mitigated by undertaking additional Swept Path Analysis, and a trial run of the chosen vehicle along the route in both directions
17	Political acceptance of a bus-based service over the original aspiration for reinstating railway services. Proposed service may not be seen as a 'rail equivalent' service.	L	S	TfW	Careful management of the narrative, current affordability challenges versus potential to build demand for rail over the longer term
18	Additional subsidy requirement due to demand assessment / revenue / passenger growth assumptions being incorrect compared to observed demand and revenue.	H	C	TfW, WG	Additional market testing, revenue assessment and fare analysis at Full Business Case stage
19	Additional subsidy requirement due to stakeholder / public / political pressure for lower fares or acceptance of concessionary fares could lead to lower revenue than currently assumed	M	C	TfW	Additional revenue assessment and fare analysis to inform decision making around changes to assumptions.
20	Marketing and measures to stimulate demand are not undertaken alongside implementation of the service, leading to lower levels of demand, and higher subsidy costs	M	C	TfW	Ensure that measures to maximise awareness of the service for key user groups are undertaken
21	Low levels of operator competition during procurement causes higher than expected operating cost.	H	C	TfW	Consider measures to stimulate competition during procurement exercise as part of Full Business Case development

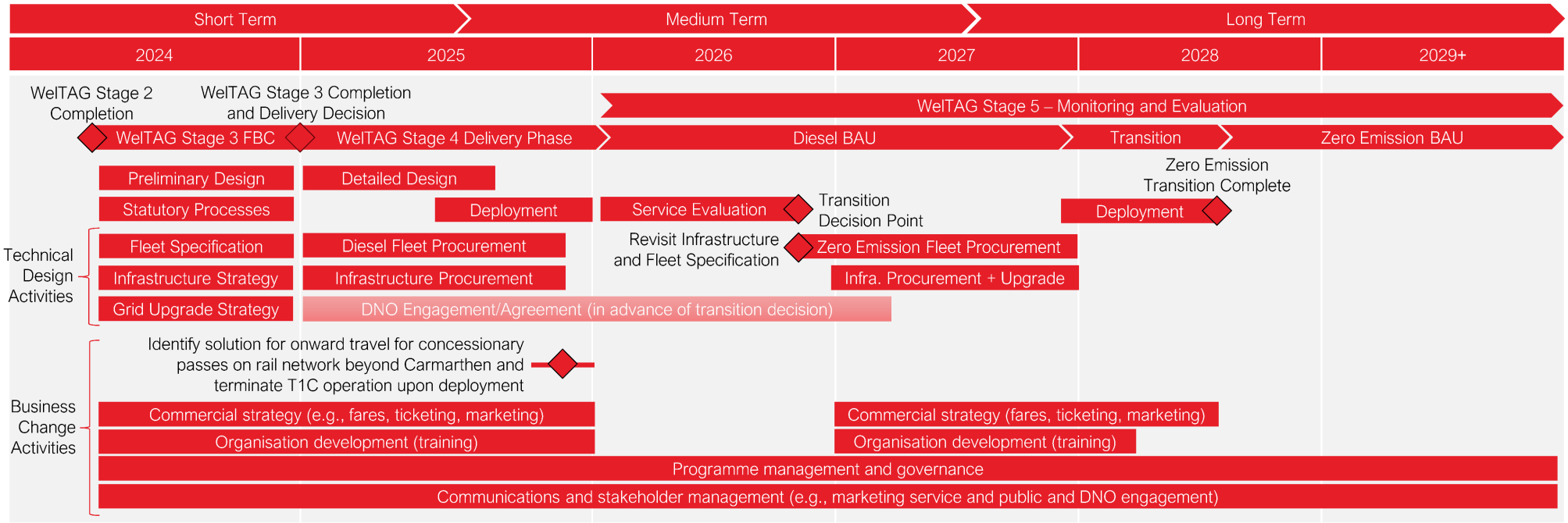
9. Management Dimension

The proposed timeline aims for service deployment by the end of the current Senedd term (understood to be 2026)

9.3 Implementation Roadmap

The following implementation roadmap in Figure 9.1 has been developed to indicate a potential timeline for delivery for the preferred option by 2026. At this stage, the programme is indicative, and options may be developed sooner or later than anticipated depending on the planning process, stakeholder engagement and funding. The roadmap highlights a mixture of technical and business change activities. It is not exhaustive but offers a view of short-, medium- and long-term ambitions that TfW could adopt.

Figure 9.1: Implementation roadmap of preferred option.



10. Recommendations and Next Steps

10. Recommendations and Next Steps

Development of an OBC based on the Five Case model identifies a good case for investment in shortlisted interventions

10.1 WelTAG Stage 2 / 3 Summary and Conclusions

A range of Route Design, Service Design and Vehicle and Supporting Infrastructure options have been considered within this North-South Wales Bus Connectivity WelTAG Stage 2/3 study. The option development and sifting process, supported by engagement with the Review Group, has identified a preferred option in each of the three categories as identified opposite.

Whilst a demand assessment has been undertaken, analysis of demand for existing public transport services on the corridor highlights the absence of significant long-distance trips being made by public transport on the corridor currently. The proposed measures to enhance connectivity should be delivered in parallel with measures to stimulate demand through a targeted approach, particularly aimed at key user groups for the service – tourism sector and university students.

Whilst a recommendation of an ultimate frequency of 8 coaches per day has been made to replicate likely service provision of a rail corridor and maximise opportunities for onward travel via rail connections, the service frequency in particular is largely dependent on budget. The deployment of vehicles could be phased in over time alongside an evaluation of realised demand conducted regularly to de-risk implementation.

Whilst the Affordability Dimension sets out the challenging funding context and Welsh Government's reduction in spending power caused by record high levels of inflation, active travel and public transport are the main focus for transport investment in Wales going forward, and the cost of the proposed service is significantly lower than a rail equivalent.

The Deliverability Dimension identifies that shortlisted options can be delivered in the short term, demonstrating good opportunity for improvements by the end of the current Senedd term (understood to be 2026) and provides an indicative view of the likely involvement of different parties in delivery of interventions if typical processes are followed. The Management Dimension highlights key risks which will need to be managed in subsequent stages of the project.

Options Summary

Route Design Options

- Option 2: Coach service with intermediate stops, focusing on town centre locations and rail stations, with two stops in larger towns/cities
- Preferred Option 3: Express coach with limited stops at town centre locations and rail stations, featuring a single stop per town (+ Aberystwyth Uni)
- Option 4: Express coach with limited stops at town centre locations and rail stations, featuring a single stop per town.

Service Design Options

- Option 2: 4 coaches per day
- Option 3: 6 coaches per day
- Preferred Option 4: 8 coaches per day
- Option 5: 9 coaches per day

Vehicle Design and Supporting Infrastructure Options

- Option 1: Used diesel coach with no new infrastructure
- Preferred Option 3: Used diesel coach with transition to electric coach and supporting infrastructure.
- Option 4: Battery electric coach and standalone charging infrastructure.
- Option 5: Battery electric coach with shared charging infrastructure

10. Recommendations and Next Steps

Next steps should be expedited to facilitate delivery of the N-S Wales bus programme within the coalition agreement period

10.2 Next Steps

It is recommended that the following next steps are undertaken as part of a WelTAG Stage 3 Full Business Case:

Strategic Fit

- Undertake public consultation to understand passenger views, test willingness to pay assumptions and confirm concept design for the service. Focus could be made on student/tourism stakeholders via university fairs, tourism boards etc
- Develop plan for digital marketing and social media campaigns, to include engagement with representatives from the low-carbon tourism industry and universities/students;

Well-being Dimension

- Complete IWBA and any statutory impact assessments, as necessary.

Affordability Dimension

- Confirm availability of funding with Welsh Government, as service frequency in particular is highly dependent on budget;
- Commercial and digital work package that outputs a preliminary fare/ticketing design, cognisant of feedback from potential users as part of the public consultation exercise;
- Additional revenue assessment and fare analysis to inform decision making around changes to assumptions;

Deliverability Dimension

- Procurement investigation – undertake engagement with the supply chain to establish detailed lead times for vehicle types;
- DNO engagement to gather further details on timelines for supporting infrastructure and grid upgrade strategy;
- Undertake market testing to establish willingness of operators to deliver the service and inform the procurement strategy;
- Obtain statutory consents, regulatory approvals and other necessary permissions;
- Integration of fares and adding 'virtual rail stations' (bus stops added to national rail system) so the service comes up within combined train searches;

Management Dimension

- Undertaking additional Swept Path Analysis, and a trial run of the chosen vehicle along the route in both directions;
- Engagement with landowners and Network Rail to abate risks/conflict/issues; and
- Update monitoring and evaluation plan and risk register.

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Appendix A

Dolgellau Bus Interchange Options Appraisal

Appendix A

Dolgellau Bus Interchange Options Appraisal

A.1 Introduction and Objectives

As part of a wider study on North-South Wales Bus Connectivity, Ove Arup and Partners Ltd (Arup) have been commissioned by Transport for Wales (TfW) to undertake options appraisal work associated with the development of a new bus interchange facility for local bus services in Dolgellau, Gwynedd, north-west Wales. The exercise will consider potential improvements to Eldon Square and potential alternative locations for establishing a new bus interchange within Dolgellau. The agreed scope is outlined to the below:

- Highway Network and Constraints Review
- Bus Service Mapping
- Location Selection and Initial Discussions
- SWOT Review
- Concept Layout Plans
- Location Selection and Stakeholder Consultation
- Option Appraisal
- Preferred Option

Project objectives were agreed with representatives from TfW and Cyngor Gwynedd, as set out in the table opposite.

It is noted that whilst interchange proposals at locations alternative to Eldon Square are presented, these would be additional stops aimed at improving the safety and resilience of bus interchange, and not instead of Eldon Square being serviced as a pick-up/drop-off bus stops.

Study Objectives	
	Improve the safety of bus interchange, facilitating a high standard of services and supporting pulse timetabling (4 buses)
	Improve bus passenger experience, waiting facilities and travel information
	Improve the capacity and flexibility of bus stop infrastructure in Dolgellau and resilience to future network changes
	Reduce impact on other highway users and support the function of Dolgellau town facilities

Appendix A

Dolgellau Bus Interchange Options Appraisal

A.2 Highway Network and Constraints Review

Dolgellau is served by six bus routes, including three TrawsCymru services and three local services. The TrawsCymru timetables for the T2 and T3 services are coordinated for interchange. This means that buses arriving at Eldon Square are timed to facilitate smooth transfers between different routes and passengers can switch from one bus to another conveniently without long waiting times. Four buses arrive and depart from Eldon Square around the same time by design, every two hours. This intentional scheduling aims to minimise waiting times for passengers and enhance connectivity, however the current bus stands in Eldon Square have insufficient space to accommodate all the buses.

Due to the limited stand space, buses queue and block traffic lanes which regularly impacts on overall traffic flow and cause delays for other road users. This also creates difficulties for pedestrians and wheelchair users, where the lack of formal facilities makes it difficult for people with mobility issues to board and alight buses safely.

As such, while Dolgellau benefits from multiple bus routes and coordinated timetables, addressing the space constraints at the bus stands is crucial to ensure smoother operations and better accessibility for all passengers.

Bus Congestion at Eldon Square

Appendix A

Dolgellau Bus Interchange Options Appraisal

A.2 Highway Network and Constraints Review

The key bus routes and stops in Dolgellau are set out on the map to the right:

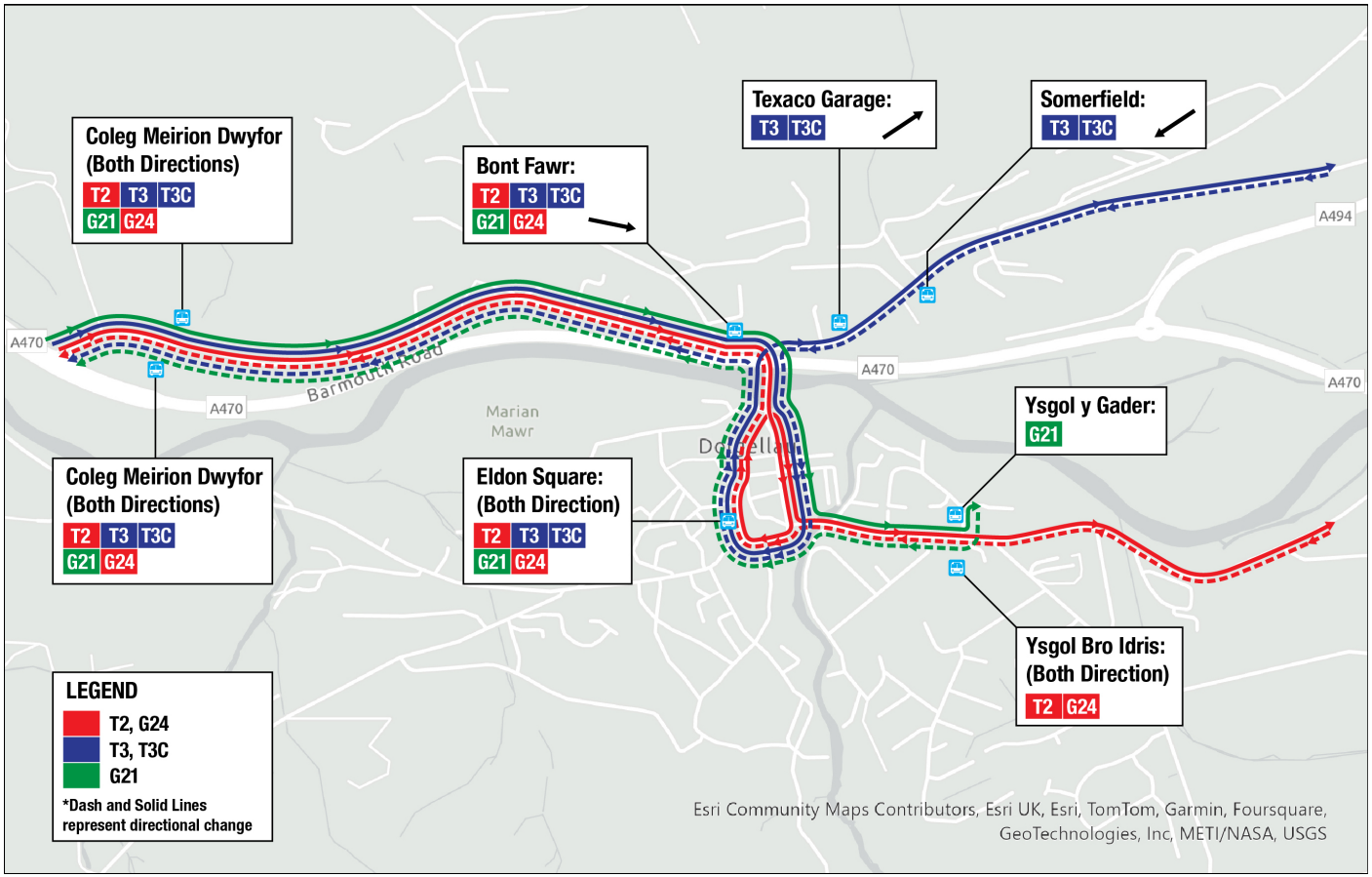
T2: Bangor to Aberystwyth *(1 bus every 2 hours)*

T3/T3C: Barmouth to Wrexham *(1 bus every hour)*

G21: Machynlleth to Dolgellau *(1 bus every 2 hour)*

G24: Dolgellau to Tywyn *(1 bus every 2 hour)*

All of these services currently use the Coleg Meirion Dwyfor and Eldon Square stops in both directions, with the T3 services to and from Wrexham continuing along Bala Road to the north of the river, whilst the T2 and G24 services continue along Arran Road to the south.



Bus Routes and Stops around Dolgellau

Appendix A

Dolgellau Bus Interchange Options Appraisal

A.3 Location Selection and Initial Discussions

Seven potential locations for the bus interchange have been identified around Dolgellau, aligning with some of the project objectives. These sites are shown on the accompanying map. To narrow down the focus the study, an initial evaluation of these options was undertaken considering the key benefits and disbenefits of each site, as summarised in the table overleaf. The process of site selection and sifting was a collaborative effort involving representatives from TfW (Transport for Wales) and Cyngor Gwynedd, ensuring that the requirements and insights of key stakeholders were taken into account.

1. Eldon Square
2. Marian Mawr Car Park
3. Bala Road Texaco
4. Lloyd's Coaches Depot
5. Area behind Texaco
6. Coleg Meirion Dwyfor
7. Bala Road / Pen Y Cefn Rd

Bus Interchange Potential Locations

Appendix A

Dolgellau Bus Interchange Options Appraisal

A.3 Location Selection and Initial Discussions (continued)

Location	Benefits	Limitations	Carried Forward
1. Eldon Square	Central location Close to existing shops and facilities Public support	Not space for four buses Poor stop infrastructure Causes congestion	Yes
2. Marian Mawr Car Park	Fairly central Close to shops and facilities Space for four buses	Requires rerouting of buses Congestion in summer Loss of parking	Yes
3. Bala Road Texaco	Some local facilities On carriageway Limited bus delay	Not space for four buses Limited options for improvement (third party land)	No
4. Lloyd's Coaches Depot	Space for four buses Opportunity to provide new interchange facility	Third party land Removed from town centre Rerouting of T3	Yes
5. Area behind Texaco	Some local facilities Opportunity to provide new interchange facility	Uncertain land ownership Removed from town centre Rerouting of T2	No
6. Coleg Meirion Dwyfor	Space for four buses No rerouting of existing T2/T3 services	Removed from town centre No facilities Interaction with school transport	Yes
7. Bala Road / Pen Y Cefn Rd	Fairly central Close to Council offices	Not space for four buses Limited options for improvement	No

Appendix A

Dolgellau Bus Interchange Options Appraisal

A.4 SWOT Review – Eldon Square

The SWOT analysis for Eldon Square option is set out below. This was discussed with representatives from Transport for Wales and Cyngor Gwynedd, and agreed that while a four-stand bus interchange could not be delivered at Eldon Square due to the physical constraints, improvements should be taken forward to deliver a two-stand option to allow continuation of services to the town centre, in support of the four-stand interchange. A concept design for this was developed at the previous project stage which improves the public realm in the square whilst improving the facilities at the bus stops.

Strengths	**Weaknesses**
Close to local shops/facilities Close to centre of town Strong public support for stops Within existing highway boundary	Unable to safely accommodate four buses Needs to be improved in conjunction with another option
Opportunities	**Threats**
High quality stop infrastructure Wider public realm improvements Improved public square 'Supporting role' for interchange	Careful timetabling to ensure only two buses arrive at once May lead to initial public confusion

Eldon Square – WelTAG Stage 2 Concept Design

Appendix A

Dolgellau Bus Interchange Options Appraisal

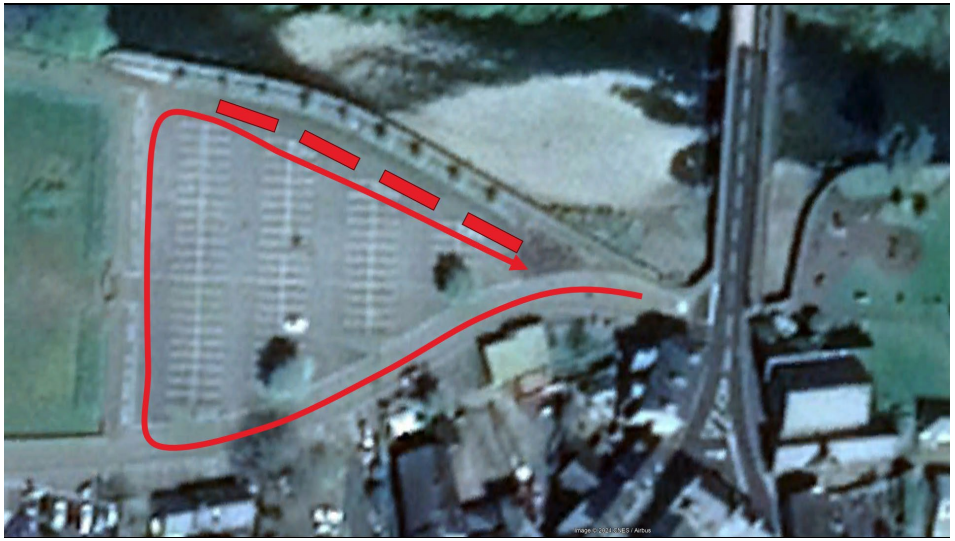
A.4 SWOT Review – Marian Mawr Car Park

The SWOT analysis for Marian Mawr Car Park option is set out below. This was discussed with representatives from Transport for Wales and Cyngor Gwynedd, and agreed that this would form the preferred location for the four-stand bus interchange due to the close proximity to the town centre and space available to provide an improved interchange, and that Option B should be taken forward as this would minimise the impact on the existing car parking provision.

The left turn out of the car park onto the bridge is very constrained for large vehicles. Although coaches and articulated HGVs do currently complete this turn, but to do this use both sides of the carriageway and thus rely on other vehicles to make space for them. It is also evident that the stone walls have been impacted, and it is likely that this has been caused by large vehicles failing to properly complete the turn.

Strengths	**Weaknesses**
Close to local shops/facilities Within existing land ownership Able to accommodate 4 buses	Reduction in car parking (~20 space) Slightly removed from town centre Possible resistance from public
Opportunities	**Threats**
High quality stop infrastructure Wider public realm improvement Would work well in conjunction with Eldon Square	Car park busy during peak summer season Additional delay/journey time

Marian Mawr Concept Design (Option A)



Marian Mawr Concept Design (Option B)

Appendix A

Dolgellau Bus Interchange Options Appraisal

A.4 SWOT Review – Lloyds Coaches Depot

The SWOT analysis for the Lloyds Coaches Depot option is set out below. This was discussed with representatives from Transport for Wales and Cyngor Gwynedd, and agreed that this site would be excluded due to the uncertainties regarding the acquisition of third-party land and the difficulties in finding a suitable alternative site for the depot.

Strengths Space for 4+ buses Provision of purpose-built interchange	**Weaknesses** Removed from town centre Limited access to shops/facilities Requires acquisition of third-party land & alternative site for Lloyds Coaches Depot Possible resistance from public
Opportunities High quality stop infrastructure	**Threats** Additional delay/journey time for T3

Lloyds Coaches Depot Concept Design (Option A)

Lloyds Coaches Depot Concept Design (Option B)

Appendix A

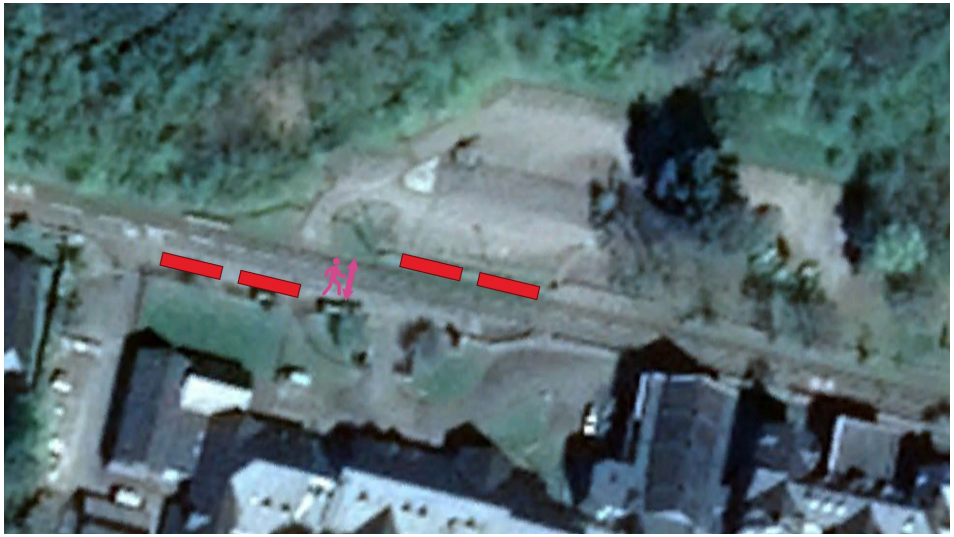
Dolgellau Bus Interchange Options Appraisal

A.4 SWOT Review – Coleg Meirion Dwyfor

The SWOT analysis for Coleg Meirion Dwyfor option is set out below. This was discussed with representatives from Transport for Wales and Cyngor Gwynedd, and agreed that this would form this would not be the preferred location for the four-stand bus interchange due to the remote location, and lack of access to local facilities.

However, it was noted that due to the limited infrastructure requirements, and lack of detour for existing bus services, this could form a sensible 'quick-win' option should the delivery of the preferred option be problematic.

Strengths Within existing highway boundary Able to accommodate 4 buses No deviation from existing T2/T3 routes	**Weaknesses** Removed from town centre No existing shops/facilities Interaction with school transport at beginning/end of day
Opportunities Would work well in conjunction with Eldon Square	**Threats** Likely resistance from public/college



Appendix A

Dolgellau Bus Interchange Options Appraisal

A.5 Preferred Option Development and Appraisal

Marian Mawr

To allow more detailed consideration of the physical constraints, bus operations, and impact on the existing parking provision, four outline design options have been developed based on the Marian Mawr Car Park Option B concept design. Drawings of these options are shown on the following pages.

Option 1 provides four bus stands along the northern edge of the car park within the existing hard standing area, aiming to minimise the impact on the parking. In order to fit four stands in this area, the stands are too close together to allow a bus to pull into a stand if the one behind is already occupied. Arriving buses would need to pull forward into the furthest available space, meaning that the stops could not be allocated to particular services which may be confusing to passengers, and limiting future flexibility. This would require the loss of 12 car parking spaces.

Option 2 extends the length of the bus stand area in order to allow independent operation of each stand. ie a bus can arrive and depart when there are buses at the adjacent bus stands. This would allow fixed allocation of bus stops, for example the four TrawsCymru service could each have a dedicated stop location, simplifying interchange for passengers and allowing flexibility should the service pattern change in the future. This would require the loss of 24 car parking spaces, and loss of the triangular planted area at the entrance to the car park.

Option 3 provides four bus stands in a sawtooth configuration which would simplify the manoeuvres for buses approaching the bus stands, whilst still allowing independent operation of each stand. This would also create more space for waiting passengers, whilst reducing the impact on parking compared to Option 2, with a loss of 19 car parking spaces.

Option 4 also provides four bus stands in a sawtooth configuration but retains the triangular planted area at the entrance to the car park by moving one of the bus stands to the western edge of the car park. This would reduce the space available for coach parking in this area and reduce the connectivity of the four bus stops. Overall, this would require the loss of 19 car parking spaces.

These options were presented to Cyngor Gwynedd, and it was agreed that Option 3 should be taken forward as the preferred option as this would allow independent operation of each bus stand, with dedicated stops for each TrawsCymru service, whilst balancing the impact on the car park. An initial cost estimate for these works is approximately £500,000-£1,000,000.

Cyngor Gwynedd highlighted that there has previously been strong opposition to buses not serving Eldon Square. It is noted that this option would retain stopping locations at Eldon Square, but make for a safer and more resilient interchange point for interchanging passengers.

Dolgellau Bridge

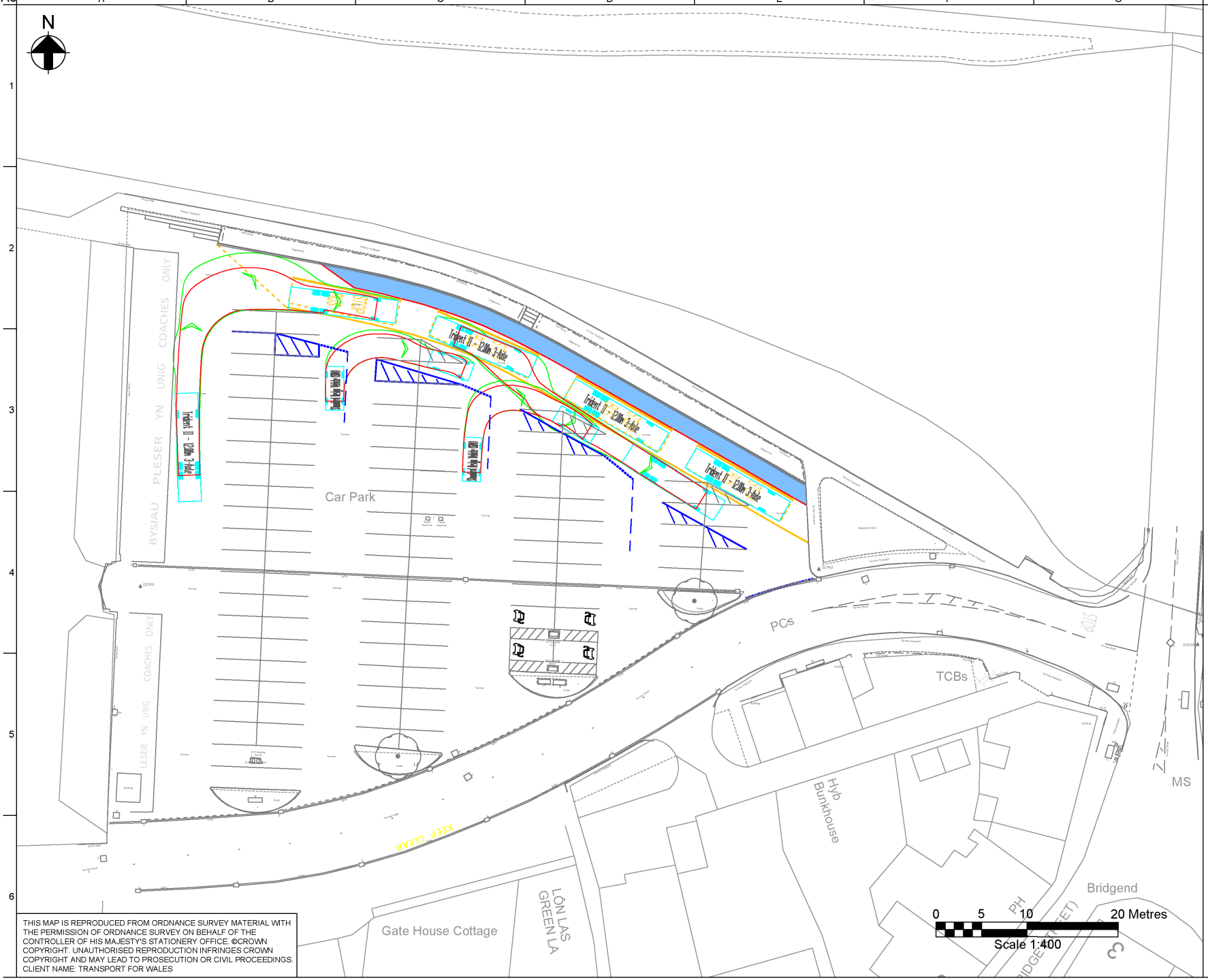
It was noted the left turn from the Marian Mawr Car Park towards the bridge was very constrained for large vehicles, and initial options to improve this were considered, including widening of the junction to the car park, flaring the bridge approach, and traffic signal control. Given the impact on the Grade II listed bridge and river flood defences these improvements are challenging, and it was agreed that (in the short-term at least) buses should be routed to turn right out of the car park along Ffos-Y-Felin, and either turn through Eldon Square or Arran Road depending on their destination. Notwithstanding the difficulty, enabling the left turn out of Marian Mawr could enhance future flexibility of the interchange and further consideration and option development should be developed at the next stage.

Eldon Square

The creation of a four-bus interchange in Marian Mawr would allow rationalisation of the bus stops in Eldon Square. A concept sketch for this was presented at Stage 2, which would allow two buses to stop simultaneously with improved stop facilities, along with an increase in pedestrian space and formalisation of the wider highway infrastructure. This would also allow associated improvements to the public realm.

A more detailed version of the highway infrastructure has been developed as part of this study based on a topographical survey, to consider vehicle swept path requirements and to ensure that the buses and other vehicles can use the space more effectively, whilst creating a more pleasant and functional pedestrian environment.

Depending on the level of associated public realm improvements, an initial cost estimate for these works is approximately £1,000,000-£2,000,000

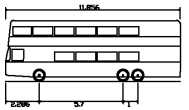


Do not scale

References:
Landmark Surveys Wales, Dolgellau Car Park Topographic Survey 2D, Ref : 6850A, February 2024.

Standard Design Vehicle (SDV)

Overall Length	4.800m
Overall Width	2.000m
Overall Body Height	1.950m
Min Body Ground Clearance	0.100m
Track Width	2.000m
Lock to lock time	4.00s
Wall to Wall Turning Radius	6.000m



Trident II - 12.00m 3-Axle

Overall Length	11.856m
Overall Width	2.496m
Overall Body Height	3.140m
Min Body Ground Clearance	0.311m
Track Width	2.363m
Lock to lock time	4.00s
Kerb to Kerb Turning Radius	9.500m

Rev	Date	By	Chkd	Appd
01	02/05/24	BS	PC	DM
Draft Issue				

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Client
Transport for Wales

Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Dolgellau
Option 1 - Stacked

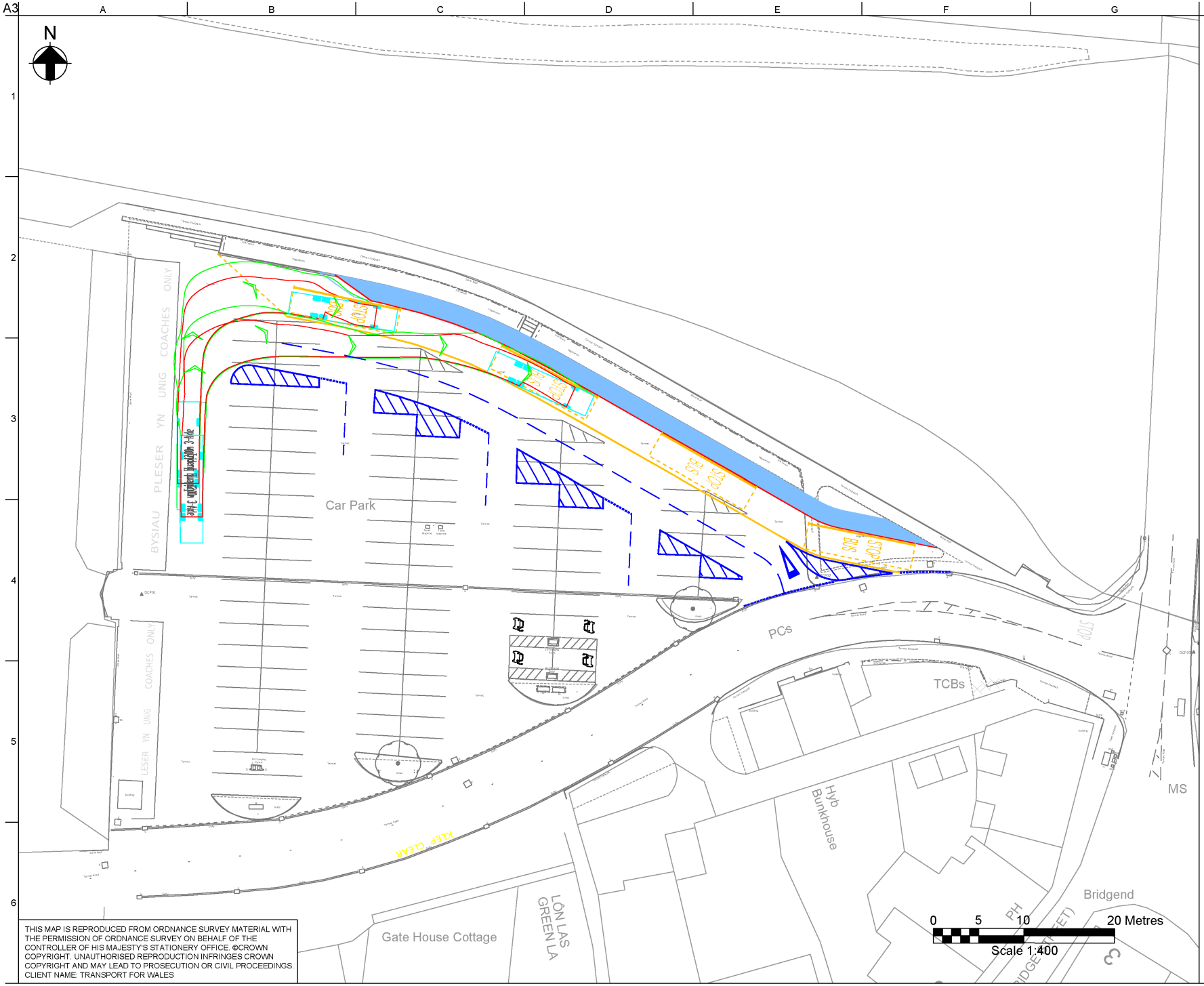
Scale at A3 1:400

Role Transport Planning

Suitability Draft

Arup Job No **299103-00** | Rev **01**

Drawing No **299103-00_ARUP_DR_TP_0060**



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References:
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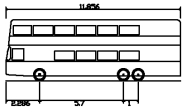

Trident II - 12.00m 3-Axle

Overall Length	11.856m
Overall Width	2.496m
Overall Body Height	3.140m
Min Body Ground Clearance	0.311m
Track Width	2.363m
Lock to lock time	4.90s
Kerb to Kerb Turning Radius	9.500m

Rev	Date	By	Chkd	Appd
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WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Dolgellau
Option 2 - Indepedent Straight Stops

Scale at A3 1:400

Role Transport Planning

Suitability Draft

Arup Job No 299103-00

Rev 01

Drawing No 299103-00_ARUP_DR_TP_0061

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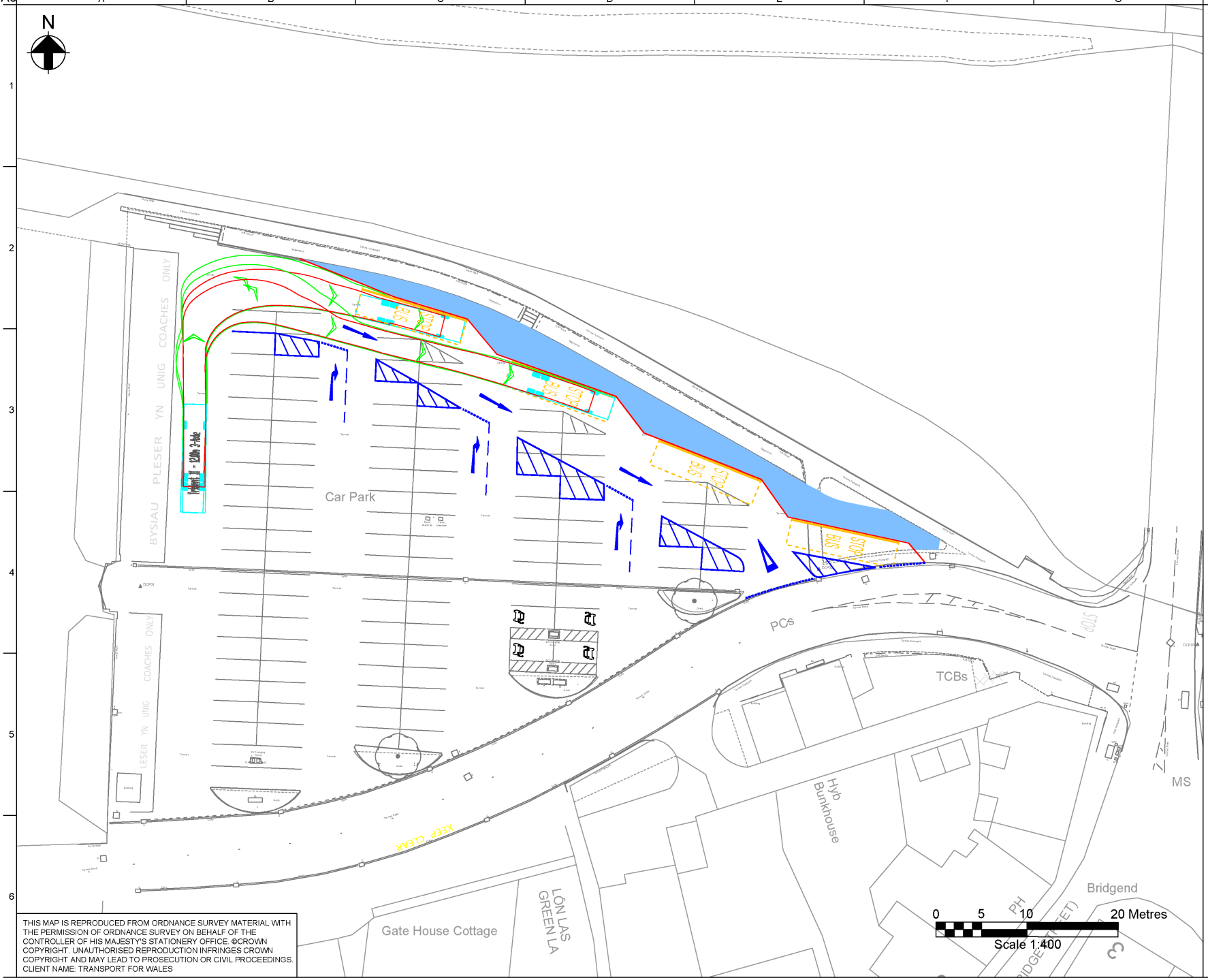

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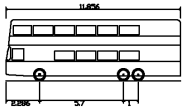

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Overall Length	11.856m
Overall Width	2.496m
Overall Body Height	4.140m
Min Body Ground Clearance	0.311m
Track Width	2.363m
Lock to lock time	4.90s
Kerb to Kerb Turning Radius	9.500m

Rev	Date	By	Chkd	Appd
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North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Dolgellau
Option 3 - Sawtooth

Scale at A3 1:400

Role Transport Planning

Suitability Draft

Arup Job No 299103-00

Rev 01

Drawing No 299103-00_ARUP_DR_TP_0062

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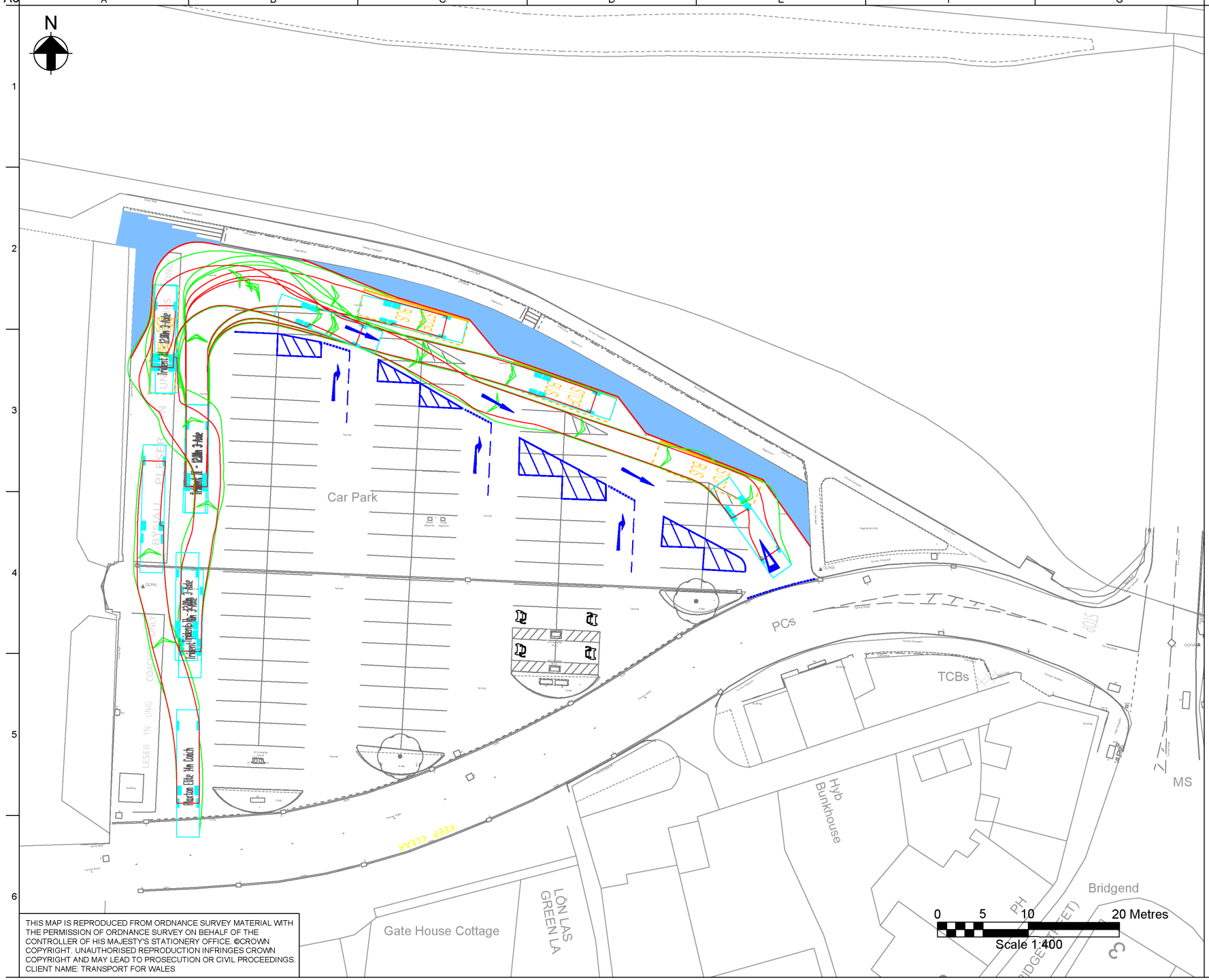

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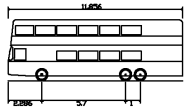
References:
Landmark Surveys Wales, Dolgellau Car Park Topographic Survey 2D, Ref : 6850A, February 2024.



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Overall Width	2.496m
Overall Body Height	4.140m
Min Body Ground Clearance	0.311m
Track Width	2.363m
Lock to lock time	4.90s
Kerb to Kerb Turning Radius	9.500m

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Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Dolgellau
Option 4 - Bus Stop in existing Coach Bay accompanied by Sawtooth

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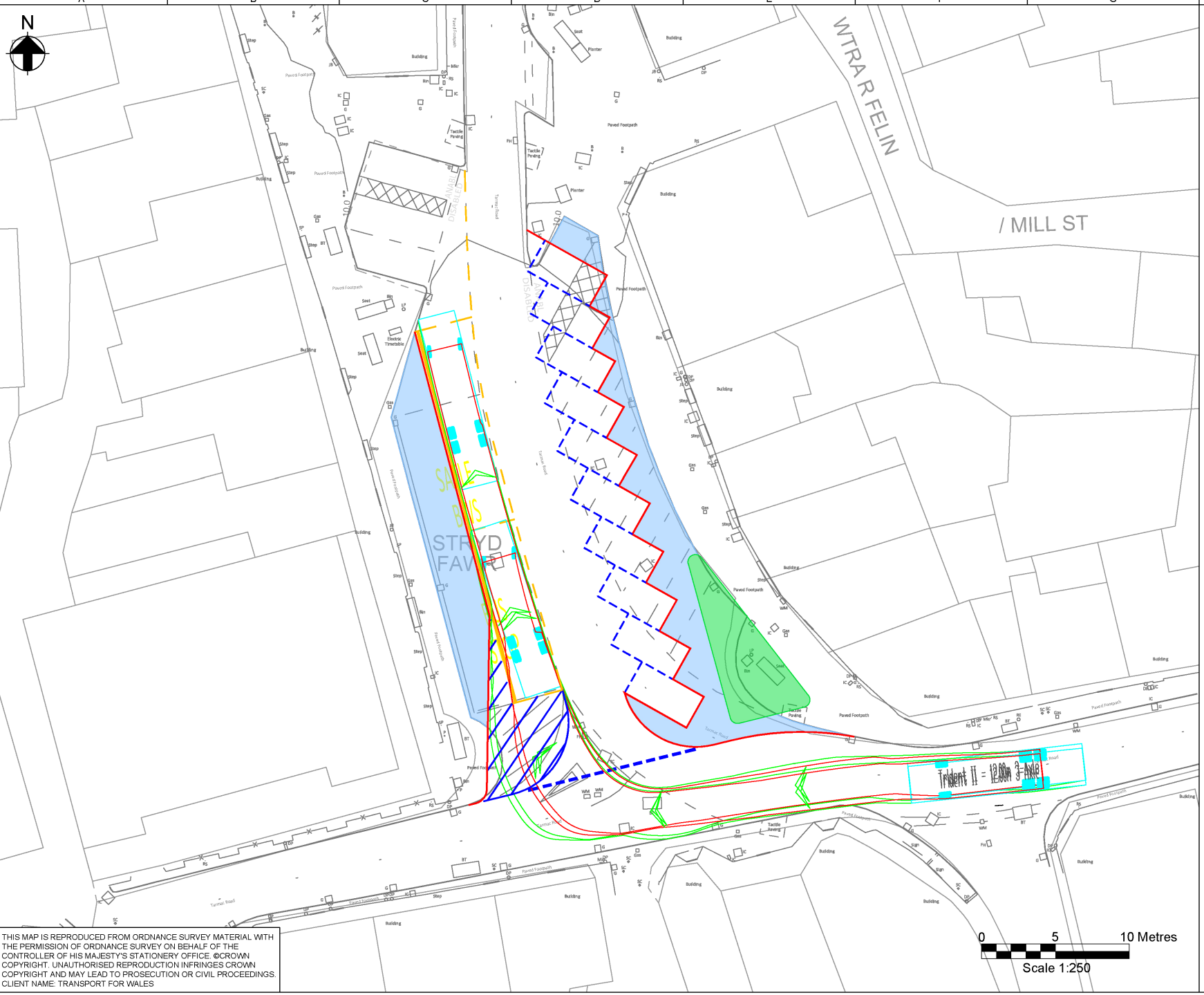
Suitability	Draft
Arup Job No	299103-00
Rev	01
Drawing No	299103-00_ARUP_DR_TP_0063



References:
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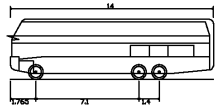

Plaxton Elite 14m Coach	
Overall Length	14.000m
Overall Width	2.500m
Overall Body Height	4.157m
Min Body Ground Clearance	0.397m
Max Track Width	2.497m
Lock to lock time	5.005
Wall to Wall Turning Radius	12.500m

Rev	Date	By	Chkd	Appd
01	03/05/24	BS	PC	DM
	Draft Issue			

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Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Dolgellau
Town Square

Scale at A3 1:250

Role Transport Planning

Suitability Draft

Arup Job No **299103-00** | Rev **01**

Drawing No **299103-00_ARUP_DR_TP_0064**

Do not scale

Appendix A

Dolgellau Bus Interchange Options Appraisal

A.6 Next Steps

Marian Mawr Car Park

The outline proposals for Marian Mawr should be presented to a wider stakeholder group to ensure that the diverse needs of the whole community can be taken into account. Additionally, land ownership and access rights/requirements should be explored further, in particular relating to the Marian Mawr Trust, the Rugby and Cricket clubs, and the Marian Mawr Enterprise Park. This would allow further design development of the proposals, and a more detailed cost assessment to be undertaken.

Dolgellau Bridge

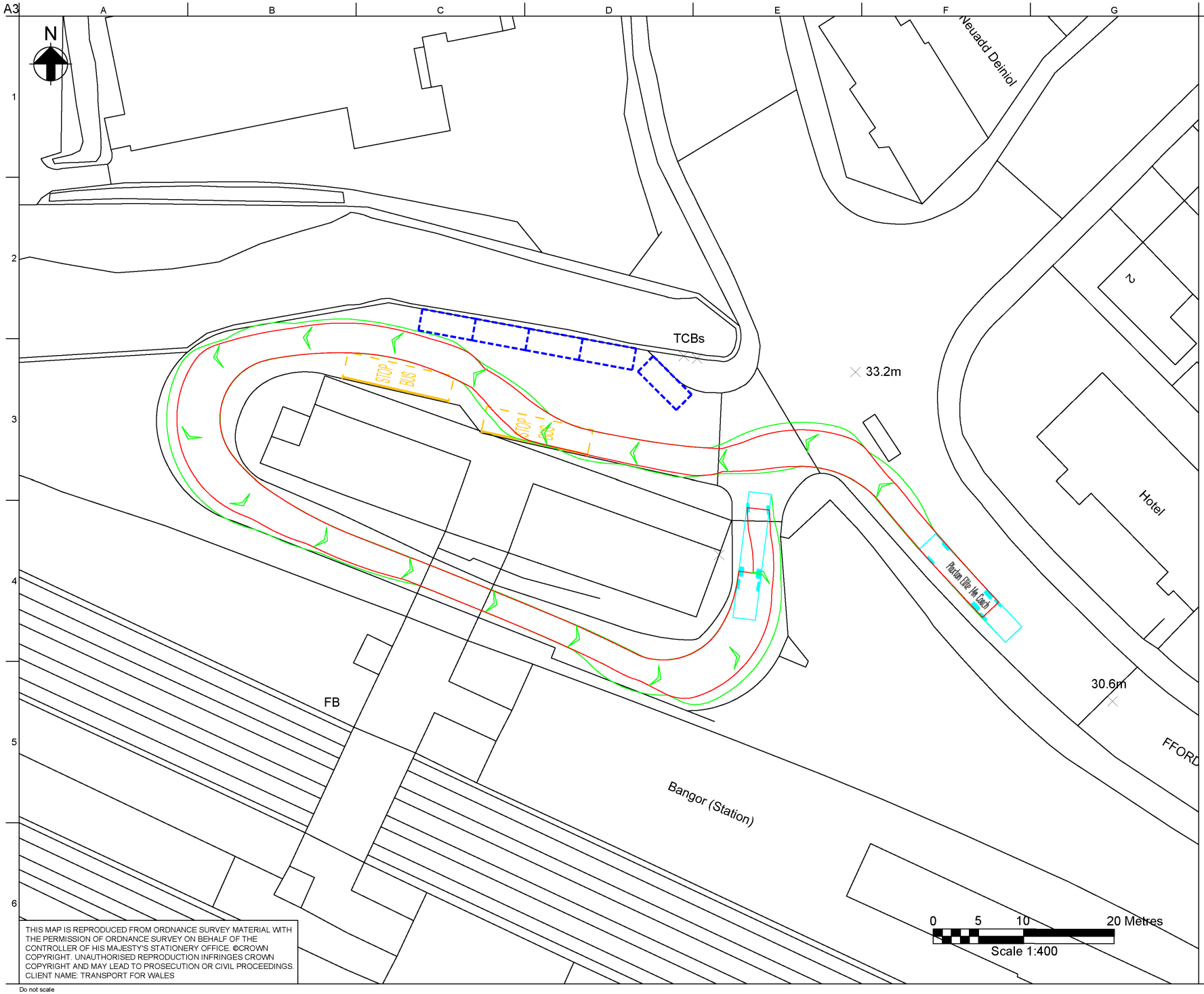
A more detailed study of the constraints should be undertaken, in particular relating to the Grade II listed bridge structure and the river flood defences. This would allow further investigation of the options to allow vehicles to turn left from Marian Mawr, or confirmation that they can be ruled out.

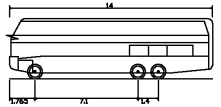
Eldon Square

The Eldon Square proposals should be presented to a wider audience, to allow input from a more diverse stakeholder group and ensure buy-in from the local community before progressing further with the design development.

Appendix B

Proposed Bus Stop Improvements and Vehicle Tracking





Plaxton Elite 14m Coach	
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Overall Width	2.500m
Overall Body Height	4.197m
Min Body Ground Clearance	0.397m
Max Track Width	2.497m
Lock to lock time	5.005
Wall to Wall Turning Radius	12.500m

Rev	Date	By	Chkd	Appd
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Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Bangor

Scale at A3 1:400

Role Transport Planning

Suitability Draft

Arup Job No **299103-00** | Rev **01**

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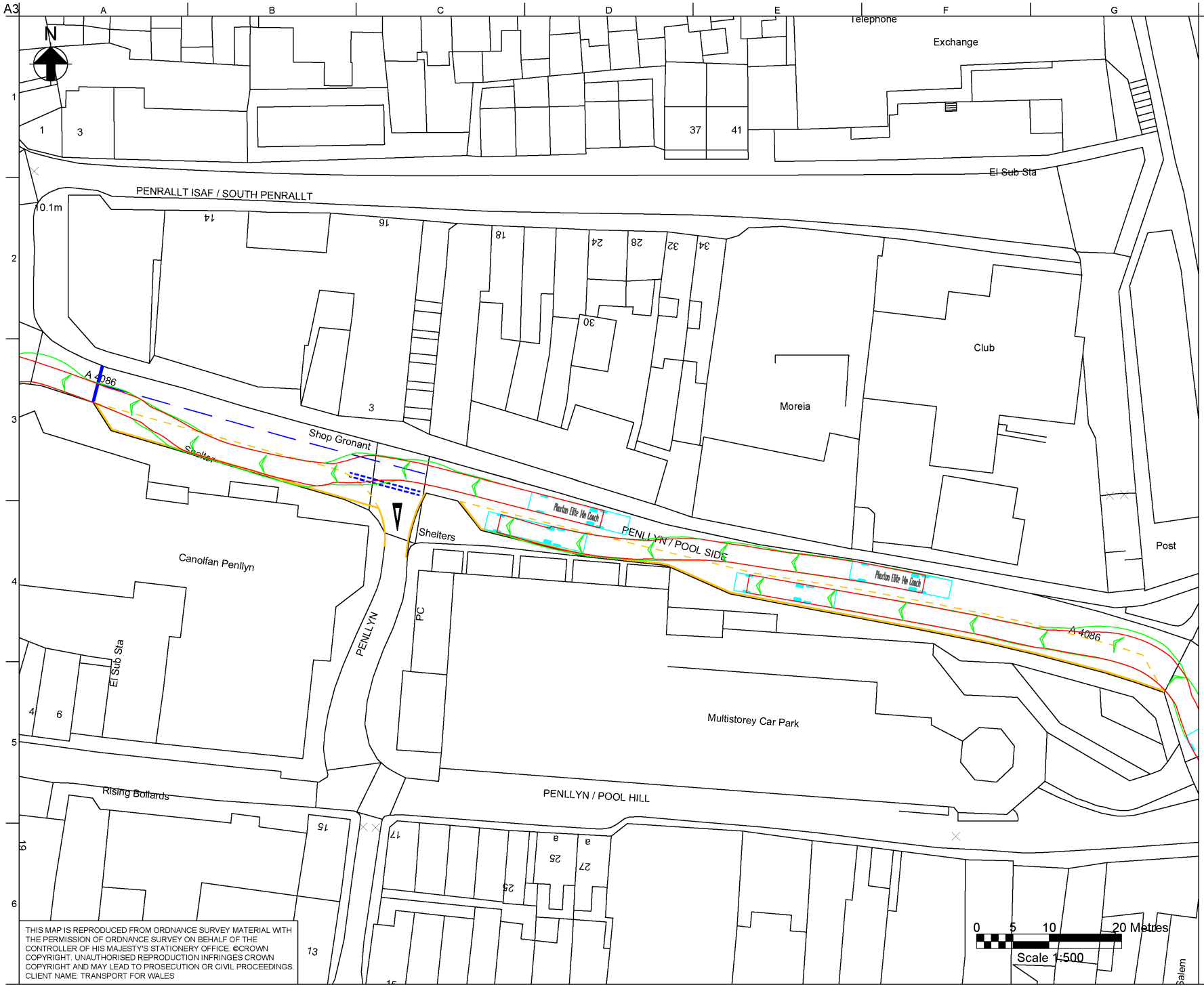

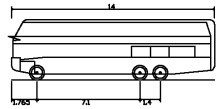

Plaxton Elite 14m Coach

Overall Length	14.000m
Overall Width	2.500m
Overall Body Height	4.197m
Min Body Ground Clearance	0.397m
Max Track Width	2.487m
Lock to lock time	5.00s
Wall to Wall Turning Radius	12.500m

Rev	Date	By	Chkd	Appd
01	07/05/24	BS	PC	DM

Draft Issue

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Client
Transport for Wales

Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Caernarfon
Option 1

Scale at A3 1:400

Role Transport Planning

Suitability Draft

Arup Job No **299103-00** | Rev **01**

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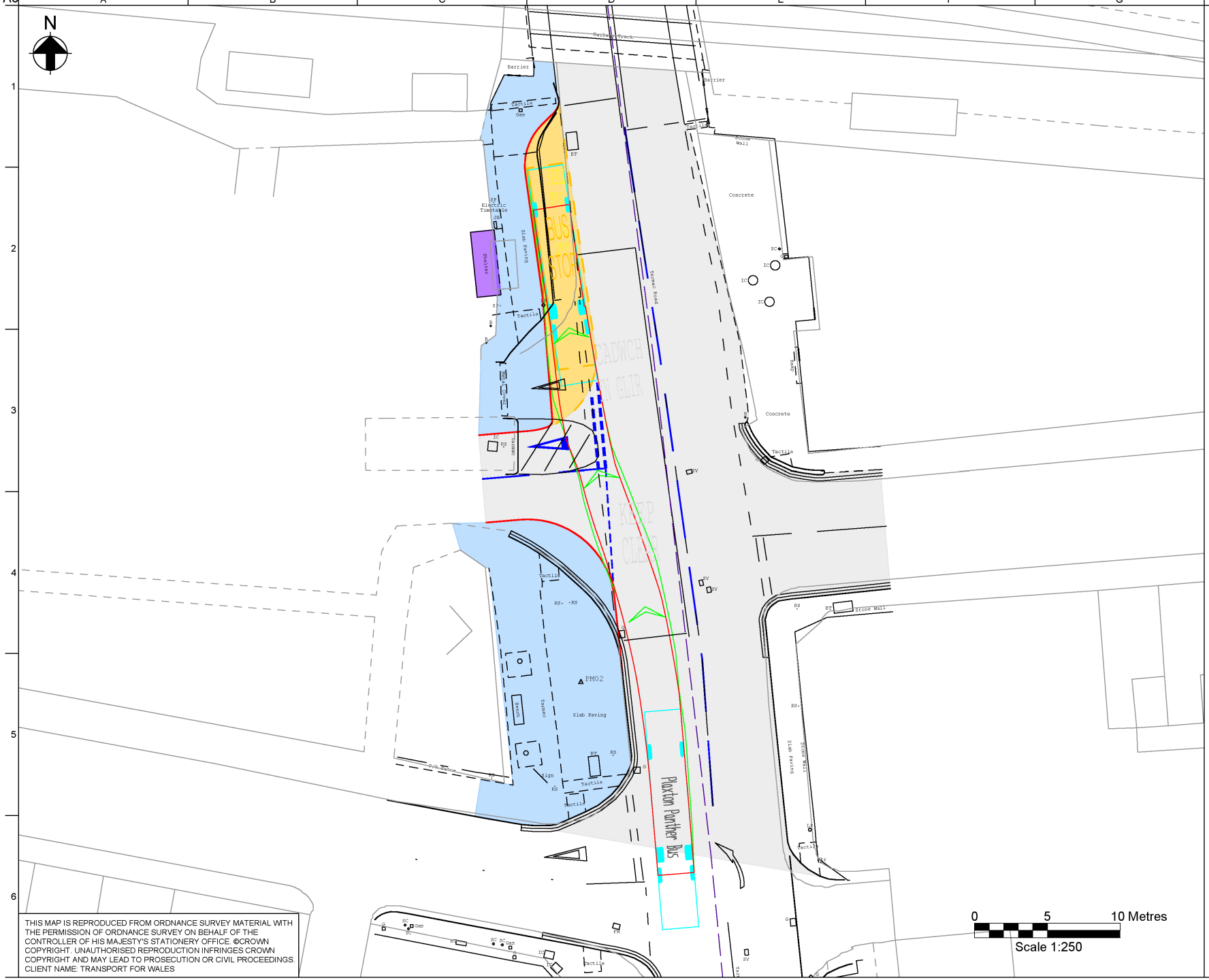

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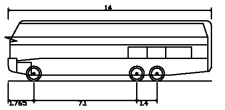
Landmark Surveys Wales. Porthmadog High Street 2d, Ref: 6850C, February 2024.



Plaxton Elite 14m Coach	
Overall Length	14.000m
Overall Width	2.500m
Overall Body Height	4.157m
Min Body Ground Clearance	0.397m
Max Track Width	2.487m
Lock to lock time	5.00s
Wall to Wall Turning Radius	12.500m

Rev	Date	By	Chkd	Appd
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Client
Transport for Wales

Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Porthmadog

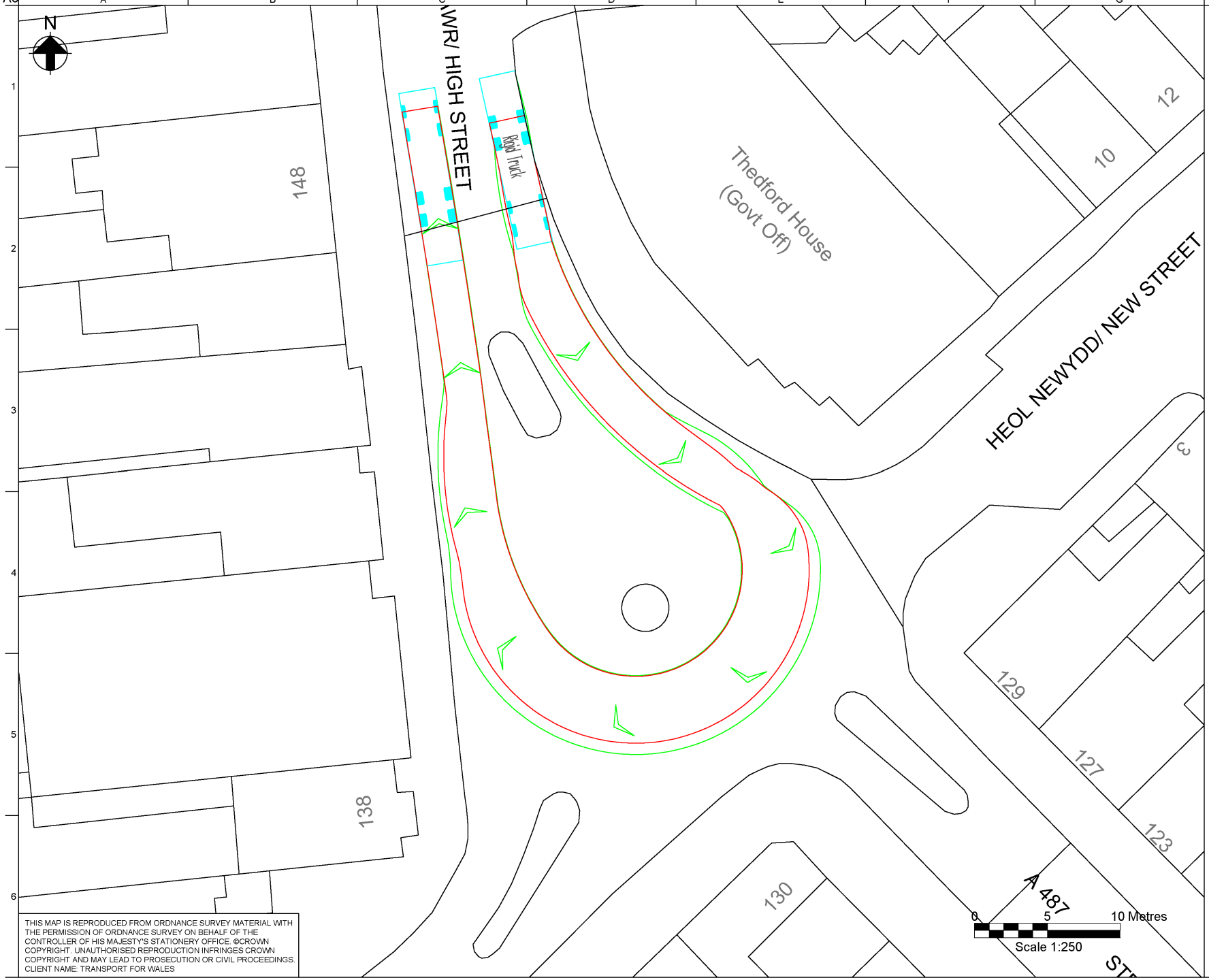
Scale at A3 1:400

Role Transport Planning

Suitability Draft

Arup Job No **299103-00** | Rev **01**

Drawing No **299103-00_ARUP_DR_TP_0090**



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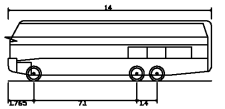

Plaxton Elite 14m Coach	
Overall Length	14.000m
Overall Width	2.500m
Overall Body Height	4.157m
Min Body Ground Clearance	0.397m
Max Track Width	2.487m
Lock to lock time	5.00s
Wall to Wall Turning Radius	12.500m

Rev	Date	By	Chkd	Appd
01	08/05/24	BS	PC	DM
	Draft Issue			

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Client
Transport for Wales

Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Porthmadog
High Street/New Street Roundabout

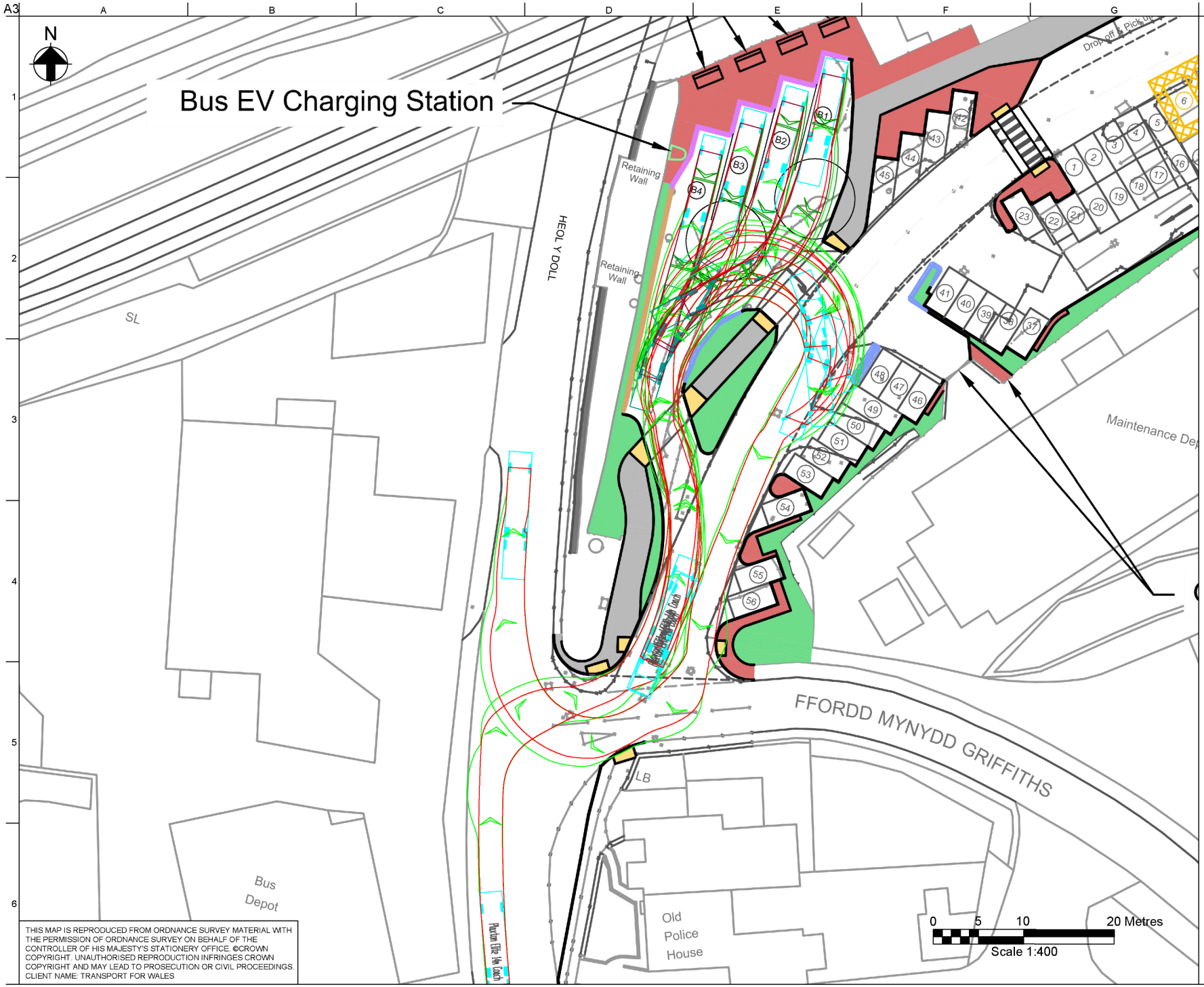
Scale at A3 1:400

Role Transport Planning

Suitability Draft

Arup Job No **299103-00** | Rev **01**

Drawing No **299103-00_ARUP_DR_TP_0091**



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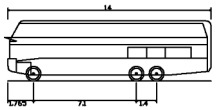
Do not scale

Notes:
Extract from Machynlleth Station Interchange - Proposed Layout Station Forecourt & Operations Yard (July 2023). Engineering Design Services, Drawing 2135 M23_03



Plaxton Elite 14m Coach	
Overall Length	14.000m
Overall Width	2.500m
Overall Body Height	4.157m
Min Body Ground Clearance	0.397m
Max Track Width	2.487m
Lock to lock time	5.00s
Wall to Wall Turning Radius	12.500m

Rev	Date	By	Chkd	Appd
01	08/05/24	BS	PC	DM
	Draft Issue			

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Client
Transport for Wales

Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Machynlleth
Proposed Bus Station

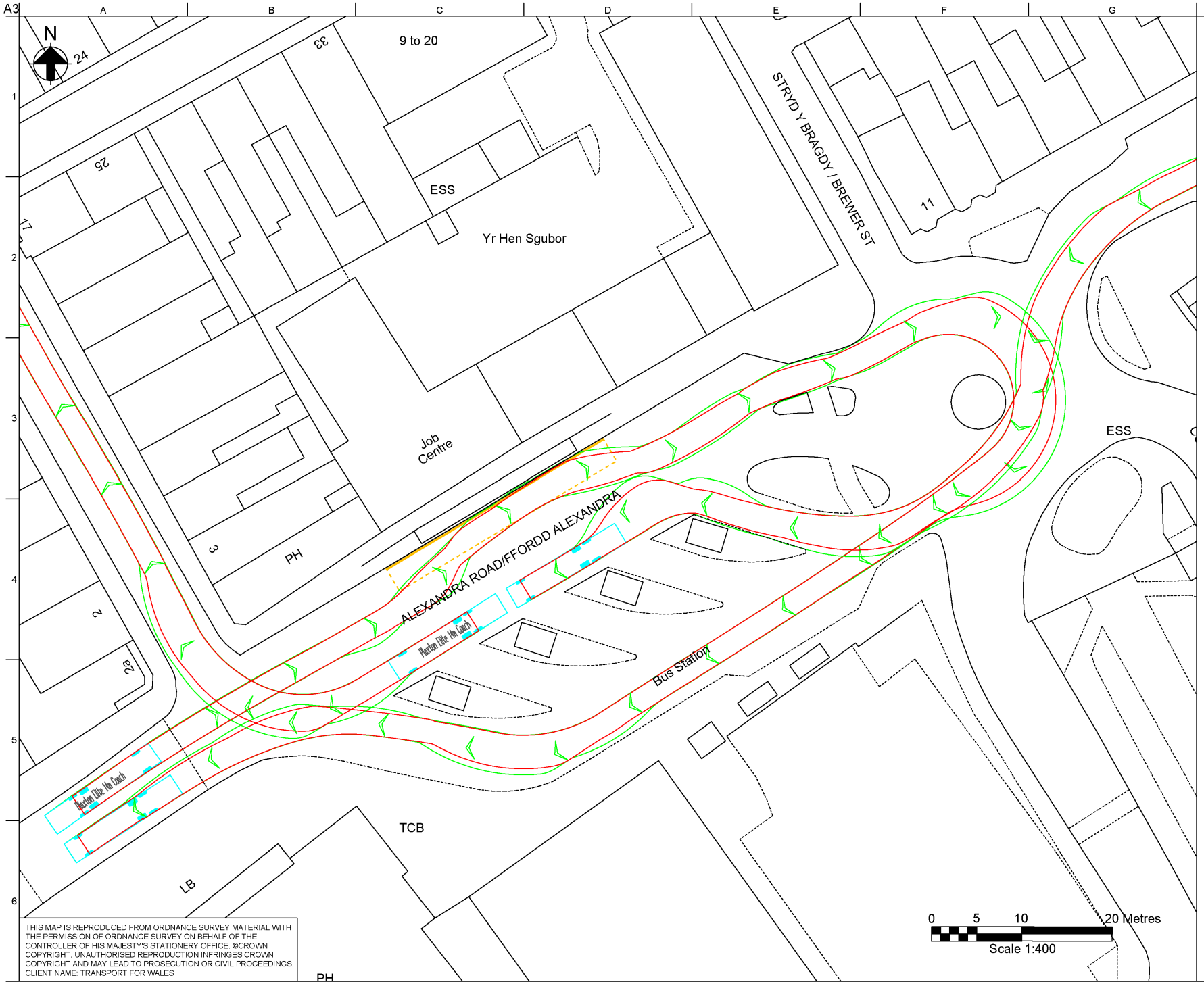
Scale at A3 1:400

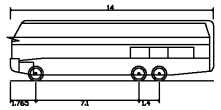
Role Transport Planning

Suitability Draft

Arup Job No **299103-00** | Rev **01**

Drawing No **299103-00_ARUP_DR_TP_0080**





Plaxton Elite 14m Coach	
Overall Length	14.000m
Overall Width	2.500m
Overall Body Height	4.197m
Min Body Ground Clearance	0.397m
Max Track Width	3.487m
Lock to lock time	7.00s
Wall to Wall Turning Radius	12.500m

Rev	Date	By	Chkd	Appd
01	03/05/24	BS	PC	DM
	Draft Issue			

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Client
Transport for Wales

Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Aberystwyth
Bus Station

Scale at A3 1:400

Role Transport Planning

Suitability Draft

Arup Job No 299103-00

Rev 01

Drawing No 299103-00_ARUP_DR_TP_0020

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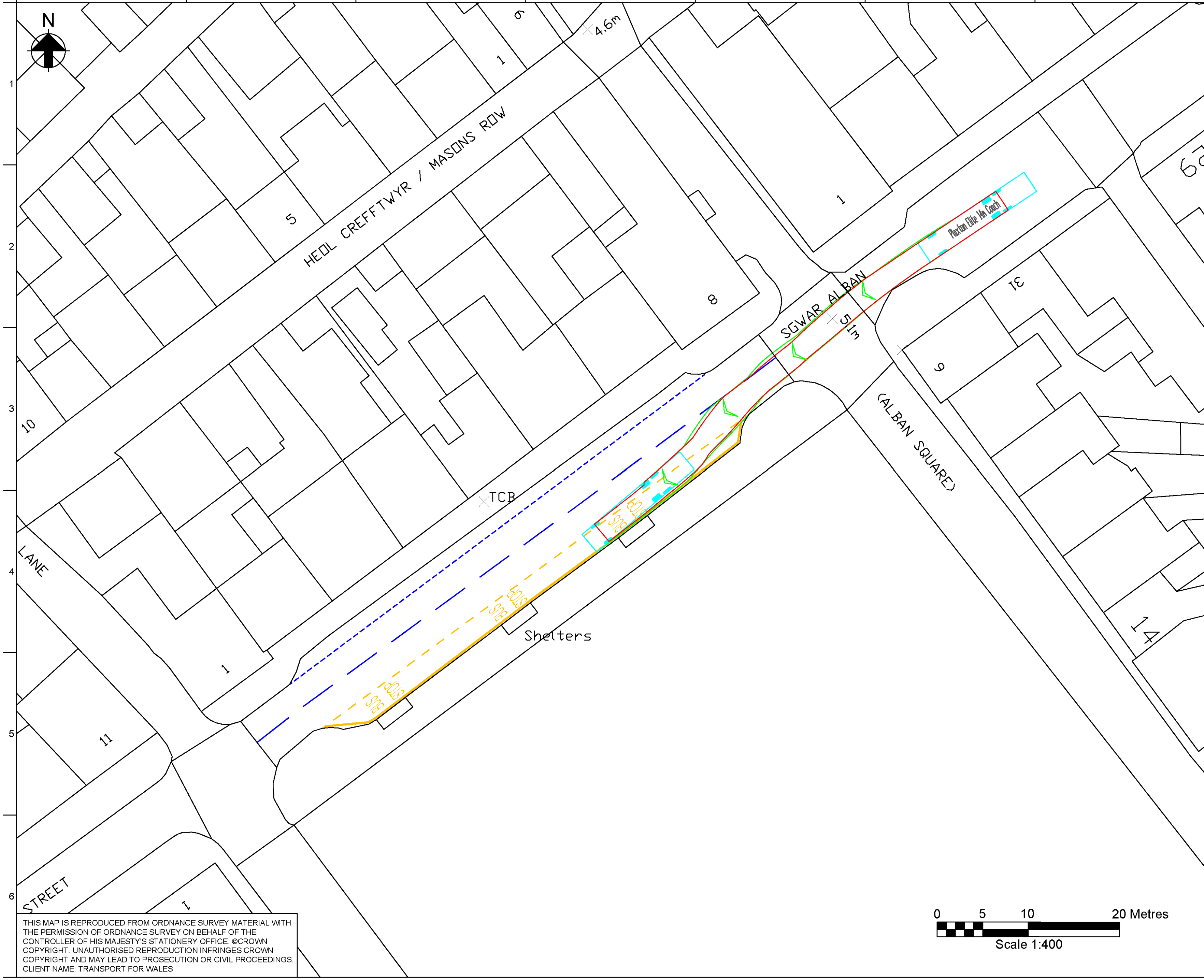

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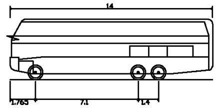

Plaxton Elite 14m Coach

Overall Length	14.000m
Overall Width	2.500m
Overall Body Height	4.157m
Min Body Ground Clearance	0.397m
Max Track Width	2.487m
Lock to lock time	5.00s
Wall to Wall Turning Radius	12.500m

Rev	Date	By	Chkd	Appd
01	03/05/24	BS	PC	DM
	Draft Issue			

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Client
Transport for Wales

Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Aberaeron
Southbound

Scale at A3: 1:400

Role: Transport Planning

Suitability: Draft

Arup Job No: 299103-00

Rev: 01

Drawing No: 299103-00_ARUP_DR_TP_0010

Do not scale

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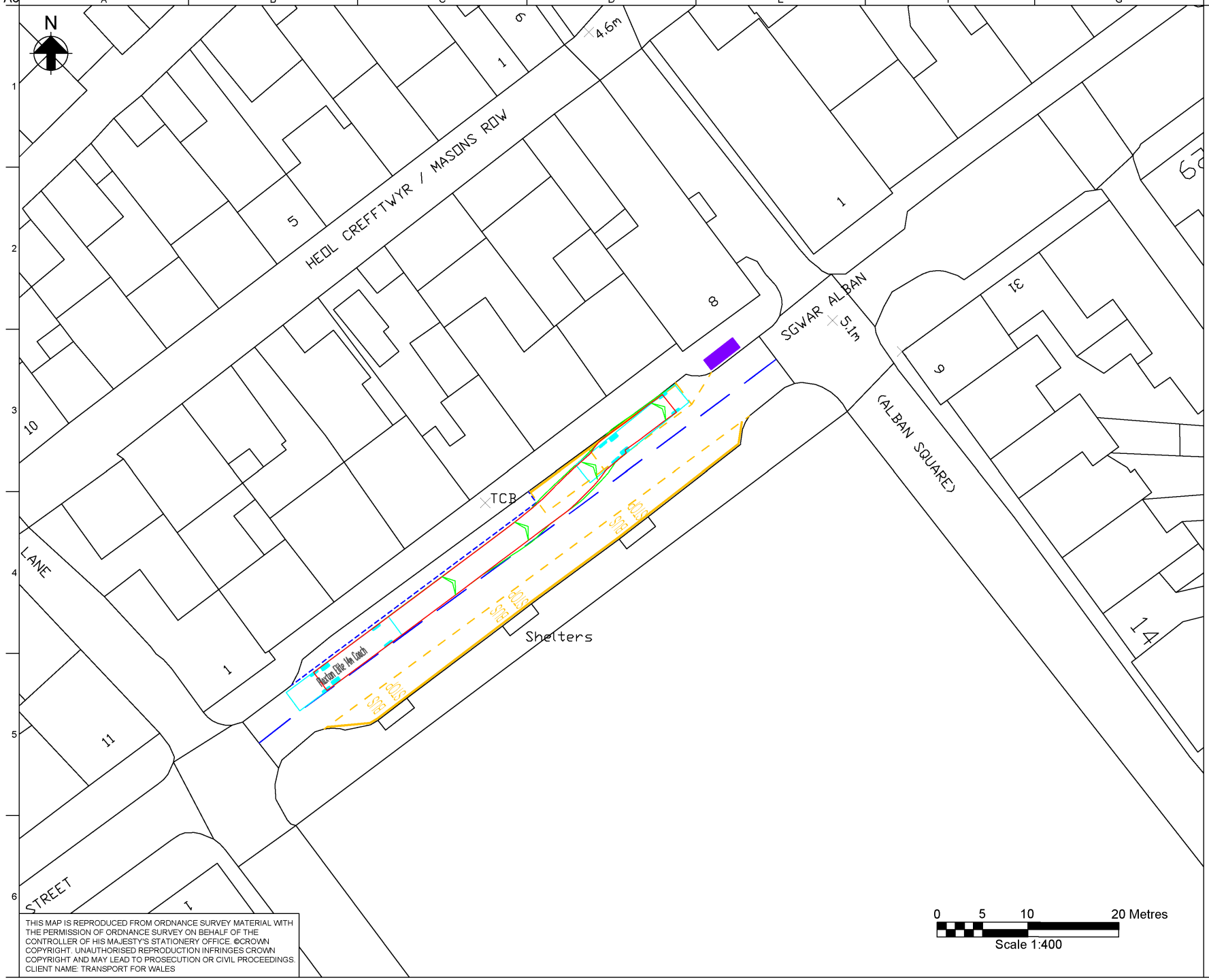

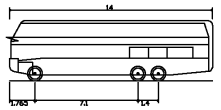

Plaxton Elite 14m Coach

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Overall Body Height	4.197m
Min Body Ground Clearance	0.397m
Max Track Width	2.487m
Lock to lock time	9.00s
Wall to Wall Turning Radius	12.500m

Rev	Date	By	Chkd	Appd
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Client
Transport for Wales

Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Aberaeron
Northbound

Scale at A3 1:400

Role Transport Planning

Suitability Draft

Arup Job No **299103-00**

Rev **01**

Drawing No **299103-00_ARUP_DR_TP_0011**

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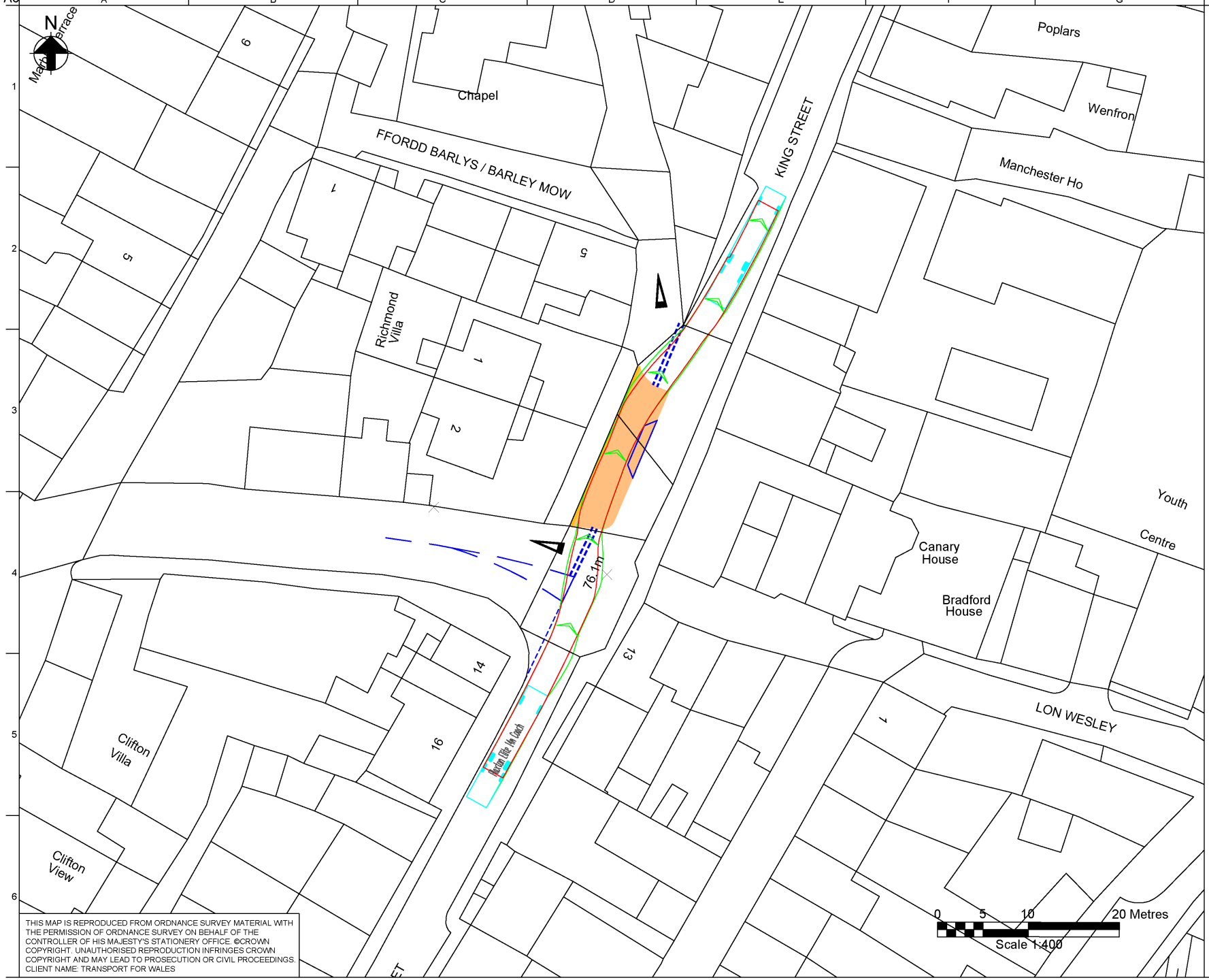

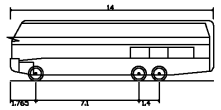

Plaxton Elite 14m Coach

Overall Length	14.000m
Overall Width	2.500m
Overall Body Height	4.197m
Min Body Ground Clearance	0.397m
Max Track Width	2.497m
Lock to lock time	7.00s
Wall to Wall Turning Radius	12.500m

Rev	Date	By	Chkd	Appd
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Client
Transport for Wales

Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Llandysul
Kings Street

Scale at A3 1:400

Role Transport Planning

Suitability Draft

Arup Job No **299103-00**

Rev **01**

Drawing No **299103-00_ARUP_DR_TP_0070**

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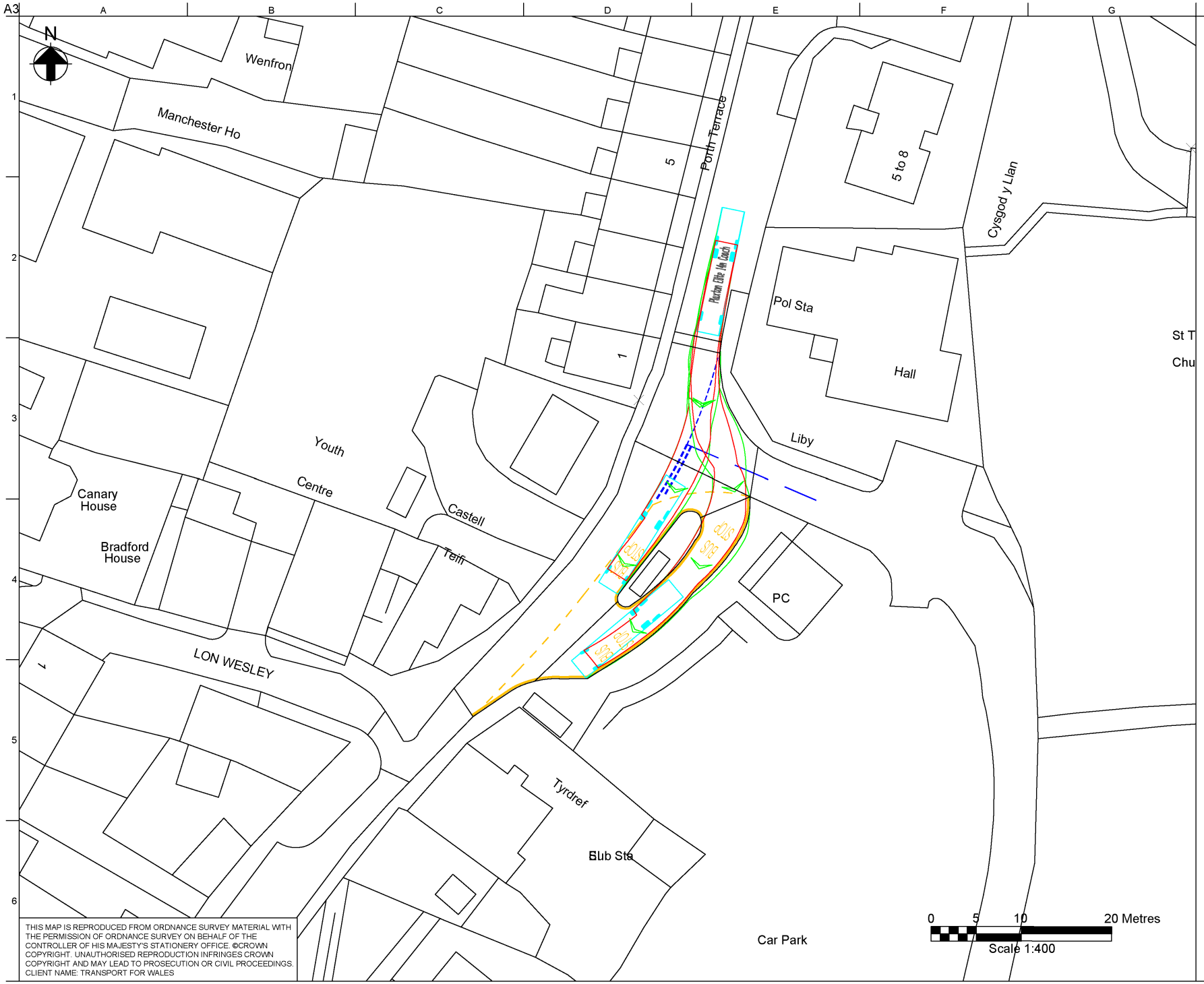

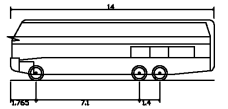

Plaxton Elite 14m Coach	
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Overall Body Height	4.157m
Min Body Ground Clearance	0.397m
Max Track Width	2.487m
Lock to lock time	8.00s
Wall to Wall Turning Radius	12.500m

Rev	Date	By	Chkd	Appd
01	07/05/24	BS	PC	DM

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Client
Transport for Wales

Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Llandysul
St Tysul's Church Stop

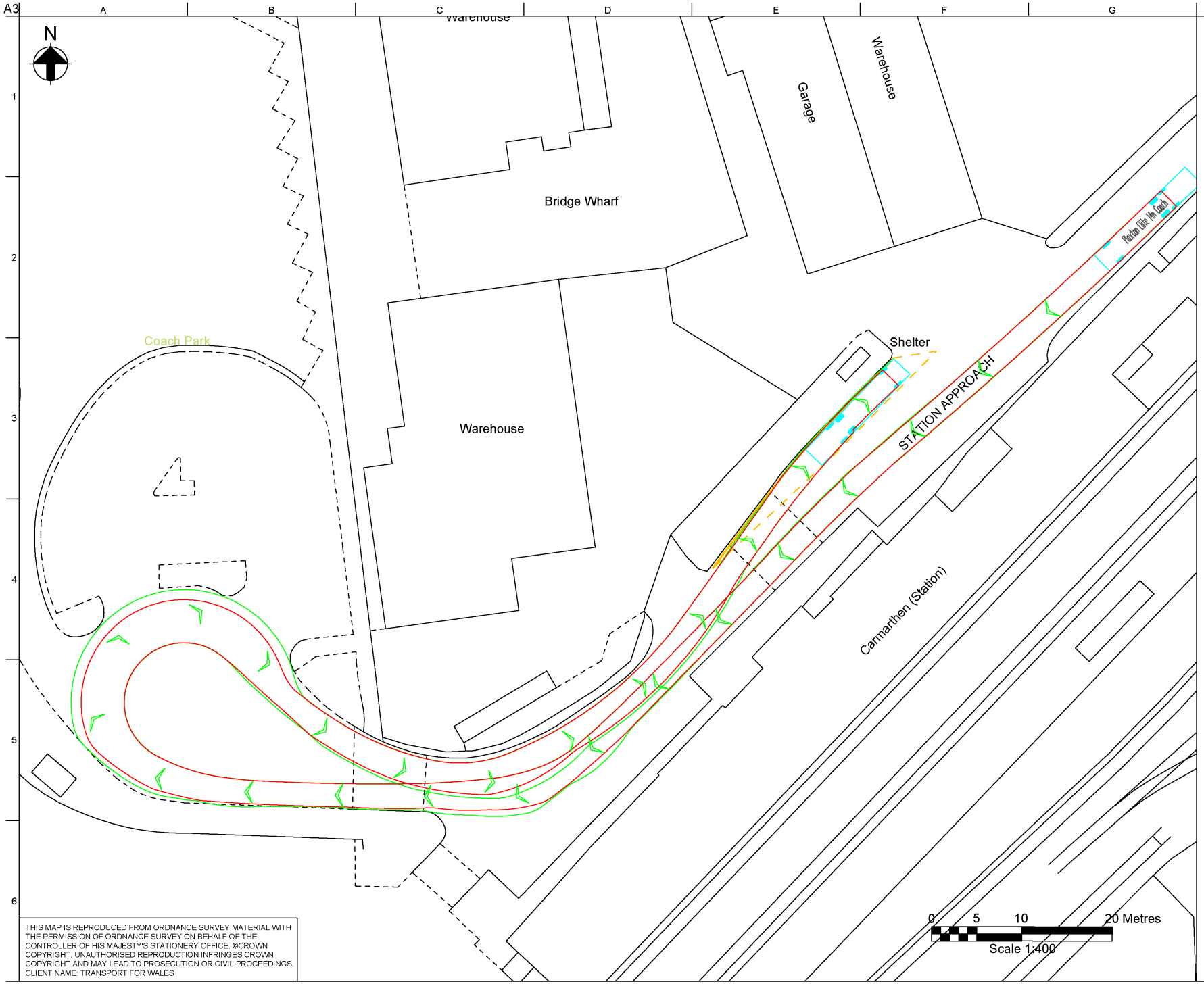
Scale at A3 1:400

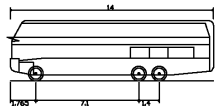
Role Transport Planning

Suitability Draft

Arup Job No **299103-00** | Rev **01**

Drawing No **299103-00_ARUP_DR_TP_0071**





Plaxton Elite 14m Coach

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Rev	Date	By	Chkd	Appd
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Client
Transport for Wales

Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Carmarthen
Rail Station

Scale at A3 1:400

Role Transport Planning

Suitability Draft

Arup Job No **299103-00** | Rev **01**

Drawing No **299103-00_ARUP_DR_TP_0050**

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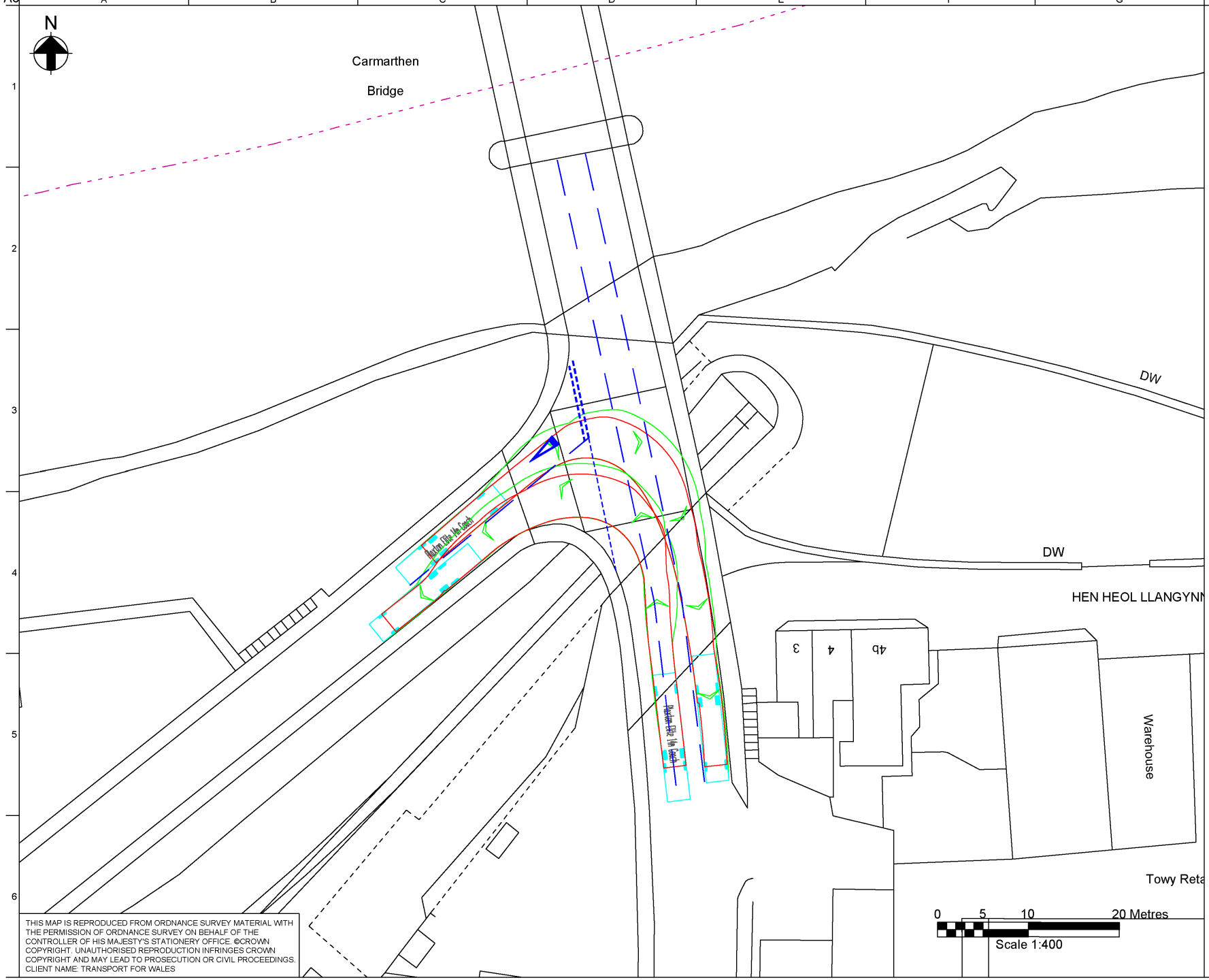

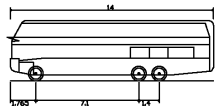

Plaxton Elite 14m Coach	
Overall Length	14.000m
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Rev	Date	By	Chkd	Appd
01	07/05/24	BS	PC	DM

Draft Issue

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Client
Transport for Wales

Project Title
North-South Wales Bus Connectivity
WelTAG Stage 2/3

Drawing Title
Vehicle Swept Path Analysis
Carmarthen
Junction on A484

Scale at A3 1:400

Role Transport Planning

Suitability Draft

Arup Job No **299103-00** | Rev **01**

Drawing No **299103-00_ARUP_DR_TP_0051**

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Appendix C

Integrated Well-being Appraisal

Route Design Options

Project name	ECS - N-S Wales Bus Connectivity
Project number	299103-00
Worksheet title	Route Design Options

WTS ambitions and aims		Description	Option 2 Coach service with intermediate stops, focusing on town centre locations and rail stations, with two stops in larger towns/cities	Option 3 Express coach with limited stops at town centre locations and rail stations, featuring a single stop per town (except Aberystwyth)	Option 4 Express coach with limited stops at town centre locations and rail stations, featuring a single stop per town.	Rationale
People and communities	**Equality**	Remove physical, attitudinal, environmental, linguistic, and economic barriers that prevent people from using sustainable transport services	**1**	**2**	**2**	Option 2: Introducing a coach service with an intermediate number of stops, including town centre locations and rail stations, will enhance accessibility for various demographics, contributing positively to equality. However, the number of stops and slower end-to-end travel time may introduce some barriers to service adoption for some users. Options 3 and 4: Providing an express coach service with fewer stops improves accessibility whilst offering faster travel times. The service is likely to be more attractive to users travelling the entire route.
	Health	Facilitate higher activity levels through walking and cycling, improve air quality, and reduce noise pollution.	**1**	**1**	**1**	All options are likely to induce a level of modal shift which could impact health outcomes through encoraging active travel as part of journeys. Also the route itself may offer additional access options to healthcare, exercise and recreational facilities.
	Confidence and safety	Enable everyone to feel safe and confident using the sustainable transport mode of their choice.	**1**	**1**	**1**	All options focus on town centre stops and railway connections which provides an opportunity to enhance actual/percieved safety for users by providing well-lit, well-established stops for users to access via this new coach option. Also, establishing stops at points of other service connection reduces the compexity of transfers for users, increasing confindence in the completion of their end-to-end journey.
Environment	**Carbon**	Deliver a significant reduction in greenhouse gas (GHG) emissions.	**0**	**1**	**1**	Route design options are not expected to play a significant role in a reduction of GHG emissions however modal shift from the introduction of the service could contibute to an emisisons reduction. The increased number of stops for Option 2 may reduce the potenital of the service to displace longer distance car journeys due to its higher journey times, hence its emissions reduction potential is expected to be lower.
	Biodiversity	Maintain and enhance biodiversity and ecosystem resilience.	**0**	**0**	**0**	Different route designs are not expected to have an impact on biodiversity/ecosystem enhancement/resilience vs a do nothing (baseline) scenario.
	Soils and water	Maintain and enhance soil quality and the water environment.	**0**	**0**	**0**	Different route designs are not expected to have an impact on soil/water quality vs a do nothing (baseline) scenario.
	Waste	Make better use of existing infrastructure.	**1**	**1**	**1**	The introduction of a coach service that focuses on town centre and railway stop locations will improve the utilisation of existing infrastructure assets.

WTS ambitions and aims		Description	Option 2 Coach service with intermediate stops, focusing on town centre locations and rail stations, with two stops in larger towns/cities	Option 3 Express coach with limited stops at town centre locations and rail stations, featuring a single stop per town (except Aberystwyth)	Option 4 Express coach with limited stops at town centre locations and rail stations, featuring a single stop per town.	Rationale
Places and the economy	**Cohesive communities**	How the transport system can help to meet the needs of different parts of Wales.	**2**	**2**	**2**	All coach service route design options could strengthen cohesive communities by enhancing transport accessibility and connectivity.
	Placemaking	Impact of the options on the landscape and how the Place Principles have been addressed.	**1**	**1**	**1**	The introduction of a new coach route with a focus on town centre locations could induce additional footfall to these areas (especially for tourism). This could positively impact placemaking principles.
	Innovation	Support innovations that encourage more people to use sustainable transport.	**1**	**2**	**2**	Introducing a coach service with intermediate stops from North to South Wales fosters innovation in the transport sector by exploring a new service model to improve sustainable public transport access however the express coach options are likely to be a more innovative service model with higher potential to displace car journeys.
	Distribution of goods	Create a more sustainable system of distributing goods in Wales.	**0**	**0**	**0**	The route design options do not directly impact the distribution of goods, as the focus is primarily on enhancing passenger transport rather than freight logistics.
	Transport affordability	Make sustainable transport more affordable.	**2**	**2**	**2**	Intermediate Option: Introducing a coach service with intermediate stops could improve transport affordability by providing a transport options at a competitive price, particularly for individuals living in areas with limited access to public transport. An express coach service with limited stops may enhance transport affordability by offering faster and more efficient transport options, which can lead to cost savings for passengers in terms of both time and money.
Culture and the Welsh language	**Welsh language**	Support the Welsh language and increase the use of Welsh in the transport system.	**1**	**1**	**1**	The coach service could provide opportunities to incorporate Welsh language signage and communication in transport facilities, contributing to the promotion and preservation of the Welsh language.
	Art, sport, and culture	Help more people to access culture, sports and arts by sustainable transport modes.	**1**	**2**	**1**	The additional univeristy stop in Aberystwyth provides access to culture, sports and arts by sustainable transport modes whilst keeping the service express and therefore viable for a North-South journey.
	Historic environment	Protect and enhance the historic environment in transport interventions.	**2**	**2**	**2**	Introducing this coach service could influence the historic environment by providing transport access to historic towns and heritage sites, potentially contributing to heritage preservation and tourism. Also, the service may reducing congestion or private car flows into historic town centres, enhancing the visitor experience and protecting heritage assets.

Service Design Options

Project name	ECS - N-S Wales Bus Connectivity
Project number	299103-00
Worksheet title	Service Design Options

WTS ambitions and aims		Description	Option 2 4 vehicles per day	Option 3 6 vehicles per day	Option 4 8 vehicles per day	Option 5 9 vehicles per day	Rationale
People and communities	**Equality**	Remove physical, attitudinal, environmental, linguistic, and economic barriers that prevent people from using sustainable transport services	**1**	**2**	**3**	**2**	Option 2: With demand per service around 30, there could occasionally be overcrowding issues which introduces a barrier to using the service. The use of four coaches limits improvements to connectivity but could stimulate demand on other services. Lower frequency means longer wait times for users. Option 3: Demand per service decreases which makes overcrowding very unlikely. Six coaches per day should create a good improvment to connectivity, stimulate demand on other services however wait times will still be long. Option 4: Eight coaches per day achieves a service frequency of 2 hours which matches other local services and creates a strong improvement to connectivity. This frequency may slightly reduce demand on other services but this is not a concern. Option 5: Nine vehicles per day achieves similar benefits as the 8 vehicles per day option. However, at this point too much demand could be taken off other services. Demand per service is below 20. Connectivity improvement is very good but this is a diminishing return.
	Health	Facilitate higher activity levels through walking and cycling, improve air quality, and reduce noise pollution.	**1**	**1**	**1**	**1**	All options provide an improvement to connectivity and will stimulate demand for public transport iservices. This facilitation of modal shift could encourage slightly higher levels of active travel to complete end-to-end journeys and a reduction in private car use which may improve air quality and noise pollution.
	Confidence and safety	Enable everyone to feel safe and confident using the sustainable transport mode of their choice.	**0**	**0**	**1**	**1**	Options 2 and 3: Low service frequency and therefore long wait times may limit confidence in the service due to a high reliance on the punctuality and reliability of the small number of coaches. Options 4 and 5: At higher frequencies there could be an increase in confidence in the serivce as a missed service or delay would not completely undermine a users travel plans. Also, not having long wait times can improve safety/confidence outcomes.
Environment	**Carbon**	Deliver a significant reduction in greenhouse gas (GHG) emissions.	**1**	**1**	**1**	**1**	All options could facilitate a reduction in greenhouse gases through modal shift onto public transport which has lower emissions per passenger km travelled. However, this is all dependent of the demand per service achieved. At higher service frequencies low occupancy could mean the the net effect on GHG emisisons is adverse. Also there willl be an embodied emissions cost from the introduction of new vehicles and infrastructure which will require a period to reach "break even".

WTS ambitions and aims		Description	Option 2 4 vehicles per day	Option 3 6 vehicles per day	Option 4 8 vehicles per day	Option 5 9 vehicles per day	Rationale
Environment	**Biodiversity**	Maintain and enhance biodiversity and ecosystem resilience.	**0**	**0**	**0**	**0**	All options could potentially cause some disturbance to local ecosystems due to increased traffic levels however this could be offset by a reduction in other vehicle traffic from modal shift, the overall impact is expected to be negligible.
	Soils and water	Maintain and enhance soil quality and the water environment.	**0**	**0**	**0**	**0**	All options could potentially cause some adverse effects to soil quality or the water environment from e.g., from vehicle particulates and subseqent run off from the roadway however this could be offset by a reduction in other vehicle use and associated run off from modal shift, the overall impact is expected to be negligible.
	Waste	Make better use of existing infrastructure.	**1**	**1**	**1**	**1**	All options could facilitate modal shift from the introduction of the coach service could free up capacity on highway infrastrucutre.
Places and the economy	**Cohesive communities**	How the transport system can help to meet the needs of different parts of Wales.	**0**	**1**	**2**	**2**	Option 2: There will be an improvement in connectivity and stimulated demand on other services across the North-South Wales route which will help the transport system to better meet the needs of users. Option 3: Increasing the service frequency will further improve connectivity to meet the needs od users. Option 4 and 5: Increasing the service frequency allows for further improvement in connectivity and cohesion within communities.
	Placemaking	Impact of the options on the landscape and how the Place Principles have been addressed.	**0**	**0**	**0**	**0**	The provision of a coach service at the frequencies considered across these options is not expected to impact placemaking principles vs a do nothing (baseline) scenario.
	Innovation	Support innovations that encourage more people to use sustainable transport.	**0**	**0**	**0**	**0**	The provision of a coach service at the frequencies considered across these options is not expected to impact innovation vs a do nothing (baseline) scenario.
	Distribution of goods	Create a more sustainable system of distributing goods in Wales.	**0**	**0**	**0**	**0**	The provision of a coach service at the frequencies considered across these options is not expected to impact the distribution of goods vs a do nothing (baseline) scenario.
	Transport affordability	Make sustainable transport more affordable.	**2**	**2**	**1**	**1**	Options 2 and 3: This moderate service frequency provides an improved transport option with high demand per service potentially allowing for a reduction in ticket price. Options 4 and 5: Higher service frequency offers additional access to transport options and could lower reliance on other, potentially more expensive, modes of transport. However, the affordability of the service may be impacted longer term depending on realised demand per service i.e., diminishing returns.

WTS ambitions and aims		Description	Option 2 4 vehicles per day	Option 3 6 vehicles per day	Option 4 8 vehicles per day	Option 5 9 vehicles per day	Rationale
Culture and the Welsh language	**Welsh language**	Support the Welsh language and increase the use of Welsh in the transport system.	**0**	**0**	**0**	**0**	The provision of a coach service at the frequencies considered across these options is not expected to impact Welsh language support vs a do nothing (baseline) scenario.
	Art, sport, and culture	Help more people to access culture, sports and arts by sustainable transport modes.	**1**	**1**	**2**	**2**	Options 2 and 3: Moderate service frequency provides improved transport options, potentially facilitating better access to culture, sports and arts by sustainable transport modes. Options 4 and 5: Higher service frequencies enhance transport options, enabling better access to culture, sports and arts by sustainable transport modes. Increased frequency may allow for more extensive participation in these activities among residents.
	Historic environment	Protect and enhance the historic environment in transport interventions.	**1**	**1**	**1**	**1**	The provision of a coach service at all the frequencies considered across these options is expected to slightly benefit the protection of the historic environment through modal shift away from the private car near town centre stop locations vs a do nothing (baseline) scenario.

Vehicle and Charging Options

Project name	ECS - N-S Wales Bus Connectivity
Project number	299103-00
Worksheet title	Vehicle and Charging Options

WTS ambitions and aims		Description	Option 1 Used diesel coach with no new infrastructure	Option 3 Used diesel coach with transition to battery electric coach	Option 4 Battery electric coach and standalone charging infrastructure	Option 5 Battery electric coach with shared charging infrastructure	Rationale
People and communities	**Equality**	Remove physical, attitudinal, environmental, linguistic, and economic barriers that prevent people from using sustainable transport services	**1**	**2**	**2**	**2**	Option 1: Providing a new express coach service will improve equality through the reduction in barriers to access transport services that can connect communities. Though as the vehicles are used diesel coaches this is not a completely sustainable transport option despite encouraging public transport uptake. Option 3: Transitioning to electric coaches in the future offers the potential of a future equality improvement by providing a cleaner service and more time to design the most appropriate infrastructure solution. Option 4: Adoption of battery electric coaches and simple charging infrastructure from the outset of the service provides access to a sustainable transport option and encourages public transport uptake. Option 5: This option offers the greatest potential for promoting equality by supporting the sustainability of not only this service but other services through the supply of a comprehensive shared charging infrastructure.
	Health	Facilitate higher activity levels through walking and cycling, improve air quality, and reduce noise pollution.	**-1**	**0**	**0**	**1**	Option 1: Introducing a diesel coach service will contribute to air pollution and noise however coaches with bike storage capability on service may indirectly contribute to multimodal travel that involves an active component. The use of used vehicles does not create as much embodied emissions via the manufacture of new vehicles. Option 3: Introducing a diesel coach service will contribute to air pollution and noise however, the transition to zero emission coaches offers the potential for improving air quality, health outcomes, and noise pollution. Bike storage capability on service may indirectly contribute to multimodal travel that involves an active component. Use of used vehicles initially reduces contibution from embodied emissions. Option 4: Adoption of battery electric coaches and simple charging infrastructure can improve air quality and health outcomes by reducing emissions and noise of the service. Bike storage capability on service may indirectly contribute to multimodal travel that involves an active component. Option 5: This option offers the greatest potential for improving health outcomes by adopting battery electric coaches from the outset and a shared charging infrastructure removes barriers to decarbonise other nearby services encouraging emission and pollution abatement more broadly.
	Confidence and safety	Enable everyone to feel safe and confident using the sustainable transport mode of their choice.	**0**	**1**	**1**	**1**	Option 1: The deployment of a diesel coach service does provide more choice but not necessarily on a sustainable mode. Reliance on used vehicles could reduce confidence in the reliability/safety of the service. Appropriate refurbishment could alleviate this. Option 3: The deployment of a diesel coach service does provide more choice but not necessarily on a sustainable mode. Reliance on used vehicles initially could reduce confidence in reliability/safety. Appropriate refurbishment could alleviate this. Transitioning to modern zero emission coaches in future offers potential for improving future per safety and confidence and more time is available to design prior to transitioning. Option 4: Adoption of battery electric coaches and supporting infrastructure from the outset provides additional sustainable transport choice however teething problems with new electric coaches or infrastructure could cause percieved confidence/safety/reliability concerns. Option 5: Adoption of battery electric coaches and a comprehensive shared supporting infrastructure from the outset provides additional sustainable transport choice (potenitally for other modes also) however teething problems with new electric coaches or infrastructure are a risk and could cause percieved confidence/safety/reliability concerns.

WTS ambitions and aims		Description	Option 1 Used diesel coach with no new infrastructure	Option 3 Used diesel coach with transition to battery electric coach	Option 4 Battery electric coach and standalone charging infrastructure	Option 5 Battery electric coach with shared charging infrastructure	Rationale
Environment	Carbon	Deliver a significant reduction in greenhouse gas (GHG) emissions.	-1	1	2	3	Option 1: Continued reliance on diesel coaches without improvements maintains high levels of carbon emissions, although to a lesser extent than the Do Nothing option. Modal shift to coach could reduce car related emissions. Option 3: Transitioning to electric coaches offers future potential for reducing carbon emissions. Providing more design time for future decarbonised service allows for more accurate PVR decision, infrastrucutre provision and alignment with other policy e.g., franchising. Modal shift to coach could reduce car related emissions. Option 4: Adoption of battery electric coaches and simple charging infrastructure can reduce carbon emissions of the service, contributing to climate change mitigation. Modal shift to coach could reduce car related emissions. Option 5: This option offers the greatest potential for reducing carbon emissions by adopting battery electric coaches with comprehensive shared charging infrastructure, ensuring substantial reductions in emissions. Infrastructure will encourage emissions reductions in other services. Modal shift to coach could reduce car related emissions.
	Biodiversity	Maintain and enhance biodiversity and ecosystem resilience.	0	0	0	0	Introducing a new coach service will contribute to emissions and therefore to a limited extent climate change which could indirectly harm biodiversity. Construction of new vehicles and supporting infrastrucutre could damage biodiversity however this infrastructure supports the decarbonisation of other services. Modal shift from the car could counteract emissions are therefore indirectly improve biodiversity. Overall the expected impact of all options is expected to be neutral.
	Soils and water	Maintain and enhance soil quality and the water environment.	0	0	0	0	Introducing a new coach service may to a limited extent degrade soil and water quality through run off from vehicles, however model shift from cars could counteract this degredation. Overall the expected impact of all options is expected to be neutral.
	Waste	Make better use of existing infrastructure.	1	3	1	1	Option 1: Introduction of a diesel coach route has the potential to induce modal shift and this contributes to the efficient utilisation of highway infrastrucutre. Utilisation of used vehicles increases cirularity and utilisation of existing resources/emodied emissions. Option 3: Introduction of a diesel coach route has the potential to induce modal shift and this contributes to the efficient utilisation of highway infrastrucutre. Utilisation of used vehicles increases cirularity and utilisation of existing resources/emodied emissions. Transitioning to electric coaches offers potential for futher emissions reductions and a longer period to trial and plan a future service and maximise potential for success/minimisation of waste e.g., stranded assets or sunk costs from infrastrucutre upgrades that are poorly used. Option 4 and 5: Adoption of battery electric coaches immediately with a simple charging infrastructure has the potential to induce modal shift and this contributes to the efficient utilisation of highway infrastrucutre. However, the supply of new electric vehicles will contibute to scheme waste if the service proves unsuccesful, similarly a simplistic infrastrucutre could end up as a stranded asset if the route is discontinuted. Shared charging infrastructure has the potential to be utilised by other services if the route is discontinuted but the setting up of this shared infrastrucutre needs to be considered carefully.
Places and the economy	Cohesive communities	How the transport system can help to meet the needs of different parts of Wales.	2	3	2	2	All of the options (as they introduce a new North to South express coach service) will address many transport needs of communities along the route. However, the de-risking of route delivery through a trial used diesel service offering with a medium term plan to upgrade has the larger prospect of realising subsequent benefits and maintaining them long term such as ensuring equitable access to transport and essential services across the region.
	Placemaking	Impact of the options on the landscape and how the Place Principles have been addressed.	1	1	1	1	The introduction of a coach service will create a level of modal shift near to route stops. These communities could potentially benefit from reduced car use, changing parking usage patterns, increasing pedetrian activity and this could work to benefit Place Principals e.g., movement, mix of uses, and public realm.

WTS ambitions and aims		Description	Option 1 Used diesel coach with no new infrastructure	Option 3 Used diesel coach with transition to battery electric coach	Option 4 Battery electric coach and standalone charging infrastructure	Option 5 Battery electric coach with shared charging infrastructure	Rationale
Places and the economy	**Innovation**	Support innovations that encourage more people to use sustainable transport.	**-1**	**3**	**2**	**3**	Option 1: Continued reliance on diesel coaches perpetuates the use of internal combustion engines and associated value chains and limits opportunities for advancements in sustainable transport, especially in the realm of long distance coach travel. There is still potential for innovation in the delivery of the service e.g., ticketing, marketing etc. as with the other options. Option 3: Transitioning to zero emission coaches represents an opporunity to develop and understand sustainable coach transport. The use of used coaches first allows for the tailoring of future infrastrucutre to the success of the service and time to determine the necessary training and development of associated organisations. Future policy developments such as franchising and TfW depot strategy can also be given time to be effectively embedded into a future transition. Option 4: Adoption of battery electric coaches and simple charging infrastructure promotes innovation in sustainable transport, encouraging more people to use environmentally friendly modes of transport. However, the simplicity of the charging infrastrucutre does not leave much room for innovation from this perspective. Option 5: This option offers the greatest potential for immediate innovation by adopting battery electric coaches with a comprehensive shared charging infrastructure, ensuring widespread adoption of sustainable transport modes and fostering advancements in other services. This ambitious roll-out does however have risks.
	Distribution of goods	Create a more sustainable system of distributing goods in Wales.	**0**	**1**	**1**	**1**	Option 1: The adoption of a diesel coach service does not impact the distribution of goods. Option 3, 4 and 5: Focusing on the adoption of battery electric coaches will result in the development of charging infrastructure i.e. the supply of electricity as a transport fuel.
	Transport affordability	Make sustainable transport more affordable.	**-1**	**3**	**2**	**2**	Option 1: reliance on used diesel coaches may marginally address some initial affordability challenges (CAPEX), although it does not effectively make sustainable transport more affordable for all users in the long term due to fuel costs and potential maintenance costs. Especially if parts become more scarce, the sale of internal combustion HGVs is outlawed, taxation rules change (road pricing, VED, emission zoning) or resale of vehicles becomes problematic. Option 3: This option maximises affordability initially to trial the service.Transitioning to electric coaches in a more controlled manner then can reduce long term OPEX savings in the longer term. The delay between trial and transition can help to minimise risk of future stranded infrastructure. Option 4 and 5: these options are more costly to implement up front, however the expected lower OPEX of running an electric coach can be passed onto users more immediately. However, the risk of service success is greater.
Culture and the Welsh language	**Welsh language**	Support the Welsh language and increase the use of Welsh in the transport system.	**1**	**1**	**1**	**1**	All options: the introduction of a new coach service may offer some opportunities to support the Welsh language by ensuring that all aspects of the service, including signage and marketing materials, are available in Welsh, thus promoting effective communication and engagement within Welsh-speaking communities.
	Art, sport, and culture	Help more people to access culture, sports and arts by sustainable transport modes.	**1**	**2**	**2**	**2**	Option 1: The introduction of used diesel coaches will improve access to culture, sports and arts, although it does not effectively increase accessibility through sustainable transport modes (other than from the encouragement of modal shift). Options 3, 4 and 5: These options will also improve accessibility to culture, sports and arts, although the lack of infrastructure may limit immediate benefits and the ultimate use of zero emission vehicles will ensure this is accessiblity is provided through a sustainable mode.
	Historic environment	Protect and enhance the historic environment in transport interventions.	**1**	**1**	**1**	**1**	All options may marginally address some challenges related to the historic environment e.g., through encouraging less car usage/more efficient usage of infrastrucutre. Although these options do not actively prioritise its protection or enhancement.

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